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# Key Requirements for the Successful Development of Resource Exchanging Clusters

TU Delft

# Key Requirements for the Successful Development of Resource Exchanging Business Parks

By

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# Executive Summary

The objective of this research project was to develop a set of requirements for the successful development of resource sharing business parks. In this research resource sharing business parks differ from EIPs in that there is no closed loop condition for materials and energy for resource sharing business park as this condition creates extra burdens for firms. From reading literature I conclude this condition is the main reason that intentions to create EIPs fail.

The main research question of this research project is:

*What is a coherent set of Requirements for the successful development of resource sharing business parks?*

This research question is answered by first explaining which factors are required for the successful development of resource sharing business parks according to literature. Then it is explained to what extent the factors for the successful development of resource sharing business parks found in literature correspond with the factors that were identified at two cases. Finally experts are consulted to find out if the improved set of requirements could really be used to successfully develop resource sharing business parks?

The literature review showed little overlap between EIP literature and cluster literature. That is striking as EIPs are a sub-category of clusters. The literature review produced the following Preliminary Set of Requirements for the successful development of resource sharing business parks:

1. **Resource Availability**: there need to be enough resources available at the location
2. **Agglomeration Effects**: positive externalities serve as a force of attraction
3. **Cluster Governance Policy**: this policy should focus on creating the right conditions and should allow for freedom and decentralisation for the park participants
4. **Network Activities**: Having a well-functioning network with many activities is important for knowledge sharing and to uncover opportunities
5. **Mutually Profitable Transactions**: having transactions between companies that is profitable for both parties is important for the successful development of a resource sharing business park
6. **Business Opportunities**: if there are not enough business opportunities the initiative will fail

Two cases were studied to see if this Preliminary Set corresponds with reality. HOST Park on Hawaii and Biopark Terneuzen in the Netherlands were selected because these are both successfully developed resource sharing business parks and the access to information in each case.

At HOST Park warm and cold seawater are pumped up and distributed to tenants on site. These tenants use this water and solar energy as input for their activities. These activities include: water bottling, desalination, energy generation, and food production. Biopark Terneuzen is an initiative that was started in an existing port area. Opportunities to share resources between the companies are identified and these companies then decide to collaborate.

From the results it was concluded that the Preliminary Set of Requirements did not adequately prescribe how resource sharing business parks should be developed. The results showed that:

- The availability of resources is crucial; there are key resources that enable the use of other resources;
- In each case Agglomeration Effects were not crucial;
- The cluster governance policy indeed should focus on creating a good environment for doing business by for example, removing business barriers or by facilitating and initiating collaborations between companies. How strict the policy is depends on how independent the park management can operate from the park participants;
- The importance of Network Activities depends on the need for collaboration;
- Mutually Profitable Transactions should be considered as a form of Business Opportunity; and
- A strategy document containing a vision for the development of the cluster should be developed to gather support from businesses, knowledge institutions, governments, and society.

Based on these results the Revised Set of Requirements was created which improved the Preliminary Set and included what was learned from the case studies. The Revised Set of Requirements consists of:

1. **Compelling Vision**;
2. **Availability of Critical Resources**;
3. **Fitting Park Governance Policy**;
4. **Business Opportunities**; and
5. **Fitting Level of Network Activities**

To find out if these Revised Requirements are the answer to the main research question and would really be usable in practice, the Revised Requirements were presented to experts. The experts added the following remarks:

| Compelling Vision |
|---|
| - The vision should not only be created, it should also be executed. Many strategy documents are shelved.<br>- Agreement should be reached on a technological ambition level that is reasonable and attainable. A technological ambition level that is too high introduces huge risks and adds to the complexity of the project. |
| Availability of Critical Resources |
| - The continuity of the availability of critical resources should be guaranteed for the life time of the project to earn back investments<br>- Besides financial capital, human capital, and infrastructure, logistics should be added as critical.<br>- Some critical resources might not be present from the start of a project. Possibilities to develop these resources should then be investigated. |
| Fitting Park Governance Policy |
| - It should be clear on how the park is going to be managed and who is responsible for what.<br>- The policy should be consistent and should be developed for the long term. Changing policies creates risks for the cluster participants.<br>- Trust is crucial for collaboration.<br>- There should be a focus on business creation. |
| Business Opportunities |

| |
|---|
| - New business opportunities are also potential risks. |
| Fitting Level of Network Activities |
| - Collaboration does not just emerge. It has to be initiated and companies have to be willing to collaborate. |

These Revised Requirements were adapted to include these remarks and thus created the Final Set of Requirements for the successful development of resources sharing business parks. Using the Requirements cannot guarantee success but the experts generally agreed that if their remarks were included, the Set of Requirements greatly increase the chance of a successful development and are indeed a coherent set that can be used for the successful development of resource sharing business parks.

# Table of Contents

# 1 Introduction

This chapter introduces this research project and sheds light on the background of it. The research design is then outlined. Finally, a chapter overview of this thesis will be provided.

## 1.1 Background

In light of today's increasing importance of sustainability in business decisions, Eco-Industrial Parks are an interesting type of clusters. These are business parks which view companies as part of a system of companies, the environment, and society. These parks have closed-loop systems for materials and energy. Linkages are created between organisations to close these loops. Inputs and outputs are coupled and resources, waste, heat, etc. are shared between companies.

There is much literature on EIPs which focus on the characteristics of such parks and on benefits of having closed loops and sharing resources. In theory there is much potential for EIPs but what is missing in literature are clear and tried approaches on how to successfully create EIPs. This research project is going to develop such an approach. EIPs can be considered as a sub-category of clusters. It is therefore logical to examine success factors for the development of clusters in addition to the success factors for EIPs. It is expected that combining these two fields creates huge opportunities for learning from both fields. This research project will use the research design approach as outlined by Verschuren & Doorewaard (2010).

## 1.2 Research Design

### 1.2.1 Problem Description

There is plenty of scientific literature to be found on EIPs. Frequently, researchers give recommendations on how EIPs could be developed but it is not clear if these recommendations are the result of tested methods. A coherent set of requirements for the successful development of EIPs is not provided in the literature studied for this research project. Literature actually shows that many efforts to develop EIPs fail. This shows that there is a need for an approach for EIP development that works. This research project will take the first steps into developing a set of requirements for the successful development of resource exchanging business parks by comparing EIP and Cluster literature with two existing cases.

### 1.2.2 Research Objective

The research objective is to develop a set of requirements for the successful development of resource sharing business parks by comparing knowledge from relevant literature on EIPs with information about how existing cases were developed.

First, information on EIPs is to be collected from literature. Then a comparison is made between information from literature and information from selected cases. This comparison will provide insights in what the requirements are for the successful development of resource sharing business parks.

For this research project resource sharing business parks will be defined as geographic concentrations of interconnected companies and institutions in a particular field which exchange

and/or share resources. This definition is based on Porter's definition of clusters (Porter, 1998) and is different from EIPs as there is no closed loop condition for materials and energy in this definition.

The reason is that operating in a closed loop system of materials and energy creates extra burdens (e.g. costs) for firms. But these firms have to compete with other firms that do not have these burdens. I believe this is the main reason that intentions to create EIPs fail (see Literature Review).

### 1.2.3 Relevance

The requirements for the successful development of resource sharing business parks can be used by project initiators including landowners, project developers, and civil servants. It will give them support in bringing order in the chaos of everything that is said to be important in EIP development. What the user of the requirements needs to understand however, is that the successful design of a resource sharing business park cannot be guaranteed. Nearly everyone interviewed for this research project cited plain luck as a factor that contributed to successful development of a business park. What is possible though, is to increase the chance of success by adhering to the requirements.

Literature describes many issues that occur when designing EIPs but very few provide a set of factors that can be used to successfully develop a cluster. This study clearly has scientific relevance as it is designed to address this gap. The goal of this research is not to solve problems. This is an explorative research project that contributes towards creating successful approaches for developing EIPs. It provides bases for further research on this subject.

### 1.2.4 Research Framework

The research framework explains the approach of this research project. The goal of this project is to develop a set of requirements for the successful development of resource sharing business parks. Many steps are needed to achieve this objective. First of all, the current knowledge on clusters and EIPs has to be described. This knowledge is then used to develop a preliminary set of requirements. This set is then compared with information from real life cases. The results of this comparison is used to revise the set of requirements. This revised set is then tested for its validity by being presented to experts. Their input is used to describe the final set of requirements. Figure 1 captures the just described approach in a schematic diagram.

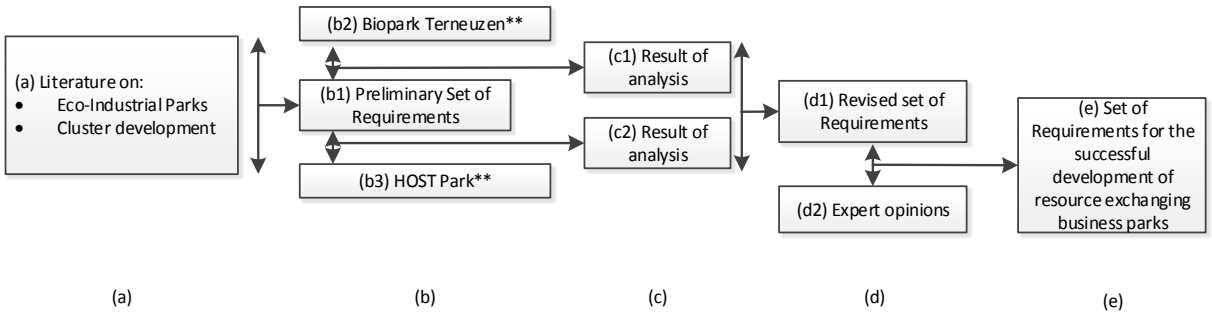


Figure 1 – Research Framework

The figure reads as follows: The research project starts with a literature study (a). This literature study is used to understand the factors that are important for EIP and cluster development and results in a preliminary set of requirements (b1). Then two cases are studied (b). The results of the case studies are then compared to each other (c). This will then lead to a revised set of requirements

(d). Opinions of experts will then be used to validate the revised set of requirements (d) which will yield the final set of requirements: a set of requirements for the successful development of resource sharing business parks (e).

### 1.2.5 Research Questions

Based on the research structure and objective of this study the following main Research Question is formulated:

*What is a coherent Set of Requirements for the successful development of resource sharing business parks?*

This main research question is split up in several sub-questions. The main research question will be answered step-by-step by answering these sub-questions:

1. Which factors are required for the successful development of resource sharing business parks according to literature?
   1.1. What are characteristics of clusters according to scientific literature?
   1.2. What are characteristics of EIPs according to scientific literature?
   1.3. What phases and corresponding characteristics can be identified regarding the development of EIPs and clusters?
2. To what extent do the factors for the successful development of resource sharing business parks found in literature correspond with the factors that were identified at HOST Park?
3. To what extent do the factors for the successful development of resource sharing business parks found in literature correspond with the factors that were identified at Biopark Terneuzen?
4. Is the set of requirements adequate to successfully develop resource sharing business parks?
   4.1. What are the similarities and differences between the set of requirements and the factors the tenants mention?
   4.2. Are these factors case-specific or location-specific?

### 1.2.6 Research Methodology

*This research project consists of several parts: a literature review, case studies and validation by experts. This section explains the methods used in each of these parts.*

#### *1.2.6.1 Literature Review*

Because of today's importance of the 3Ps, the focus of EIPs on sustainability, the little overlap of EIP and cluster literature despite EIPs being a sub-category of clusters, and for manageability reasons, the literature review focuses on EIPs and clusters. Desk research of scientific literature is used to gather knowledge and to create an understanding of clusters and EIPs. An algorithm that was learned at Delft University of Technology was used to select relevant articles.

##### 1.2.6.1.1 Selection of articles on the subject of clusters

Scopus.com, a database of peer-reviewed literature is used as the source of scientific research. The articles used for the cluster literature part of the literature review were selected by searching 'clusters' on Scopus.com. The results were limited to subject areas 'Business, Management and Accounting' and 'Economics, Econometrics and Finance'. The results were then sorted on 'cited by' see Figure 2.

| | | | | | |
|---|---|---|---|---|---|
| 1 | Clusters and the new economics of competition.<br>TU Delft full text | Porter, M.E. | 1998 | Harvard business review | 1905 |
| 2 | Location, competition, and economic development: Local clusters in a global economy<br>TU Delft full text | Porter, M.E. | 2000 | Economic Development Quarterly | 985 |
| 3 | Bridging ties: A source of firm heterogeneity in competitive capabilities<br>TU Delft full text \| Show abstract \| Related documents | McEvily, B., Zaheer, A. | 1999 | Strategic Management Journal | 731 |
| 4 | The application of cluster analysis in strategic management research: An analysis and critique<br>TU Delft full text | Ketchen Jr., D.J., Shook, C.L. | 1996 | Strategic Management Journal | 574 |
| 5 | On the nature, function and composition of technological systems<br>TU Delft full text | Carlsson, B., Stankiewicz, R. | 1991 | Journal of Evolutionary Economics | 495 |
| 6 | Regional innovation systems, clusters, and the knowledge economy<br>TU Delft full text | Cooke, P. | 2001 | Industrial and Corporate Change | 494 |
| 7 | The determinants of national innovative capacity<br>TU Delft full text | Furman, J.L., Porter, M.E., Stern, S. | 2002 | Research Policy | 485 |
| 8 | The relationship between environmental commitment and managerial perceptions of stakeholder importance<br>TU Delft full text | Henriques, I., Sadorsky, P. | 1999 | Academy of Management Journal | 458 |
| 9 | An introduction to concept mapping for planning and evaluation<br>TU Delft full text | Trochim, W.M.K. | 1989 | Evaluation and Program Planning | 453 |
| 10 | Resource recombinations in the firm: knowledge structures and the potential for schumpeterian innovation<br>TU Delft full text | Galunic, D.C., Rodan, S. | 1998 | Strategic Management Journal | 434 |

**Figure 2 – Articles about on Scopus.com sorted on 'cited by'**

To find imported related articles, the articles that cited the first three articles from Figure 2 were also listed, limited to subject areas 'Business, Management and Accounting' and 'Economics, Econometrics and Finance', and sorted by 'cited by'. This created three additional lists of articles (see Figure 3). These lists were combined and a selection of *relevant* articles was made by reading abstracts and scanning through articles. This selection was supplemented with other articles to gather information on certain aspects of clustering (e.g. social relations, cluster policies and creation of clusters).

| | | | | | |
|---|---|---|---|---|---|
| 1 | Clusters and knowledge: Local buzz, global pipelines and the process of knowledge creation<br>TU Delft full text | Bathelt, H., Malmberg, A., Maskell, P. | 2004 | Progress in Human Geography | 1217 |
| 2 | Deconstructing clusters: Chaotic concept or policy panacea?<br>TU Delft full text | Martin, R., Sunley, P. | 2003 | Journal of Economic Geography | 766 |
| 3 | The elusive concept of localization economies: Towards a knowledge-based theory of spatial clustering<br>TU Delft full text | Malmberg, A., Maskell, P. | 2002 | Environment and Planning A | 555 |
| 4 | Sectoral systems of innovation and production<br>TU Delft full text | Malerba, F. | 2002 | Research Policy | 553 |
| 5 | Comment est-ce que l'insertion dans des chaînes de valeur mondiales influe sur la revalorisation des regroupements industriels? \| [How does insertion in global value chains affect upgrading in industrial clusters?]<br>TU Delft full text | Humphrey, J., Schmitz, H. | 2002 | Regional Studies | 478 |
| 6 | Chapter 49 Evidence on the nature and sources of agglomeration economies<br>TU Delft full text | Rosenthal, S.S., Strange, W.C. | 2004 | Handbook of Regional and Urban Economics | 364 |
| 7 | Industrial symbiosis: Literature and taxonomy<br>TU Delft full text | Chertow, M.R. | 2000 | Annual Review of Energy and the Environment | 354 |
| 8 | Theory and research in strategic management: Swings of a pendulum<br>TU Delft full text | Hoskisson, R.E., Hitt, M.A., Wan, W.P., Yiu, D. | 1999 | Journal of Management | 348 |
| 9 | Knowledge, clusters, and competitive advantage<br>TU Delft full text | Tallman, S., Jenkins, M., Henry, N., Pinch, S. | 2004 | Academy of Management Review | 336 |
| 10 | Innovation systems: Analytical and methodological issues<br>TU Delft full text | Carlsson, B., Jacobsson, S., Holmen, M., Rickne, A. | 2002 | Research Policy | 315 |

**Figure 3 – One of the additional lists of articles on Scopus.com**

#### 1.2.6.1.2 Selection of articles on the subject of Industrial Symbiosis and Eco-Industrial Parks

To select articles for the Industrial Symbiosis and Eco-Industrial Parks part of the literature review, Scopus.com was used to search “industrial ecology”, “industrial symbiosis”, “eco industrial parks” and several variations. Next, the search results were sorted from the most cited articles on top to the least cited articles on the bottom. Then from the top ten of most cited articles a selection was made of *relevant* articles. This was done by scanning through articles and reading abstracts. This selection was supplemented with articles recommended by Gijsbert Koorevaar, Industrial Symbiosis teacher at Delft University of Technology, and Ellen van Bueren, Professor Urban Development Management at Delft University of Technology.

### *1.2.6.2 Case Studies*

The Preliminary Set of Requirements that follows from the literature review is a broad and rough concept that needs more focus and refinement. Improvement and refinement of the Set will happen in the next part. The Preliminary Set does not allow for gathering quantitative information. Case studies and interviews will be suitable research methods to improve the Preliminary Set. Case studies and interviews allow for interpreting and creating a better understanding which will help improve rough concepts.

Two cases are selected: HOST Park on Hawaii and Biopark Terneuzen in the Netherlands. These cases are selected because they both are successfully developed resource sharing business parks. A more practical reason to select these cases are that there is access to information in each case.

At HOST Park warm and cold seawater is distributed to tenants on site. These tenants then use this seawater for green energy technologies, ocean-related research, education and commercial activities including aquaculture, water bottling, salt extraction, shrimp farming, microalgae production, and cooling. Biopark Terneuzen is different than HOST Park in that it is an industrial cluster of companies that decided to exchange resources. Comparing both cases might create opportunities for great insights for the set of requirements since both cases have developed successfully.

During the case studies many written sources will be consulted including reports (financial, audit, etc.), news articles, documents from web sites, press releases, and policies. The information will be supplemented with information from interviews.

#### *1.2.6.3 Validation*

Comparing the preliminary set of requirements with the results from the case studies will yield a revised set of requirements. In order to make sure that this set is useful and that it serves its purpose this revised set will be validated with experts. Four people who were involved in developing resource sharing business parks where resources are distributed among several parties on site will be invited to give their opinion on the revised set of requirements for the successful development of a resource sharing business parks. Their opinions will be used to create the final list of requirements.

## 1.3 Overview of Thesis Chapters

This Thesis continues with *Chapter* 2 *Literature Review* which discusses the current knowledge on clusters and EIPs and ends with a Preliminary Set of Requirements for the successful development of resource sharing business parks. *Chapters* 3 *and* 4 then discuss the two cases and extract information from these cases. In *Chapter* 5 *Analysis of Results Case Studies* the information from both cases is analysed and compared with the Preliminary Set of Requirements resulting in a Revised Set of Requirements. In *Chapter* 6 *Validation of Revised Requirements* this Revised Set is discussed with experts to produce the Final Set of Requirements. The overall conclusions and discussions are part of *Chapter* 7 *Conclusions*.

Table 1 shows in which chapter the Research Questions are answered. The table also shows what the results are of the chapters.

**Table 1 – Which RQ related to which chapter and results of chapters**

| RQ | Chapter | Result |
|---|---|---|
| **1** | 2 Literature Review | Preliminary Set of Requirements |
| **2 & 3** | 3 and 4 Case Studies, and<br>5 Assessing the Preliminary Set of Requirements | Revised Set of Requirements |
| **4** | 6 Validation of Revised Requirements | Final Set of Requirements |

# 2 Literature Review

This chapter presents a literature review. First the most important notions from cluster literature are explained. Then the notions of Industrial Ecology are outlined. This chapter concludes with the Preliminary Set of Requirements for the development of a resource exchanging business park.

## 2.1 Clusters

There are many examples that show that companies from similar industries tend to cluster (Head, Ries, & Swenson, 1995; Porter, 1998; Bresnahan, Gambardella, & Saxenian, 2001; Stuart & Sorenson, 2003). According to Porter (1998) “clusters are geographic concentrations of interconnected companies and institutions in a particular field.” Clusters can span regions or even countries and can include customers, suppliers, manufacturers, related companies, channels, and governmental institutions (Porter, 1998).

Clusters are critical to competition; they affect competition by increasing productivity, by driving the direction and pace of innovation and by stimulating the formation of new businesses which expands and strengthens the cluster itself (Porter, 1998). Inside a cluster, competition and cooperation can take place simultaneously where cooperation is mainly vertically (e.g. related industries). Porter (1998) states that clusters will fail without fierce competition.

Clustering seems to be a logical behaviour for markets where transportation costs are a large portion of the total costs. For stable, labour-intensive activities, low factor costs are often decisive for locational choices of companies (Porter, 1998). But markets where the central production inputs such as intellectual property or financial capital could move easily also show clustering (Stuart & Sorenson, 2003). That shows that lower transportation costs are not the only explanation for clustering. According to Bathelt, Malmberg & Maskell (2004) it is well-known that cost advantages are not enough to explain that firms locate within a cluster: “it has been shown that socio-institutional settings, inter-firm communication and interactive processes of localised learning play decisive roles in processes of innovation and growth” (Bathelt, Malmberg, & Maskell, 2004).

Generally speaking, there are two theories that explain clustering. The first is the factor endowment theory which explains that companies cluster at locations with ample supply of production factors such as natural resources, labour and infrastructure. Lower transportation costs are a result from this theory. A second theory is that companies cluster on locations that have positive externalities (financial and technological) and agglomeration economies.

Both theories explain the clustering of companies but only the notions of externalities (or external effects) give an explanation for locations becoming more attractive when clustering takes place (Head, Ries, & Swenson, 1995). With the theory of external effects two locations with equal amount of important input factors can develop differently. One region could receive more investments and could become more attractive than the other region. In practice such scenarios occur. However, the theory of supply of production input would not allow for such a scenario since both regions would be equally attractive.

### 2.1.1 External effects

A positive externality (or external effect) is "… anything that raises the return to particular firms located in a region as a result of the location of other firms in the same region" (Bresnahan,

Gambardella, & Saxenian, 2001). Examples of positive externalities are knowledge sharing (technical spillovers), a pool of specialised labour, supporting industries, supporting organisations, and suppliers.

Externalities cause companies to follow each other to locate in the same region. If for a certain industry there is activity in a region, other companies from the same industry are easier attracted to this region because of the externalities (Head, Ries, & Swenson, 1995). Spillovers are probably the most cited external effects but according to Head, Ries, & Swenson (1995) specialised labour, and the supporting industry and suppliers may play equally important roles.

Bresnahan, Gambardella, & Saxenian (2001) distinguish between direct and indirect external effects. Direct external effects are learning about market or technological developments and firms in close proximity that are each other's customers or suppliers (Bresnahan, Gambardella, & Saxenian, 2001). Indirect external effects are ample supply of key resources (skilled labour, knowledge, venture capital) and a high level of commercial activity (Bresnahan, Gambardella, & Saxenian, 2001).The authors cite increasing returns to scale in the supply of these key resources as causes of indirect external effects.

#### *2.1.1.1 Knowledge spillovers*

Innovative activity tends to cluster more in industries where knowledge spillovers are crucial (Audretsch & Feldman, 1996). “That is [in industries] where industry R&D, university research and skilled labour are the most important” (Audretsch & Feldman, 1996). Knowledge is especially important for innovation and technological change (Audretsch & Feldman, 1996). Knowledge sharing helps in innovating because it enables cluster firms to continuously combine and re-combine similar and non-similar resources to produce new knowledge and innovations” (Bathelt, Malmberg, & Maskell, 2004). Firms also benefit from clustering by learning about characteristics of each other’s products and quality and cost of production factors (Bathelt, Malmberg, & Maskell, 2004). “Advantages of proximity thus arise from continuous monitoring and comparing” (Bathelt, Malmberg, & Maskell, 2004).

Bathelt, Malmberg & Maskell (2004) use the concepts of buzz and pipelines to form a “knowledge- and learning-centred theory of clustering.” They refer to buzz as “the information and communication ecology created by face-to-face contacts, co-presence and co-location of people and firms within the same industry and place or region”. The authors explain pipelines as channels to distant locations of knowledge. According to Oinas (1999) “the creation of new knowledge (learning) might be best viewed as a result of a ‘combination’ of close and distant interactions” (as cited in Bathelt, Malmberg & Maskell, 2004). A strategic partnership between a firm within a cluster and a distant organisation is an example of how firms inside a cluster can obtain knowledge from outside (Bathelt, Malmberg, & Maskell, 2004).

Using the concepts of buzz and pipelines, Bathelt, Malmberg & Maskell (2004) present four arguments to explain their theory why firms can gain competitive advantage by locating in a cluster:

- High quality knowledge sharing by face-to-face contact and by just being at a certain location (buzz) creates a perfect setting for dynamic interaction within the cluster.
- The more information that flows from outside sites of knowledge into the cluster, the higher the quality of buzz which all firms benefit from.

- Strong enough buzz creates a balance between a too much inward-looking and a too much outward-looking firm structure. This balance ensures that external knowledge can flow throughout the firm and that internal knowledge reaches the departments that can turn the knowledge into commercially useful knowledge.
- Firms in a cluster can maintain more pipelines together than firms can do individually.

#### *2.1.1.2 Specialised skills*

Clusters often create a pool of specialised labour. Head, Ries & Swenson (1995) explain two mechanisms that attract skilled workers to clusters. The first is that clusters create a shorter unemployment time. Laid-off workers can find jobs easier at nearby companies from similar industries.

A second effect explaining the attraction of clusters to employees is that individuals invest in their own, industry-specific education since they see possibilities to get a job in these clusters (Head, Ries, & Swenson, 1995). These mechanisms result in the creation of a pool of specialised labour near clusters.

An additional benefit for companies in a cluster is that the larger supply of employees has a lowering effect on wages. On the other hand, strong competition for highly skilled workers between firms creates an upward pressure for wages.

#### *2.1.1.3 Supporting organisations and suppliers*

Clusters also attract supporting industries, supporting organisations, and suppliers such as consultancy firms, patent law firms, financial institutions, research facilities, and suppliers of industry-specific goods (Stuart & Sorenson, 2003). According to Head, Ries & Swenson (1995) economies of scale and transportation costs make it beneficiary for users and suppliers of intermediate inputs and components to cluster. This clustering lowers transportation costs even further and increases demand for specialised components, which attracts even more companies and creates more specialisation.

### 2.1.2 Social relations

Stuart & Sorenson (2003) add a sociological perspective to the theories of externalities to explain the emergence of clusters. In their view social relations to resource providers are key factors for clustering. They explain that to create businesses, entrepreneurs need to mobilise essential resources like intellectual property, human capital and financial capital. Resource providers (investors, customers, specialised workers, collaborators) are the holders of these essential resources.

Resource mobilisation is hard to achieve when entrepreneurs reside far from resource providers since existing and potential social relations with resource providers need to be activated and mobilised to create businesses and to discover opportunities (Stuart & Sorenson, 2003).

Since the people most likely to start businesses of a particular type tend to cluster in space and the social and professional relations of these people with important resource providers tend to cluster in space, start-ups emerge where there are enough and strong relations to providers of essential resources (Stuart & Sorenson, 2003).

### 2.1.3 Standards

There are examples where the creation of industrial standards has been very important for the creation of clusters. Technical and legal standards facilitate and give direction to research and development, lead to a more effective process, give clarity, lower risks, guide the patenting process, etc. (Stuart & Sorenson, 2003).

Not only is the result of a standard setting process important. There needs to be coordination between multiple organisations in order to achieve a standard. The process of standard setting itself shows cooperation and coordination between different organisations (Stuart & Sorenson, 2003).

### 2.1.4 Policies

Clusters can have an enormous positive impact on (regional) economies if they increase the rate of invention and if indirect external effects are being strongly developed. Furthermore, the entrepreneurs, investors, and supporting organisations can gain privately if their efforts succeed in clusters. This explains the attention in policies for clusters.

Some government policies create incentives like subsidies or added infrastructure for companies. The rationale is that important companies located in a region will attract more companies. Simulations by Head, Ries & Swenson (1995) showed that for companies the attractiveness of a region is more important than incentives. Furthermore, the costs of incentives might offset the benefits. In this respect it would be better to invest in the conditions that allow for a cluster to emerge.

### 2.1.5 Creation of a cluster

A study by Bresnahan, Gambardella & Saxenian (2001) gives insights into the conditions that are important for the creation of a cluster. Bresnahan, Gambardella & Saxenian (2001) distinguish two phases in the development of clusters: a start-up phase and a phase in which the cluster continues. They found that factors that are important in the start-up phase are different than the factors that are important for keeping the cluster going.

Bresnahan, Gambardella & Saxenian (2001) found that traditional factors like “firm-building capabilities, managerial skills, a substantial supply of skilled labour and connection to markets were crucial” for the start of clusters of entrepreneurship and innovation. There are no externalities, agglomeration economies, and social increasing returns yet at the start of clusters. These factors emerge after a cluster is formed. The supporting organisations (e.g. venture capital firms) are attracted in later phases.

### 2.1.6 Policy implications

There is no special formula for creating a cluster. Policies often assume that a university should take care of a supply of skilled labour. But besides universities there are other sources of skilled workers Bresnahan, Gambardella, & Saxenian (2001) mention training by companies and immigration as other sources of skilled employees. Managerial skills are also necessary besides technical skills.

For cluster formation many existing theories and policies focus on externalities and the resulting agglomeration benefits. Many policies have been top-down policies, directed by governments and centred on firms with privileges (e.g. national champions) (Bresnahan, Gambardella, & Saxenian, 2001).

The policy implications of research findings are that the focus should be on creating a fertile environment for companies to develop. This means focusing on organisational and firm-building capabilities, a supply of managerial skills, a supply of skilled labour, and demand factors. Externalities and agglomeration economies will emerge after companies co-locate. Policy makers do not have to lead. There should be some freedom in the choices of entrepreneurs.

## 2.2 Criticism on the cluster concept

The cluster concept was popularised by Porter's work in the 1990s (Martin & Sunley, 2003). His theories have received harsh critics by for example, Martin & Sunley (2003). According to these authors "The cluster literature is a patchy constellation of ideas, some of which are clearly important to contemporary economic development and some of which are either banal or misleading" (Martin & Sunley, 2003).

Martin & Sunley (2003) especially have issues with the vagueness and ambiguities of the theory which stem from the broad definitions of clusters, the lack of clarity in terms of geography and industry, and from the unclearly defined scale of the clusters (national vs. regional/local). They present two key limitations of Porter's cluster concept. They argue that first, the concept of clusters cannot provide a deterministic model on how agglomeration is related to economic growth because the concept is so vague and ambiguous. Second, they argue that it is not proven that clustering is the cause of economic strength of clusters. The evidence to prove this causality often generalises particular results (Martin & Sunley, 2003).

Martin & Sunley (2003) also criticize the popularity of Porter's cluster theory among policy makers. They argue that theories are applied widely without asking fundamental conceptual, theoretical and empirical questions. The cluster concept might be so popular among policy makers because of the language used by Porter and because of the way he markets the concept: "Clever positioning and marketing of the cluster idea have been extremely influential in selling it to policy-makers the world over" (Martin & Sunley, 2003).

What attributes to the popularity of the cluster concept is Porter's linkage of its cluster theory to competitiveness which aligns with policy makers' focus on competitiveness, his framing of his cluster theory in terms of economics of business strategy as opposed to technical terms that other researchers use, and the generic character of the concept (Martin & Sunley, 2003).

Martin & Sunley (2003) go as far as calling Porter's 'clusters' constructs and saying that Porter's cluster concept is "being deliberately vague and sufficiently indeterminate as to admit a very wide spectrum of industrial groupings and specializations". In my opinion this should not be a problem per se. Ambiguity and vagueness does not mean that a concept is incorrect or not useful. I argue that presenting a concept or theory can create a breeding ground for further discussions and can improve the theory or even serve as the basis of newer theories. As discussed later in this chapter, there were many definitions of EIPs. The definition got improved many times as more research was done and as more results were coming in.

In the end, cluster theories exist even if the concept is real or not. The cluster concept has provided a breeding ground for a huge amount of research and other existing concepts and theories have been coupled to the cluster concept (e.g. theories on learning and knowledge spillovers).

## 2.3 Eco-Industrial Parks

This section presents a review of the literature on Eco-Industrial Parks (EIPs). EIPs use notions of Industrial Ecology and Industrial Symbiosis. This section will therefore start by shortly explaining the notions of Industrial Ecology and Industrial Symbiosis.

### 2.3.1 Industrial Ecology

In the last decades Industrial Ecology (IE), Industrial Symbiosis (IS), and Eco-Industrial Parks (EIPs) have become very active fields of research. IE compares and relates industrial systems to ecological systems. In the theories of IE industrial clusters are seen as open systems in which companies are interdependent. Traditionally industries have been regarded as individual companies that operate independently from each other. According to IE companies do not only depend on each other, but also on the environment and on communities. Implementing notions from IE means going from a linear throughput system to a closed-loop system for materials and energy (Ehrenfeld & Gertler, 1997).

### 2.3.2 Industrial Symbiosis

IS and EIPs are part of the field of IE. IS is a field of research that explains the linkages and exchanges that can take place between companies and industries. EIPs are industrial parks where the notions of IS are implemented.

According to Ehrenfeld & Gertler (1997): “Industrial symbiosis [...] involves the creation of linkages between firms to raise the efficiency, measured at the scale of the system as a whole, of material and energy flows through the entire cluster of processes.” These linkages can be in the form of resource exchanges. Chertow (2007) mentions three options for resource exchanges: by-product reuse, utility/infrastructure sharing and joint provision of services.

IS is not a new phenomenon. Symbioses occur in the petrochemical industry for a long time and trading and resource exchanges exist since primitive people shared animal parts (Ehrenfeld & Gertler, 1997; Chertow M. R., 2007). As a criterion to distinguish between IS and other types of exchanges, Chertow (2007) adopted a 3-2 heuristic: “at least three different entities must be involved in exchanging at least two different resources to be counted as a basic type of industrial symbiosis.” According to Lombardi & Laybourn (2012) practical experience showed that IS is more than exchange of by-products: IS includes “collaborating on sharing of assets, logistics, expertise and knowledge transfer” (Lombardi & Laybourn, 2012).

There are many definitions of IS because it is a relatively new field of research. Côté & Cohen-Rosenthal (1998) show some definitions of IS in literature. Actors, interaction, synergies, efficiency, community, ecology, and the sharing of resources are mentioned many times in these definitions. Chertow (2000) introduced a definition that is widely used in research (Lombardi & Laybourn, 2012):

*“The part of industrial ecology known as industrial symbiosis engages traditionally separate industries in a collective approach to competitive advantage involving physical exchange of materials, energy, water and by-products. The keys to industrial symbiosis are collaboration and the synergistic possibilities offered by geographic proximity.”*

Lombardi & Laybourn (2012) proposed a new definition of IS based on lessons learned. Their study compared the definition of IS by Chertow (2000) with their practical experience and they proposed a new definition:

*"IS engages diverse organizations in a network to foster eco-innovation and long-term culture change. Creating and sharing knowledge through the network yields mutually profitable transactions for novel sourcing of required inputs, value-added destinations for non-product outputs, and improved business and technical processes."*

### 2.3.3 What are Eco-Industrial Parks

Industrial Ecology is the theoretical part in this story. It puts companies in a closed-loop system that includes the environment and communities. Industrial Symbiosis focuses on the linkages between organisations that transforms the system into a closed-loop system. EIPs are all about parks or clusters of organisations that implement the notions of Industrial Ecology and Industrial Symbiosis. EIPs put the theories into practice.

Essentially an EIP is an industrial park designed to minimize waste and energy use and to use resources efficiently by exchanges and interaction between companies, communities and by taking the environment into account.

#### *2.3.3.1 Examples of Eco-Industrial Parks*

There are multiple examples of EIPs and IS. Styria in Austria is a well know example of a location where symbiotic relations and exchanges between companies have emerged. But the best known example is Kalundborg, a town in Denmark. At Kalundborg there is a group of companies that has developed very strong symbiotic relations. These companies exchange heat, steam, multiple types of sludge, ash, fuel gas, water and sulphur (Ehrenfeld & Gertler, 1997). What is special about this case is that these relations were not designed upfront. The many exchanges between companies are the result of business decisions between individual companies over a period of 25 years (Ehrenfeld & Gertler, 1997). The companies located at Kalundborg simply tried to reduce costs or create revenues from the exchanges of materials and energy. For these companies economic motives were the most important driver for the decisions to exchange materials and energy.

At Kalundborg cooperation is based on contracts and alliances. There is no organization in charge that dictates which companies should exchange what materials. The symbiotic relations are the result of self-organization.

Ever since the Kalundborg case was discovered and described in literature many initiatives to recreate these symbiotic relations between companies have emerged all over the world. Côté & Cohen-Rosenthal (1998) show a list of 15 EIP developments. In their 2007 paper, Gibbs & Deutz present their findings based on a survey of all EIP projects they could find in the United States and in Europe. They found 35 projects in the US and 26 in Europe. An amount of these listed projects (such as Kalundborg) where not designed upfront as EIPs or to show symbiotic relations, but it was uncovered later that symbiotic relations existed on these sites.

#### *2.3.3.2 Benefits of EIPs and IS*

There are multiple benefits associated with EIPs and symbiotic relations. An important one is the perceived positive effect on the environment resulting from resource efficiency. IS activities can reduce waste created by the system of companies, increase the resource efficiency and reverse

environmental degradation. This is an important reason that many EIP initiatives are being developed. However, nowhere is the impact of EIPs on the environment actually being measured (Gibbs & Deutz, 2007; Chertow M. R., 2007).

Cost savings are other benefits of EIPs and IS. Measures like by-product exchange reduce pollution and save potential costs of pollution (Ehrenfeld & Gertler, 1997). Ehrenfeld & Gertler (1997) mention interesting potential cost savings resulting from IS. It is possible that in the future firms will be held accountable for pollution that has been caused in the past. These costs can be for example, costs for cleaning up the pollution or costs for maintaining a legal staff to deal with the problems.

Even though the environmental benefits are often emphasized in literature, countless researchers and examples of EIPs showed that business reasons are the most important reasons companies engage in symbiotic relations. Firms cooperate out of self-interest; the positive impact on the environment is the result and not the goal of these choices to cooperate (Lombardi & Laybourn, 2012). Companies cooperate to increase resource efficiency, to reduce costs, to improve revenues, to diversify business, and to manage risks (Lombardi & Laybourn, 2012).

Besides financial benefits of cooperation in IS settings, other company benefits are risk reduction, removal of problems, improved relations, improved reputation, and achieving certain company goals (Lombardi & Laybourn, 2012). These benefits are rarely mentioned because they are difficult to quantify but in multiple cases these benefits were reasons to start symbiotic relations (Lombardi & Laybourn, 2012).

Local governments and communities also see benefits such as regional development, creation of opportunities to develop new businesses, creation of jobs, infrastructure upgrades and an increase in community involvement (Chertow M. R., 2007; Gibbs & Deutz, 2007).

There are of course also risks associated with IS. The risk of depending on one critical supplier of resources is often mentioned. However, IS relationships are not different than a normal supplier-customer relationship (Ehrenfeld & Gertler, 1997; Lombardi & Laybourn, 2012).

#### *2.3.3.3 Designed Eco-Industrial Parks are unsuccessful*

Many authors such as Ehrenfeld & Gertler (1997) and Lowe (1997) offer strategies on how EIPs should be developed without mentioning how these strategies have performed. These articles provide little empirical evidence that the mentioned strategies work in practice (Gibbs & Deutz, 2007). Gibbs & Deutz (2007) call this the 'implementation gap': the difference between the theory of IS and EIPs and what has been achieved in practice.

Gibbs & Deutz (2007) and Chertow (2007) address this implementation gap with their research. These studies show that designed EIP initiatives have been very unsuccessful compared to EIPs that emerged by self-organization of the companies involved.

Gibbs & Deutz (2007) performed surveys at many EIPs in the US and in Europe and performed in-depth interviews at 16 EIPs to find out what the status was of the EIPs and what this implementation gap entails. They found that there are many EIP initiatives in the US and in Europe and there are intentions to create waste, material and energy exchanges at these parks. But after all this time very few of these materials and energy exchanges materialised. These exchanges are still potential

exchanges or are in the planning phase. Infrastructures have been built and there is some networking at the EIPs but it has proven very difficult to attract tenants.

One possible reason for the difficulties in attracting tenants that Gibbs & Deutz (2007) mention is that for a company there are many factors that play a role in the choice of a location. Sustainability is just one of these factors. The prospect of making profits however, is a more important factor. Companies first have to be able to survive on the market before they can think about creating linkages with other companies. Gibbs & Deutz (2007) found that EIPs located in successful economic contexts were more successful in attracting tenants because of the better economic prospects that could be offered to tenants. A remote location with very few possibilities for a company to develop can prevent tenants to locate at an EIP even if the company fits perfectly within the philosophy of the EIP.

Another reason that most designed EIPs have been unsuccessful so far are the added costs of sustainability demands (Gibbs & Deutz, 2007). It was estimated that these demands added 10-20% to costs (Gibbs & Deutz, 2007).

Something else that the evaluation of designed EIPs revealed is that the effect on the environment is rarely measured (Gibbs & Deutz, 2007; Chertow M. R., 2007). There are some direct effects that can be measured like a reduction of fossil fuel use, but overall the effect of EIPs on the environment is unknown. This is strange given the fact that often the rationale to develop such a Park is to reduce the effect that industries have on the environment.

#### *2.3.3.4 Alternative approach*

Because many designed EIPs fail and self-organised EIPs have more success, Chertow (2007) proposes a different approach to EIPs. She explains a model in which symbiotic relations are uncovered. There are three stages in this model. In the first stage local companies make individual decisions to exchange materials and/or energy based on business reasons such as cost reduction or revenue increase. In the second stage the companies share knowledge and there is regional participation. In stage three a sustainable industrial district emerges where exchange is in the strategy of the district. In this model at some time the patterns of symbiotic relations are uncovered by, for example, researchers. This creates awareness and this allows for more exchanges and the relations to be exploited better.

Chertow (2007) mentions many examples of sites with symbiotic relations that have seemed to develop according to this model. Kalundborg, the most important example of industrial symbioses, also developed according to this model.

With the lessons learned from previous experiences and the explained model in mind, Chertow (2007) proposes three policy ideas to develop symbiotic relations:

1. Uncover kernels of cooperation (independent exchanges by local companies)
2. Support these kernels
3. Provide incentives to catalyse new kernels

#### *2.3.3.5 Social science approaches*

Many studies focused on economic and environmental benefits of IS (Ehrenfeld & Gertler, 1997; Lowe, 1997; Côté & Cohen-Rosenthal, 1998). More recently researchers are using social science

approaches to study IS (Ashton, 2008). Ashton (2008) applies Social Network Analysis (SNA) to the Barceloneta, Puerto Rico network of traders, chemical (including pharmaceutical), waste treatment, food, paper, metal, and electrical companies. SNA is used to identify correlations between social linkages and IS at Barceloneta. What this research found was that "different IS activities displayed distinctive network topologies" (Ashton, 2008):

- By-product exchanges occurred at pairs of companies. That is, company A exchanges by-products with company C, company D exchanges by-products with company B, etc.
- Solvent recovery services were provided by few companies to many.
- The companies that participated in utility sharing activities were fully connected. That is, they all interacted with each other.

This finding shows that the type of IS activity has implications for how robust a network is and perhaps on how easy or how difficult it is to set up certain IS activities. Another finding was that formal and informal relations, and membership in the main professional association on Puerto Rico correlated with IS activity (Ashton, 2008). This does not mean that there is a causal relation. However, for establishing IS activities it does seem important for managers to know and interact with each other formally and informally (Ashton, 2008). The third supplement to Ashton (2008) shows that in the case of Barceloneta managers most often met each other for the first time in professional settings. A third finding confirmed that trust indeed was important for IS activities.

## 2.4 Comparing EIP and Cluster literature

The two bodies of literature show little overlap. That is striking since EIPs are a sub-category of clusters. I suspect the little overlap has to do with the starting points of both fields of research.

In cluster literature authors are trying to explain phenomena that already exist. With EIPs it is the other way around. EIPs are a theoretical concept that people are trying to put into practice. It started with the theories of Industrial Ecology and Industrial Symbiosis. EIPs are then designed to implement these theories. I suspect that authors of articles related to EIPs don't explicitly see EIPs as a sub-category of clusters and therefore don't see a relation between EIPs and clusters.

The most important difference between the two bodies of literature is that in EIP literature attention is mainly paid to sustainability and the technical part of creating parks. There is little attention for the business side. In cluster literature attention is paid to additional (business) reasons. These reasons range from cost savings and revenue increases to external effects, risk management, etc.

In the field of EIPs it seems that scholars are just recently becoming aware of the importance of (business) factors other than sustainability. Indeed Lombardi & Laybourn (2012) state that business reasons are the most important reasons for organisations to engage in symbiotic relations.

## 2.5 Towards a Preliminary Set of Requirements

### 2.5.1 Most important notions from literature

A couple of notions seem very important in cluster and EIP literature. The first is knowledge sharing. It is important in cluster literature as well as in EIP literature. Knowledge sharing seems to be an important precondition for innovation and industries in which knowledge sharing is crucial have a propensity to cluster (Bathelt, Malmberg, & Maskell, 2004). Knowledge sharing is also important for

EIP development as it allows companies to learn from each other's activities and it helps to create resource exchanges (Lombardi & Laybourn, 2012). Knowledge sharing allows a kernel of cooperation to move from the first stage to the third stage in Chertow's model for symbiotic relations (Chertow M. R., 2007).

The literature review also reveals the importance of the availability of resources. The availability of resources like natural resources, skilled labour, capital, and infrastructure makes locations attractive for firms to locate in.

Social relations seem very important for knowledge sharing and for creating resource exchanges as shown by Ashton (2008) and Stuart & Sorenson (2003). The third supplement to Ashton (2008) showed that in the case of Barceloneta managers most often met each other for the first time in professional settings and that trust indeed was important for IS activities. Network activities can be used to bring people together and to create trust by arranging face-to-face interactions.

Mutually profitable transactions are especially important for EIPs as these parks are designed to minimize waste and energy use and to use resources efficiently by creating exchanges between companies. If the transactions are profitable for just one party it is not attractive for parties to participate in certain initiatives and resource exchanges will probably not emerge.

One of the most important notions is the need for business opportunities. Gibbs & Deutz (2007) explain that the prospect of making profits is more important than sustainability. Companies will not locate at certain locations just for the sake of sustainability. They have to be able to make profits and to survive on the market before they can think about creating linkages with other companies.

### 2.5.2 Preliminary Set of Requirements

Based on the important notions and all of the knowledge found in literature the Preliminary Set of Requirements for the successful development of resource sharing business parks is:

1. Resource availability
2. Agglomeration effects
3. Cluster governance policy
4. Network activities
5. Mutually profitable transactions
6. Business opportunities

The remainder of this section continues by explaining each requirement and operationalising the requirements. The intended use of this set of requirements is that the more a park satisfies these factors, the higher the chance the park will be developed successfully.

#### *2.5.2.1 Resource Availability*

The availability and characteristics of needed resources at the location has a significant impact on the successful development of a cluster. However, as the failure of most efforts to design EIPs on the basis of resource availability shows (Head, Ries, & Swenson, 1995; Stuart & Sorenson, 2003; Chertow M. R., 2007; Lombardi & Laybourn, 2012), resource availability is "only crucial in locational decisions if they are the most important inputs of a firm (Desrochers 2004), or where materials and energy comprise a large part of the budget (Cohen-Rosenthal 2000)." (Lombardi & Laybourn, 2012).

Physical resources are not the only resources to be considered. According to Stuart & Sorenson (2003) intellectual property, human capital, and financial capital are central production inputs for the high-tech industry. Resource providers (investors, customers, specialised workers, collaborators) are the holders of these essential resources. The social relations between resource providers and entrepreneurs determine whether these resources are mobilised (Stuart & Sorenson, 2003).

The costs of human capital (e.g. skilled employees) as well as the source of these costs should also be considered. Artificially high wages or a high level of employment in unproductive jobs makes a location less attractive for companies (Bresnahan, Gambardella, & Saxenian, 2001; Stuart & Sorenson, 2003)

#### *2.5.2.2 Agglomeration Effects*

Besides resource availability, agglomeration effects are very important in cluster formation. Agglomeration effects (or positive externalities) are positive feedbacks that result from firms locating close to one another. Companies from the same industries tend to follow one another to certain locations because of these positive externalities. Examples of such externalities are the creation of a pool of specialised labour, attracting supporting industries and suppliers, clustering of resource providers (investors, customers, specialised skills, collaborators), and technological spillovers (Head, Ries, & Swenson, 1995).

Examples of supporting firms or specialised service providers are: consultancy firms, patent law firms, financial institutions, research facilities, and suppliers of intermediate inputs and industry-specific goods (Head, Ries, & Swenson, 1995; Stuart & Sorenson, 2003).

#### *2.5.2.3 Cluster Governance Policy*

A top-down or directive policy which directs every move of companies and picks specific industries or technologies has a negative effect on the success of clusters. In practice, a policy that allows for some freedom and decentralisation in the choice of initiatives works better than strict policies (Bresnahan, Gambardella, & Saxenian, 2001).

Usually a policy is more successful if it focuses on creating the right conditions for companies to do business instead of focusing on the result (e.g. creating a cluster). Focusing on creating the right conditions means attention is paid to factors like: creating a highly skilled labour force, creation of demand and markets, openness of the economy, creating standards, competition, supply-side factors and institutions, education, standard setting, etc. (Bresnahan, Gambardella, & Saxenian, 2001).

Some policies only focus on the positive externalities of agglomeration. These factors are not enough for creating successful clusters (Bresnahan, Gambardella, & Saxenian, 2001). Research shows that the more traditional factors like firm-building capabilities, connection to markets and demand, and the supply of technical and managerial skills should not be neglected (Bresnahan, Gambardella, & Saxenian, 2001).

A policy can work on different levels. For example, an open market with strong exports and where new niches are allowed to develop usually have better conditions for clusters to develop as opposed to protected domestic markets. Creating such a market can be part of part of public or government policy (Bresnahan, Gambardella, & Saxenian, 2001).

Policies or strategies on attracting tenants work on cluster level. Literature does not mention many specific strategies for attracting tenants. One strategy that is mentioned is to first attract an anchor tenant to a location. The idea is that an important company will attract attention from, for example, companies from the same industries, suppliers, supporting industries, etc. Other options are (tax) benefits or other privileges for firms locating at a specific site. But as mentioned before, the business environment and the economic prospect are more important for attracting tenants than incentives (Head, Ries, & Swenson, 1995; Gibbs & Deutz, 2007).

#### *2.5.2.4 Network Activity*

Having a well-functioning network is probably one of the most important factors in establishing and sustaining symbiotic relations. The most important mechanism for this is knowledge sharing through the network. New opportunities can be uncovered by sharing knowledge in a network. Events and activities in a network create opportunities for companies to get to know each other. In some cases this leads to more interaction. Knowledge sharing in these interactions can lead to uncovering of opportunities and cooperation between businesses. Trust was shown to correlate with IS activities (Ashton, 2008). People that trust each other are more willing to do business with each other.

IS relations and a strong, well-functioning network helps in sharing knowledge. This in turn leads to uncovering of opportunities. Indicators of knowledge flows are geographic location, alliances with other institutions and organisations, and R&D expenditures (Decarolis & Deeds, 1999). Indicators of knowledge stocks are products in the pipeline, firm citations, firm patents, and factor analysis (Decarolis & Deeds, 1999).

#### *2.5.2.5 Mutually Profitable Transactions*

As the literature research shows, creating symbiosis is never a goal in successful cases of IS. It rather is the result of profitable transactions between actors. Knowledge sharing, exchange of resources, fuel substitution, asset sharing, etc. all qualify as profitable transactions. If the parties involved have enough opportunities for these transactions, symbiotic relations are more likely to arise. A well-functioning network helps in identifying opportunities for business transactions.

Mutually profitable transactions were mentioned as a success factor for EIPs. It would be interesting to know what role this factor plays in a 'regular' cluster.

#### *2.5.2.6 Business Opportunities*

Companies will cooperate out of self-interest. The rest (environmental benefits) is the result. If there are no opportunities for cooperation, symbiotic relations or even normal business relations will most likely not arise.

Rising wages and high rents at other locations can create opportunities for companies to locate in certain regions (Bresnahan, Gambardella, & Saxenian, 2001). External shocks like global warming, energy supply shocks, materials security (rare earths, precious metals) can also create opportunities for doing business.

#### *2.5.2.7 Operationalisation of Requirements*

Table 2 shows the operationalisation of the preliminary set of requirements in a table.

Table 2 – Operationalisation of the Preliminary Set of Requirements

| Requirements | Indicators |
|---|---|
| **1. Resource availability** | **Natural resources**<br>Availability: Low, Medium/Low, Medium, Medium/High, High |
| | **Infrastructure**<br>Availability: Low, Medium/Low, Medium, Medium/High, High |
| | **Human capital**<br>Availability of investors, customers, specialised workers, collaborators: Low, Medium/Low, Medium, Medium/High, High<br>Costs of human capital compared to other regions: Low, Medium/Low, Medium, Medium/High, High |
| | **Financial capital**<br>Availability of financial capital: Low, Medium/Low, Medium, Medium/High, High |
| **2. Agglomeration effects** | **Pool of specialised labour**<br>Absent, Low, Growing, Medium, High |
| | **Supporting industries and suppliers**<br>Presence of consultancy firms, patent law firms, financial institutions, research facilities, and suppliers of intermediate inputs and industry-specific goods.<br>Absent, Low, Growing, Medium, High |
| | **Knowledge sharing**<br>Absent, Low, Growing, Medium, High |
| **3. Cluster governance policy** | **Description of policy**: for example, strict vs. freedom, top-down vs. bottom-up, focus of policy |
| **4. Network activity** | **Knowledge sharing**<br>Low, Medium/Low, Medium, Medium/High, High |
| | **Network events and activities**<br>Low, Medium/Low, Medium, Medium/High, High |
| | **Linkages and alliances**<br>Low, Medium/Low, Medium, Medium/High, High |
| **5. Mutually profitable transactions** | **Number of mutually profitable transactions (e.g. knowledge sharing, resource exchanges, asset sharing)**<br>Low, Medium/Low, Medium, Medium/High, High |
| **6. Business opportunities** | **Description of business opportunities**: for example, external shocks, policy changes, materials security |

# 3 Case 1: HOST Park

The Prelimiary Set of Requirements from the previous chapter is going to be compared to information from two cases. This chapter will provide information on the first case: HOST Park on Hawaii. First HOST Park will be described. Then information according to the factors in the Preliminary Set of Requirements will be presented.

Information was collected from literature, reports (annual, audit, etc.), (organisation) web sites, news articles, documents, press releases, and park terms and conditions. Also, Laurence Sombardier and Keith Olson were interviewed for this case. These interviews can be found in Appendix A1 (Sombardier) and Appendix A2 (Olson).

## 3.1 Description of HOST Park

Hawaii Ocean Science & Technology (HOST) Park is a green economic development park administered by NELHA, a State of Hawaii agency. It is located in Keahole Point, North Kona on the west side of the Island of Hawaii (also known as Big Island) (see Figure 4). The park is situated around Kona International Airport (see Figure 5).


Figure 4 – HOST Park on the Island of Hawaii (source: www.google.com)

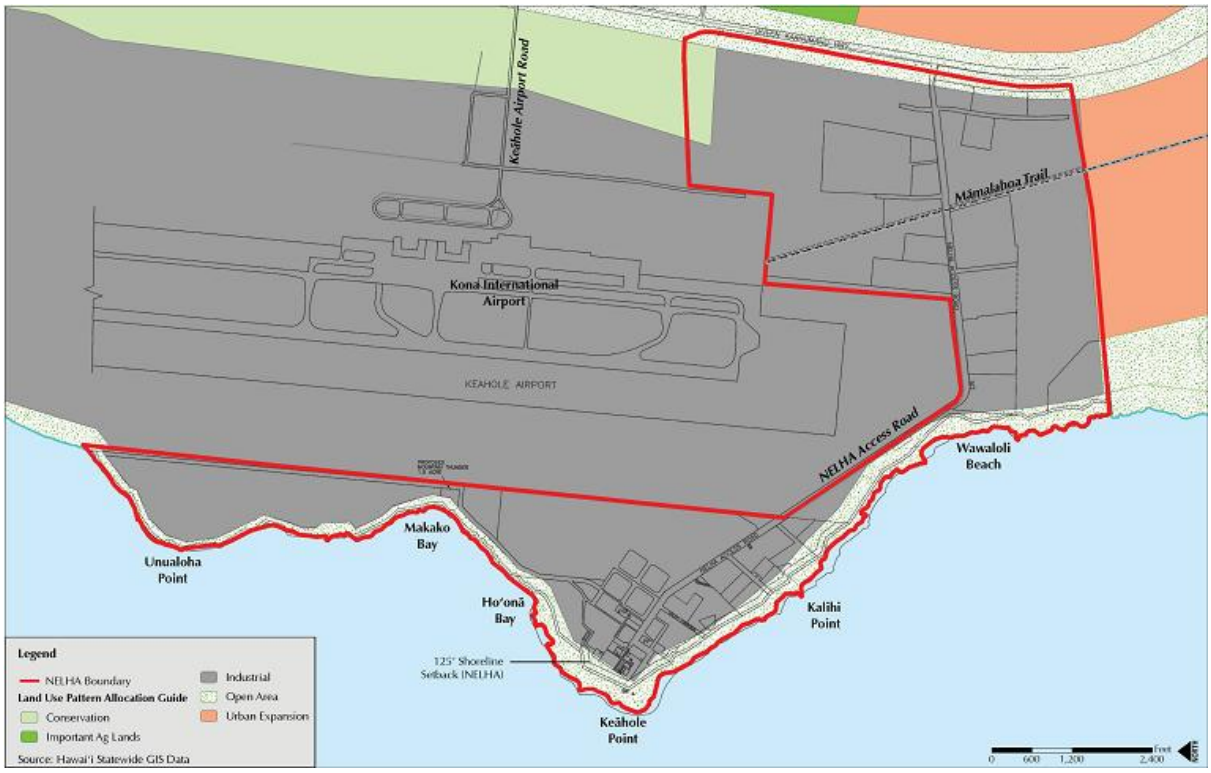


**Figure 5 – NELHA boundary. Source: (NELHA, 2011)**

HOST Park provides resources and facilities for green energy technologies and ocean-related research, education, and commercial activities (NELHA, 2014; NELHA, 2011). At HOST Park applied research is performed along with activities such as demonstration, test and evaluation, and deployment of clean energy technologies.

Tenants locate their businesses at NELHA because of the availability of clean deep seawater, warm surface seawater, and because of the high solar insolation. The access to quality seawater for private companies is considered a unique selling point by the tenants (Center for Tropical and Subtropical Aquaculture, 2008).

NELHA's mission is to contribute to the economic development of Hawaii by facilitating energy and ocean-related research, education, and commercial activities (NELHA, 2014). Commercial activities that are performed at NELHA include aquaculture, water bottling, green energy developments, and production of pharmaceuticals.

In total, HOST Park covers 870 acres of which 670.5 acres are available for tenants (NELHA, 2011). The remaining 199.5 acres are for other uses such as conservation, roads, utility corridors, pipeline easements, and support services (NELHA, 2011). Of the 670.5 acres available for tenants, 273 acres are already leased or under option. The other 397.5 acres will be developed in the future.

The 2011 Master Plan revealed plans to divide the park into six zones (NELHA, 2011): Applied Renewable Energy Zone; Economic Driver; Applied Technology Laboratories and Containerized Technology Research Centre; Science and Technology Cultural Centre; Ocean, Air, Energy and Biology Research Laboratories; and Ocean Village. These zones will be explained further in section 3.4 Cluster governance policy.

## 3.2 Resource availability

### 3.2.1 Natural resources

The most important resource at HOST Park is the seawater. Cold deep seawater and warm surface seawater are pumped up and distributed to the tenants on site. There are many uses for the seawater including: desalination, bottling, salt extraction, shrimp farming, shellfish production, finfish production, cold water agriculture, microalgae production, seaweed production, energy production, biofuels production, and cooling (NELHA, 2013).

The park is situated at a very favourable location for pumping up seawater. Of course more islands and countries have access to ocean water but what makes this location in Hawaii favourable is that the ocean bottom drops steeply offshore which makes it possible to use relatively short pipelines to pump up deep seawater (NELHA, 2011). Another benefit is that the seawater is of very high quality.

Besides the availability of seawater, another important natural resource is the availability of solar radiation. The location has a very high solar insolation and has less than 40 centimetres or rainfall per year (NELHA, 2014). This makes it possible to produce energy using concentrated solar thermal energy or using photovoltaics.

### 3.2.2 Infrastructure

The infrastructure at HOST Park is developed by NELHA over the course of 30 years. The infrastructure includes roads, a sewer system, buildings, parking spaces, a freshwater system, a drainage system, and the seawater distribution system. The funds to plan, to design and to put the initial infrastructure in were covered by state funds (NELHA, 2013; Sombardier, 2015). Small repairs and maintenance are covered from normal operational funds (see Appendix A1). For larger infrastructural projects NELHA requests Capital Improvement Project (CIP) funds annually and project based (see Appendix A1). These funds are then used for building roads, major pipeline repairs, expansions, the seawater system, and other infrastructure improvement projects (see Appendix A1).

The most important infrastructural system at HOST Park is the seawater distribution system. There are three pipelines at NELHA pumping up seawater continuously. Two of these pipes pump up cold deep seawater from a depth of approximately 600 metres and approximately 900 metres respectively, with a maximum capacity of 164,287 litres per minute (NELHA, 2014). The warm surface seawater pipe pumps up seawater from a depth of 24 metres with a maximum capacity of 210,469 litres per minute (NELHA, 2014). The seawater is then distributed with a 16km distribution system (NELHA, 2014).

There is plenty of pumped up seawater available for the tenants (see Appendix A1). The design capacity is not being approached yet so there are no constraints regarding the amount of seawater that the clients are using (see Appendix A1). Of course the clients pay for the amount of water they use but this is not regarded as a constraint. If the design capacity would be approached, the clients would have to stick to the amount of water that they said they were going to use (see Appendix A1). Since using more water than expected is currently not a problem, the current capacity allows for the growth of the number of tenants.

### 3.2.3 Human capital (employees)

There are around 41 tenants at NELHA (West Hawaii Today, 2014; UHERO, 2012). The tenants at HOST Park employ 335 people. By executing the 2011 Master Plan, in 15 years 480 additional jobs are expected to be created at HOST Park and 2700 jobs are expected to be created in West Hawaii (excluding construction related jobs) (NELHA, 2011).

The amount of people that HOST Park employs and will employ in the future is significant. Table 3 shows the top ten employers on the island. Using the information from this table, it is calculated HOST Park employs about 0.4% of the total county employment. This does not seem to be a large amount, but it is in the same order of magnitude of the bottom part of the top ten employers, especially if indirect jobs are included (presumably) and if the additional jobs are created by executing the Master Plan.

**Table 3 – Top ten employers in the County of Hawaii in 2010 (The Department of Finance, 2011)**

| Rank | Employer | Number of employees | Percentage of total county employment |
|---|---|---|---|
| **1** | State of Hawaii | 8,063 | 10,7% |
| **2** | County of Hawaii | 2,663 | 3,5% |
| **3** | US Government | 1,421 | 1,9% |
| **4** | Hilton Waikoloa Village | 881 | 1,2% |
| **5** | Wal-Mart | 770 | 1,0% |
| **6** | KTA Super Stores | 700 | 0,9% |
| **7** | The Fairmont Orchid | 618 | 0,8% |
| **8** | Four Seasons Resort Hualalai | 550 | 0,7% |
| **9** | Mauna Kea Beach Hotel | 550 | 0,7% |
| **10** | Mauna Lani Resort (Operations) Inc. | 529 | 0,7% |
| | Total | 16,745 | 22,1% |

Although HOST Park employs a significant amount of people, attracting and retaining certain staff is challenging (see Appendix A). HOST Park is located in an isolated area, there is not a university with an educational programme in the vicinity that produces people that have the types of skills needed for some positions (see Appendix A). One way this is solved is by bringing people in from outside of Hawaii (see Appendix A2).

Higher level positions are less challenging to attract and retain. The challenges are more on the technician side (see Appendix A1). PhDs in Marine Biology or microalgae experts for example are easier to attract (see Appendix A1). People are willing to move over to Hawaii because Hawaii is seen as a paradise (see Appendix A). But retaining employees sometimes is a challenge because the costs of living in Hawaii are very high (see Appendix A1).

Another way NELHA tries to solve this problem is by working with the local community college to develop programmes and curricula for technicians (see Appendix A). HOST Park also has many linkages with universities throughout the US. Internships are fulfilled with students from all over the US (NELHA, 2015). These linkages create a connection to potentially future employees of HOST Park.

A third issue with human capital is the non-compete clause that some private companies use to restrict employees to find employment in the same region (Center for Digital Education, 2015). In practice, this sometimes means that an employee has to move to a different state (Center for Digital Education, 2015). These clauses reduce the number of available skilled and experienced workers. Hawaii recently passed a bill that restricts these non-compete clauses (Hawaii State Legislature, 2015). This indicates that it is perceived as a real problem. However, these problems are not an issue to a point that it would cause problems for the companies (see Appendix A1).

### 3.2.4 Financial capital

NELHA was always supported with government funds. In the 1970s the initial infrastructure was developed with government funds. On average NELHA receives about $2 million annually from the State (Bonham, Burnett, Cintina, & Bernstein, 2012) and over the years the State has put in more than $100 million in NELHA (see Appendix A1).

The State supports NELHA with Capital Improvement Project (CIP) funds. CIP funds are requested annually and project based; NELHA submits proposals which are accepted or denied. These funds are then used to improve the infrastructure e.g. for building roads, major pipeline repairs, expansions, and the seawater system (see Appendix A1).

In 2008 $3 million was requested for emergency repairs for a deep sea pipeline (Hawaii House Blog, 2008). In 2013 another request was submitted and in January 2014 it was announced that NELHA would receive $13 million for constructing roads and intersections, to upgrade a seawater pipeline, and to renovate buildings (West Hawaii Today, 2014).

The State supports NELHA for two reasons: the park's positive economic impact on the state and the jobs that are created by NELHA's and the tenant's activities. Former governor of Hawaii Neil Abercrombie[1] saw NELHA as "a driver of innovation, economic development, and job creation on the Big Island and for our entire state" (West Hawaii Today, 2014).

According to an economic impact assessment performed by the University of Hawaii Economic Research Organisation (UHERO), in 2010 total expenditures of the tenants was an estimated $81 million of which 58% were paid to Hawaii entities (Bonham, Burnett, Cintina, & Bernstein, 2012). NELHA's economic impact was $87.7 million in 2010 and tax revenues were an estimated $4.5 million (Bonham, Burnett, Cintina, & Bernstein, 2012). Additionally, the park employed 335 people (NELHA, 2011) and the park created 583 jobs directly and indirectly in the larger Hawaii economy (Bonham, Burnett, Cintina, & Bernstein, 2012). Every dollar the State put in on NELHA generated $42.8 output in the Hawaii economy (Bonham, Burnett, Cintina, & Bernstein, 2012).

These figures even improved significantly in 2013. In 2013 the economic impact of the park and tax revenues rose to $122.8 million and $5.0 million, respectively (Burnett, Cintina, & Wada, 2015). Tenants spent about $98.8 million and the park contributed to 617 jobs directly and indirectly in the larger Hawaii economy (Burnett, Cintina, & Wada, 2015).

Although the State has supported NELHA from the start, there are changes in recent years. NELHA, financially, has to achieve greater self-reliance since the Cayetano administration[2] told them to in

[1] Neil Abercrombie, Governor of Hawaii (2010-2014)
[2] Ben Cayetano, Governor of Hawaii 1994-2002

1995 and has to be financially self-sufficient since Governor Lingle mandated this in 2003. NELHA succeeded to approach a breakeven point in 2009 and 2010 (Hawaii Department of Land and Natural Resources Office of Conservation and Coastal Lands, 2014; The Auditor - State of Hawaii, 2012). Now it is operationally self-sufficient for 6-7 years (see Appendix A1).

Until 2006 NELHA received financial capital from the General Fund of the State of Hawaii (NELHA, 2011). Now NELHA generates income from revenues generated at HOST Park (NELHA, 2011) and from occasional grants. The revenues generated at HOST Park include lease payments, revenues from analytical laboratory contracts, sale of seawater, and reimbursements from the tenants such as electricity and potable water. Tenant rent, royalties, and pass through expenses amount up to approximately $4 million (Bonham, Burnett, Cintina, & Bernstein, 2012).

In 2012 NELHA received a $3 million federal Economic Development Administration grant to expand its alternative energy and biotechnology incubator (West Hawaii Today, 2014). The operating budget of $7.2 million in fiscal year 2013-2014 (West Hawaii Today, 2014) shows the relative magnitude of these and other grants.

NELHA does still receive CIP funds, but the majority of the requests are rejected (see Appendix A1). In order to generate enough revenues NELHA decided to raise seawater prices and lease rates. For extractive tenants (e.g. water bottling) the leasing prices increased from $200/acre-month to $3,000/acre-month (NELHA, 2011). Agricultural rates increased from $100-$150/acre-month to $500/acre-month (for both new leases and lease renewals) (NELHA, 2011; Sombardier, 2015).

## 3.3 Agglomeration effects

### 3.3.1 Creation of a pool of specialised labour

A pool of specialised labour is created by experience and by people staying in the cluster when they switch jobs. According to Olson (see Appendix A2) many people stay inside HOST Park when they switch jobs. Furthermore, NELHA exists for over 40 years and over the course of years many people have worked at the cluster. This indicates that people had the opportunity to build experience. Currently HOST Park tenants employ 335 people. Additionally, in 15 years 480 jobs are expected to be created additionally (2700 jobs in the larger area) (NELHA, 2011).

The creation of jobs along with innovation and economic development are important reasons for government support of NELHA. While announcing the grant of $13 million to NELHA in 2014, Governor Neil Abercrombie cited innovation, economic development, and job creation as important impacts NELHA has on the Big Island and on the entire state (West Hawaii Today, 2014). As section 3.2.3 Human capital (employees) mentions, the State Government is removing and changing regulations that act as barriers for employment such as the non-compete clause.

NELHA is also investing in education. The organisation is involved in many educational activities including student visits, place-based training, creation of a campus (by the University of Hawaii), internship programmes, workshops and fundraisers (NELHA, 2014). High schools, community organizations, collages, universities, and research institutions are all involved in these activities. Internships are also possible at HOST Park client organizations. And NELHA is actively working together with the local community college to develop programmes and curricula for technicians (see Appendix A).

An initiative worth mentioning is the Akamai Workforce Initiative. This initiative "is dedicated to building a diverse, local workforce in Hawaii and advancing college students from Hawaii into the STEM workforce" (Institute for Scientist & Engineer Educators, 2014). Akamai offers internships, professional development activities, pre-college programmes, community outreach, industry partnerships, etc.

The existence of the park for more than 40 years, the 335 people currently employed, and the involvement in many educational projects, not only for students but also for people that are already employed as well (Akamai Workforce Initiative), all indicate that a pool of skilled workers exists and is growing. As mentioned in 3.2.3 Human capital (employees) though, there are some challenges in attracting and retaining certain employees.

### 3.3.2 Supporting industries and suppliers

There are few examples of supporting industries and suppliers at HOST Park but overall the agglomeration effects have been a challenge at NELHA (see Appendix A). The remoteness of NELHA acts like a barrier for this (see Appendix A). The Island of Hawaii has a population of less than 200,000 and there are only three population centres which are far apart from each other (see Appendix A2). This makes NELHA an out of town, remote location (see Appendix A). At HOST Park it is not like Silicon Valley where universities are close by and where many things support the cluster and industry (see Appendix A1). What made the development of HOST Park still possible is its unique resources (access to quality seawater and high solar insolation), the support from the State, and perseverance of developers and tenants (see Appendix A).

One example of a supporting firm is a water bottle preform manufacturer that established at HOST Park (Miller, 2013) & (Appendix A2). Until recently most of the companies were buying the preforms from mainland (see Appendix A1). Shipping costs are very high at Hawaii, which made this practice very expensive. Now the preform manufacturer produces preforms locally for the 4-5 desalination companies at NELHA as well as for the rest of the state of Hawaii (see Appendix A1).

NELHA is world known for the type of work that happens with deep seawater (see Appendix A1). There are some businesses that have established their selves at the island, not at HOST Park, but which are marine based (see Appendix A1). This is some evidence of HOST Park's attracting force as a result of the tenants forming a marine based cluster.

NELHA is working on attracting investors. At HOST Park it is not like there are many venture capitalists like in Silicon Valley (see Appendix A2). NELHA is just starting this kind of way; it was state funded and is now moving to self-sufficiency (see Appendix A2). This has important implications since it allows supporting industries to be created (see Appendix A2).

The 2011 Master Plan unveils many plans to develop the whole area see section 3.4 Cluster governance policy. Also, NELHA recently received $3 million to renovate a building that is going to serve as an incubator (see Appendix A1). In addition NELHA is working with the High Tech Development Corporation (HTDC) which is a state agency that runs small business grants and provides business services (see Appendix A1). HTDC is going to help NELHA to have a presence and provide services to start-up businesses (see Appendix A1). Before, people had to go to Honolulu which is on another island to get these types of services (see Appendix A1). These initiatives help create an environment that is attractive for start-ups and investors.

### 3.3.3 Knowledge sharing

The tenants at HOST Park mainly compete with each other (see Appendix A). On few occasions the tenants do collaborate. For example on marketing Specific Pathogen Free (SPF) shrimp (see 3.6 Mutually profitable transactions (collaboration)). Also, Jim Wyban, founder of shrimp broodstock firm High Health Aquaculture Inc. did mention that there is knowledge sharing going on at HOST Park (Center for Tropical and Subtropical Aquaculture, 2008).

Very little to no other indications of knowledge sharing or an organisation that is facilitating knowledge sharing between tenants at NELHA was found. In fact both Olson and Sombardier (see Appendix A) independently confirmed that little knowledge sharing is going on.

## 3.4 Cluster governance policy

There are multiple types of policies e.g. national energy policies or regional economic development policies. This section is intended to discuss the cluster policy. Other policies are left out of the scope. It is still worth to mention here that the State government has been very supportive over the years. Section 3.2.4 Financial capital explains that the reasons are that government investments in NELHA have a very good return on investment (positive economic impact) and that HOST Park creates many jobs. This support has been very important for the development of HOST Park.

### 3.4.1 Three phases of NELHA

Three phases can be identified in the development of NELHA. In early 1970s there was an oil crisis which raised concerns at the State. Hawaii, like many other countries, was concerned about its near total dependency on fossil fuels and in response the State established Natural Laboratory of Hawaii (NELH) in 1974 (The Auditor - State of Hawaii, 2012). NELH was established to perform research and development of new sources of renewable energy with a particular focus on ocean-related technologies (The Auditor - State of Hawaii, 2012). NELH had a specific focus on OTEC energy (see Appendix A). OTEC uses the temperature difference between cold deep seawater and warm surface seawater to generate electricity. Pumps and pipelines were installed to extract the ocean water.

Then, in the early 1980s energy became less of a hot topic and opportunities to develop commercial activities were recognized (see Appendix A1). A lot more could be done with the pumped up seawater before it was returned to the ocean. The seawater could be used for aquaculture, marine biotechnology, air conditioning, desalinated bottled water, agriculture, Sea Water Air Conditioning (SWAC), and alternative energy production (The Auditor - State of Hawaii, 2012; Sombardier, 2015). To exploit the value of the seawater, Hawai'i Ocean Science and Technology (HOST) Park was created adjacent to NELH. In 1990 these two organisations merged and formed Natural Laboratory of Hawaii Authority: the current NELHA.

In this second period the policy was very specific that companies had to use the water or other resources at NELHA (see Appendix A2). NELHA was supported by the State and there was not really a need to deviate from the policy. Tenant proposals had to fit a very narrow scope and the policy was very limiting (see Appendix A2).

5-7 years ago the policy changed because NELHA changed (see Appendix A2). The state agency had to become self-sustaining and had to give people opportunities to propose projects that would not have been allowed in the past (see Appendix A2). In this third period the policy is morphing from a strict, top-down policy to a more bottom-up, open-minded policy as an effect of being self-sustaining

(see Appendix A2). One example that shows this is that algae companies need $CO_2$ in addition to seawater. Previously $CO_2$ facilities would not have been allowed, but now they are (see Appendix A2). Another example is the water bottle preform facility mentioned in section 3.3.2 Supporting industries and suppliers.

### 3.4.2 The current policy at HOST Park

NELHA has outlined its current policy in documents such as its Master Plan and the Project Initiation Packet. The goal of NELHA "shall be to facilitate research, development, and commercialization of natural energy resources and ocean-related research, technology, and industry in Hawaii and to engage in retail, commercial, or tourism activities that will financially support that research, development, and commercialization at a research and technology park in Hawaii" (NELHA, 2011).

NELHA's mission is "to develop and diversify the Hawaii economy by providing resources and facilities for energy and ocean-related research, education, and commercial activities in an environmentally sound and culturally sensitive manner" (NELHA, 2011).

#### *3.4.2.1 NELHA board and staff*

Since NELHA is a public organization linked to a department of the State, several public entities are represented at its board. Previously the board had 11 members: three of them appointed by the Governor, six of them public sector directors representing the University of Hawaii; the Department of Business, Economic Development and Tourism; the Department of Land and Natural Resources; Hawaii Strategic Development Corporation; Hawaii Technology Development Corporation; and the Mayor of Hawaii County (NELHA, 2011). The remaining two are research advisory committee members (NELHA, 2011). Now, since a couple of years, the clients are represented at the board of NELHA as well by two people (see Appendix A2).

NELHA manages the park with 19 staff members: a CEO, a microbiologist, an engineer, a chemist, a fiscal officer, a tenant review specialist, mechanics, electricians, plumbers, an operations manager, administrative staff, and a groundskeeper (NELHA, 2011). These employees are paid from revenues generated by NELHA (NELHA, 2011).

#### *3.4.2.2 Themes of focus and zones of activity*

The major themes that NELHA is focusing on are (NELHA, 2011):

1. Energy production;
2. Food, aquaculture, and nutraceuticals;
3. Energy research driven programmes; and
4. Public outreach, education, and tourism

The activities derived from these themes are clustered into six zones of activities (see Figure 6):

1. Applied Renewable Energy;
2. Economic Driver;
3. Applied Technology Labs & Containerization Research;
4. Science and Technology Cultural Center;
5. Ocean, Air, Energy and Biology Research; and
6. Ocean Research Village and Zone

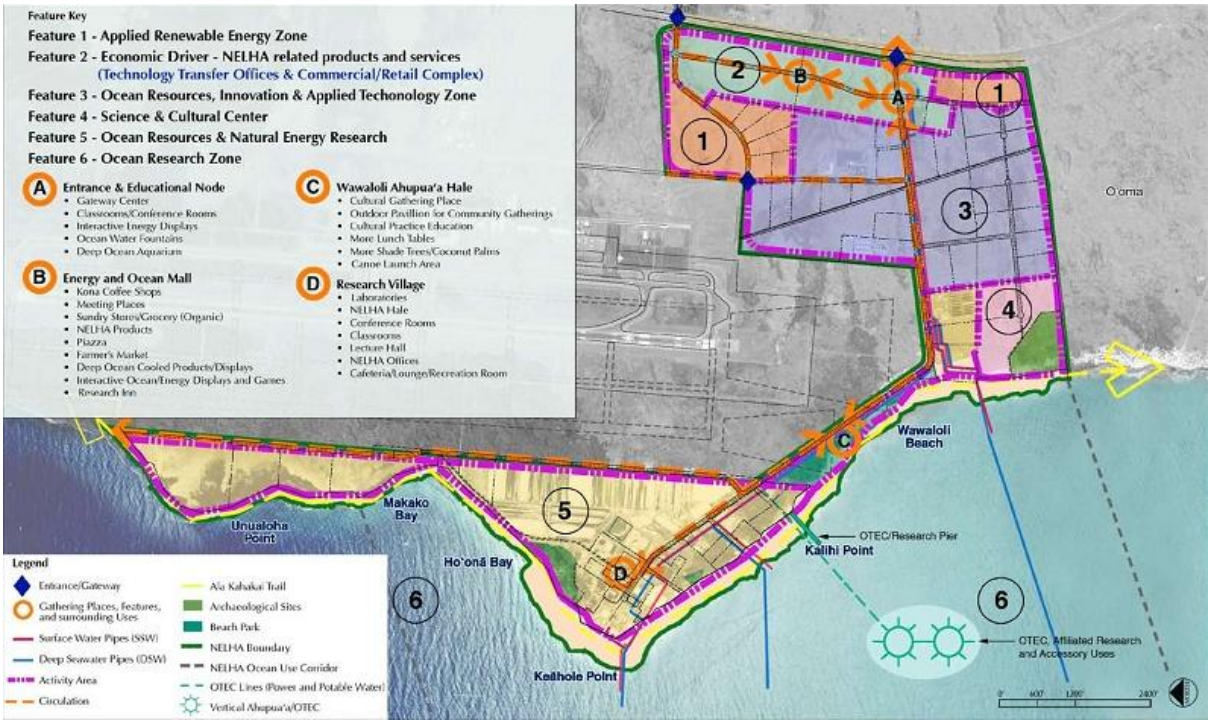


Figure 6 – Designation of the six zones on HOST Park

Table 4 lists these zones and shortly explains the focus of each of these zones. In order to foster collaboration, tenants performing similar activities are put together according to these six zones (NELHA, 2011).

Table 4 – HOST Park six zones of use

| Zone | Focus of zone |
|---|---|
| **Applied Renewable Energy Zone** | Focus on energy production and storage (including solar, wind, geothermal, and waste-to-energy technologies). |
| **Economic Driver (NELHA-related products and services)** | This zone will be similar to a shopping centre with retail, commercial activities, entertainment, an educational hub, and a business hub. |
| **Applied Technology Laboratories and Containerized Technology Research Centre** | Focus on start-up companies and business development. It will include an incubator. |
| **Science and Technology Cultural Centre** | Focus on research into the scientific bases behind traditional cultural practices |
| **Ocean, Air, Energy and Biology Research Laboratories** | A science and technology research campus for National Labs in Hawaii. |
| **Ocean Village** | Focus on ocean research and applications. |

### *3.4.2.3 Attracting tenants, types of tenants and land use agreements*

NELHA attracts tenants by going to conferences and by giving presentations at certain events (see Appendix A1). By word of mouth it is letting people know that HOST Park is a good place to do certain types of projects (see Appendix A1). According to Sombardier (see Appendix A1) "NELHA has the advantage of being established already. Anyone who knows about deep ocean water probably knows about us."

At HOST Park there are six tenant types (NELHA, 2011; NELHA, 2013):

1. Extractive commercial tenants. These tenants either extract the water or extract some other product contained in the water. Examples of activities these tenants perform are: desalination, bottling, salt extraction, nigari[3] production.
2. Productive commercial tenants who use the seawater as a medium or for cooling (aquaculture: shrimp, shellfish, and finfish production; cold water agriculture; microalgae production; seaweed production).
3. Pre-commercial tenants
4. Education/Outreach tenants (e.g. Friends of NELHA)
5. Energy tenants. These tenants produce energy (OTEC), energy related products (biofuels), or provide cooling in for example solar projects.
6. Research tenants

The Project Initiation Packet (2013) outlines the three different types of land use agreements that NELHA uses for its tenants. The first is the Memorandum of Understanding (MOU). This agreement is intended for short research projects (less than 3 months) and is appropriate for visiting researchers and students who want to use NELHA's resources.

A second type of land use agreement is the Rental Agreement (RA). This agreement is used for research, pre-commercial, and other projects and it can be applied to any type of space including office, open, lab, mixed, research campus, Gateway, and technical park spaces. The Rental Agreement spans one year and can be renewed yearly.

The third type of land use agreement is the Sublease. The Sublease is used for long term projects. The term is negotiated and has a maximum of 30 years.

#### *3.4.2.4 Permits*

NELHA is master permitted and has performed environmental studies for a variety of different applications (NELHA, 2013; Sombardier, 2015). The organisation has a Conservation District Use Permit, Special Management Area Use Permits, various Environmental Assessments and Impact Statements (NELHA, 2013). NELHA having these permits saves the tenants time and up-front costs (NELHA, 2013; Sombardier, 2015). The tenants do not have to go through the process of getting these permits themselves.

#### *3.4.2.5 Foreign Trade Zone and Enterprise Zone*

HOST Park is a designated Foreign Trade Zone (FTZ) and an Enterprise Zone (EZ). An FTZ is a secure geographic area in which merchandise is not subject to customs duties or other added value taxes (Hawaii Foreign-Trade Zone #9, 2015). Being in such an FTZ saves costs for companies involved in international trades because normally customs duties have to be paid immediately when foreign cargo enters the country (Hawaii Foreign-Trade Zone #9, 2015). The purpose of such a zone is to encourage international business and economic development (Hawaii Foreign-Trade Zone #9, 2015). The NELHA site is an FTZ and an EZ (Hawaii Foreign-Trade Zone #9, 2015).

An EZ is an area in which certain business activities, job preservation, and job creation are stimulated by tax incentives and other incentives (Hawaii Business Development and Support Division, 2015). The purpose of such EZs is to diversify the economy which is now very dependent on tourism (Hawaii Business Development and Support Division, 2015).

[3] Nigari is a product that is used in the preparation of tofu (Source: Wikipedia.org)

## 3.5 Network activity

Knowledge sharing is also a dimension of this criterion. In section 3.3.3 it was already explained that there is a low level of knowledge sharing. The tenants view each other mainly as competitors.

### 3.5.1 Stakeholders

Table 5 lists and describes the key stakeholders at HOST Park. This section then continues by providing a more information on selected stakeholders. This is not intended to be an in-depth stakeholder analysis. This section merely describes the key stakeholders.

Table 5 – Description of HOST Park key stakeholders

| Stakeholder | Description/ objective | Activities |
|---|---|---|
| **Project owners** | | |
| **NELHA** | Responsible for managing HOST Park. Its objective is to facilitate research, development and commercialization of natural energy resources and ocean-related research, technology and industry. | - Generate revenues from sales and rents<br>- Attract tenants<br>- Develop HOST Park<br>- Educate |
| **Tenants** | | |
| **Tenants** | Commercial businesses | - Generate revenues from seawater-related activities<br>- Create markets<br>- Create products and services |
| **Keahole Point Association** | Association of NELHA's tenants. It is unclear what Keahole Point Association's objectives are. | - Unclear |
| **Government** | | |
| **State of Hawaii** | Govern and develop the state of Hawaii. | - Develop policies<br>- Enforce state policy |
| **Hawaii Department of Business, Economic Development & Tourism (DBEDT)** | Resource centre for economic and statistical data, business development opportunities, energy and conservation information, and foreign trade advantages. Many agencies are attached to DBEDT including NELHA, Hawaii Strategic Development Corporation and Hawaii Technology Development Corporation | - Planned community development<br>- Create affordable workforce housing units<br>- Promote innovation sector job growth<br>- Financing<br>- Office space rental<br>- Warehousing<br>- Workshops |
| **Knowledge & Education** | | |
| **University of Hawaii** | University with three main departments on three islands, seven community colleges (in total 10 campuses), and multiple research and educational centres. Its objective is to provide economic growth, diversification, and to stimulate the local economy with jobs, research and skilled workers. | - Provide education |
| **Kealakehe High School** | High school | - Education |

| | | |
|---|---|---|
| **West Hawaii Explorations Academy** | Public charter school (middle school and high school). It is a tenant and was set up in 1994 as partnership between Hawaii Department of Energy and NELHA. | - "No child left indoors"<br>- Focus on getting students outdoors<br>- Hands-on education<br>- Emphasis on time management, technical writing and experiential research. |
| **Various** | | |
| **Friends of NELHA (FON)** | Non-profit organisation. Its objective is to educate the public about renewable energy and ocean-related technologies. FON performs public relations and outreach functions for NELHA | - Organise tours<br>- Give public presentations<br>- Provide information |
| **Local community** | The people that live in the vicinity of HOST Park. | - Participate in NELHA activities<br>- Make recreational use of areas around HOST Park |

#### *3.5.1.1 Tenants*

The tenants have their own association: the Keahole Point Association. This association represents the tenants at HOST Park (Environment Hawaii, 2006; Sombardier, 2015) and through this association, the tenants are represented at the board of NELHA (see Appendix A2).

There is not much other information to be found about Keahole Point Association. This association has no web site and is only mentioned in news articles and the audit report. What is clear however is that the relationship between NELHA and the tenants was troubled.

In early 2000s NELHA raised the seawater rates and the rental rates sharply. NELHA was accused of being not transparent about seawater pumping rates and of unilaterally increasing the prices (The Auditor - State of Hawaii, 2012; The Honolulu Advertiser, 2005; Pacific Business News, 2003). NELHA on the other hand felt like they had to increase the prices because of pressures of being self-sufficient and because of increasing costs. Tenants were paying a couple of cents while the costs to pump the water were about 15-20 $-cents (see Appendix A1).

Now there is a break-even system. NELHA does not make profits on deep seawater (see Appendix A1). Tenants pay about $0.20/1000 gallons plus electrical costs of 20-23 $-cents (see Appendix A1). In comparison, freshwater at Hawaii is about $4/1000 gallons (see Appendix A1).

Now the relationship between NELHA and the tenants seems to be improving since Greg Barbour took over as CEO of NELHA (The Auditor - State of Hawaii, 2012). The troubled relation between NELHA and its tenants were caused by the seawater price increases. Now that the process for setting these prices is agreed upon there is far less conflict (see Appendix A1). There is a seawater committee which includes tenant representatives and members of the board of NELHA (see Appendix A1). This committee looks at in-depth analyses and all the different costs of the seawater

system. The committee then presents the findings to Keahole Point Association and works together to come to an agreement on the seawater rate (see Appendix A1).

#### 3.5.1.2 Government and government organisations

The State of Hawaii supports NELHA because of its positive economic impact at the jobs it creates (see sections 3.2.3 and 3.2.4). Former governor of Hawaii Neil Abercrombie[4] saw NELHA as "a driver of innovation, economic development, and job creation on the Big Island and for our entire state" (West Hawaii Today, 2014). He saw the investments in NELHA as investments in long-term economic viability and as opportunities to improve energy sustainability and to diversify the economy (West Hawaii Today, 2014).

The positive view of NELHA is not shared among everyone however. An audit released in May 2012 was very negative about the agency. This audit was actually the first audit of NELHA specifically; there are no prior audits of NELHA (The Auditor - State of Hawaii, 2012)! According to the audit report the "achievement of NELHA's purpose is clouded by transparency and accountability issues" (The Auditor - State of Hawaii, 2012). Other issues where NELHA had to improve on were (The Auditor - State of Hawaii, 2012):

- Lack of clearly reported progress
- Difficulty convincing regulators, taxpayers, and potential tenants of its worth and successes
- Lack of a master plan, financial plan, and administrative rules
- Policies and procedures manual was out of date
- Board with high turnover and lack of training
- Questionable practices resulting from the way the board of directors was organised
- Inadequate performance reporting
- Non-uniform lease rent rates
- Unreliable fiscal information provided to the board

And although self-sufficiency has been reached on an operating level, the audit report mentions that "the authority is still reliant on state funding for capital improvement projects and will be for the foreseeable future" (The Auditor - State of Hawaii, 2012). The report did acknowledge though that the agency is making progress under the new management.

#### 3.5.1.3 Educational organisations and governmental organisations

NELHA collaborates with multiple educational organisations. There are projects with Kealakehe High School, West Hawai'i Explorations Academy, Hawaii Community College, and University of Hawai'i (NELHA, 2014). Through education NELHA is stimulating the availability of human capital by for example developing programmes and curricula for technicians in collaboration with the local community college (see Appendix A).

#### 3.5.1.4 Friends of NELHA

Friends of NELHA is a non-profit organisation run by two part-time employees and volunteers (Friends of NELHA, 2014). The purpose of Friends of NELHA is to educate the public about "sustainable technologies in renewable energy, energy efficiency, food security, water, and health, with a focus on Hawaii and the technologies demonstrated at NELHA" (Friends of NELHA, 2014).

[4] Neil Abercrombie, Governor of Hawaii (2010-2014)

#### *3.5.1.5 Local community*

NELHA's own Master Plan mentions that there is a public misperception that the educational programs do not benefit the local population enough and that a coordinated strategy and programme seems needed (NELHA, 2011). Here, financial constraints are also cited as the culprit since this prevents the authority from hiring dedicated staff for educational programmes.

There were incidents where the community on the island strongly opposed plans by NELHA. For example, when NELHA wanted to restrict access shorelines (Big Island Chronicle, 2009). Because of financial problems as a result of bureaucracy, NELHA could no longer afford security guards (Star Bulletin, 2009; West Hawaii Today, 2009).

### 3.5.2 Knowledge sharing

See section 3.3.3 Knowledge sharing.

### 3.5.3 Network events and activities

There are monthly brown bag meetings (lunch lectures) where different topics are discussed (see Appendix A). Some of these topics are NELHA related, some are completely different which might be interesting for visiting scientists (see Appendix A1).

Sombardier (see Appendix A1): "The idea is to create opportunities to network and to talk about the park. But the success of these meetings are limited. Sometimes twelve or a little bit more tenants show up while there are several hundreds of people working at the park. One reason is that the tenant are so busy that they choose to spend time on things that have to do immediately with their own projects."

Another reason for little interest from the clients is that some businesses are very different from each other (see Appendix A1). Desalination businesses have very different requirements, issues and problems than algae firms or firms growing shrimp. The activities of these companies do not always overlap (see Appendix A1).

Tenants can submit issues that they want to discuss with the board of NELHA (see Appendix A). Meetings are organised which are open to anybody who want to provide input. In such a meeting in March 2014 only 4 people showed up (see Appendix A1). The tenants do not seem to be that interested in the network events that are organised.

### 3.5.4 Linkages and alliances

Over the course of 40 years NELHA has built an extensive network through its activities. The authority is heavily linked with educational organisations such as Kealakehe High School, West Hawai'i Explorations Academy, Hawaii Community College, and University of Hawai'i (NELHA, 2014). NELHA has many interactions and meetings with individual tenants (there are currently 41 of them) and with Keahole Point Association. NELHA also has many interactions and meetings with governmental organisations such as the US Department of Energy and the State Department of Business, Economic Development and Tourism. Finally, there are linkages with the airport and the local community.

Although there are many contacts and interactions by NELHA with many organisations, there are not many formal alliances or joint efforts. The Keahole Point Association is one joint effort of the tenants. There does not seem to be an overarching network entity which is focused on stimulating

interaction, cooperation, knowledge sharing, etc. There does not seem to be an organisation in which the views and opinions of all of the stakeholders are taken into account with a purpose to support and stimulate the formation of a strong cluster with high output. Essentially at NELHA there are networks based on interactions when needed (ad hoc networks), driven by the activities of the individual organisations.

## 3.6 Mutually profitable transactions (collaboration)

There is not much collaboration going on at HOST Park (see Appendix A). The tenants mainly compete with each other (see Appendix A). On some occasions some tenants do collaborate.

Sombardier (see Appendix A1) mentions the shrimp broodstock companies as an example of competition and collaboration. Several of these companies produce Specific Pathogen Free (SPF) shrimp which are certified disease free. The park overall has a very high biosecurity policy and within each business there is a high biosecurity policy as well. These strict policies allowed businesses to develop SPF shrimp that are sold as broodstock. Broodstock shrimp are not food, they are used to start a shrimp farm. These shrimp from NELHA are well known in Asia for their high quality and high level of biosecurity. Before the development of SPF shrimp diseases could break out which made the shrimp farming business a very uncertain business. The shrimp broodstock companies at NELHA still compete with each other but they also work together on branding and marketing their product as broodstock from NELHA which translates to high quality broodstock.

Little other evidence of collaboration and knowledge sharing (see 3.5.2) was discovered. Olson (see Appendix A2): “At Berkeley University there is a lot more collaboration going on. There is research going on, people collaborating, ideas going back and forth, etc. It is part of that culture. We don’t really have that at HOST Park.”

As mentioned before (see paragraph 3.5.1.1), not much information can be found on the activities and goals of this Keahole Point Association. The tenants did cooperate amongst each other in this association when they opposed the price increases of seawater. But it is unclear whether this association promotes other forms of collaboration such as marketing, resource sharing, asset sharing, knowledge sharing, etc. between tenants. Collaboration on marketing could be an option since the 2012 audit of NELHA mentioned a lack of marketing.

NELHA now seems to consider stimulating collaboration between tenants. In its Master Plan NELHA the zoning of HOST Park puts tenants with similar activities together “in order to create cohesion as well as to foster collaboration among tenants” (NELHA, 2011). NELHA wants to create “a layout that facilitates partnerships between tenants and surrounding developments” (NELHA, 2011). All things considered, mutually profitable transactions just do not seem to be the focus for NELHA nor for the tenants.

## 3.7 Business opportunities

### 3.7.1 Oil dependency and oil prices

As explained before in section 3.4 Cluster governance policy, roughly three phases can be identified in the more than 40 years of NELHA. The State of Hawaii was near total dependent on fossil fuels and established NELHA as an answer to the oil crisis in the 1970s. In the first phase, starting from the

organisation's inception in 1974, the focus was on developing new sources of renewable energy with a particular focus on ocean-related technologies such as OTEC (The Auditor - State of Hawaii, 2012).

Then in the early 1980s opportunities were recognized to develop commercial activities and to use the residual value of the seawater (The Auditor - State of Hawaii, 2012; Sombardier, 2015). The third phase is when, under pressure, NELHA was stimulated to become self-sufficient and NELHA adopted a less strict, more open policy (see Appendix A2).

The oil issue is still relevant today. Hawaii is the most petroleum-dependent state of the US (Hawaii Clean Energy Initiative, 2015). The state is ranked number one in electricity prices and often ranked number 1 in gasoline prices (Rocheleau, 2012). In late 2000-2010, oil provided 73% of all the electricity generated for Hawaii vs. 1% in the US (Rocheleau, 2012). Renewables provided 10% of all the electricity generated (Rocheleau, 2012). Oil prices are soaring with prices close to $100 per barrel in the last 5 years (although recently oil prices dropped) (InflationData.com, 2014).

This all shows that there is still room for renewables to catch up. There are plenty of opportunities to develop alternative sources of energy and alternative technologies (SWAC, OTEC, etc.). The most important bottleneck is the financing: renewable energy projects receive funds because of high oil prices and prices for renewable energy are often higher than prices for energy generated with oil. This means that if oil prices drop, less funds will be made available for renewable energy projects and organisations that provide other sources of energy have a high risk of going bankrupt. This risk actually manifested in early 2015. In late 2014/early 2015 the oil prices dropped sharply and companies in the shale gas industry is struggled as a result (Overton, 2014; Tully, 2015).

### 3.7.2 Stimulation of renewable energy

There are multiple initiatives to stimulate the development of renewables. First, there is the Hawaii Clean Energy Initiative (HCEI) launched in January 2008. HCEI is a partnership between the State of Hawaii and the U.S. Department of Energy. The goal of this initiative is to increase clean energy to 70% by 2030 with 30% from efficiency measures and 40% coming from renewable sources.

There is also President Obama's $787 billion stimulus package for green energy (Greentech Media, 2009). The interest in Hawaii is strong and there are strong linkages between the US Department of Energy and Hawaii because of past activities (NELHA, 2011). It is expected that funds will flow to Hawaii.

### 3.7.3 Other opportunities

For a long time NELHA seemed to be lacking a focus and created a lot of uncertainty regarding its rates for distributed seawater (The Auditor - State of Hawaii, 2012; Pacific Business News, 2003; Pacific Business News, 2005). The organisation was being criticized for not realising its potential (Pacific Business News, 2003). It seems that the change of administration at NELHA and the Master Plan helped NELHA regain focus (The Auditor - State of Hawaii, 2012). The organisation developed a plan in which different zones are created on HOST Park. Appropriate strategies can be developed to fill these zones up with tenants. One of these zones is the Economic Driver zone. NELHA-related products and services will be sold there.

There is plenty space available at HOST Park since the park is currently occupied for about 40% (Star Bulletin, 2009). The current tenants would also like to expand the number of tenants on HOST Park to share costs (Pacific Business News, 2003).

NELHA also has to be self-sufficient. NELHA generates its revenues by selling seawater, by collecting rents and by taking a percentage of revenues of some tenants. NELHA and the tenants have a common interest: the more successful tenants are, the more revenues NELHA can generate.

Considering all of these opportunities for doing business, it is interesting to see that the most important driver for businesses is the availability of high quality seawater. Multiple tenants mention the availability of this seawater for private companies as the most important reason for locating at HOST Park (Pacific Business News, 2005; Center for Tropical and Subtropical Aquaculture, 2008).

If these tenants did not need seawater they would probably locate elsewhere. According to one tenant, Hawaii is one of the most expensive places in the world to do business (Center for Tropical and Subtropical Aquaculture, 2008). The tenant further adds that “any added financial burden implemented by NELHA simply makes the continuing presence of many of the aquaculture tenants at NELHA more difficult to justify” (Center for Tropical and Subtropical Aquaculture, 2008).

## 3.8 Evaluating HOST Park

HOST Park is now evaluated using the above information. The assessment uses qualitative, subjective estimates which are made robust by and supported by information collected from literature, documents, reports, and from interviews with people involved in the project. Table 6 shows how HOST Park holds up when compared to the Preliminary Requirements. The same method is used by Rabelloti, Giuliani, & Alexander (2014) for the assessment of clusters in the Caribbean. This research project applies the same format:

- Gather empirical evidence
- Analyse evidence along Requirements
- Assess each dimension based on analysis and judgement by people directly involved in the case

### 3.8.1 Resource availability

The resources that are available at HOST Park have been very important for the development of the park. Natural resources are the most important resources at NELHA. The access to warm and cold quality seawater and the high solar insolation are the most important reasons that tenants locate at HOST Park.

The infrastructure is very well developed. The seawater distribution system is one of the most important part of the infrastructure. There is plenty of pumping capacity left; more seawater can be pumped up than currently needed. State funds were used to develop the initial infrastructure. Small repairs and maintenance are covered from operational funds. For larger infrastructural projects funds are requested from the State which are not always granted.

Attracting and retaining technicians is a challenge because the location is isolated compared to the rest of the world and also compared to the rest of the island. This problem is addressed by attracting employees from all over the world and by investing in local education. The government is also doing its part by removing and changing regulations that act as barriers for employment.
But even though attracting certain employees is challenging, the numbers show that a significant amount of people on the Island of Hawaii are employed by NELHA and its tenants. Execution of the Master Plan will even create more employment.

There was enough financial capital available to support the development of the cluster over the years. The State Government has played a very important role in providing funds. It kept supporting NELHA because of the positive economic impact of it and because of the jobs that are created with the park. More recently NELHA started to focus on being self-sufficient. It receives fewer funds from the Government. The organisation has to be more creative to ensure that there will be enough funds available in the future.

Based on this information HOST Park has a high resource availability which means that many important resources were available and that the available resources have been very crucial for the development of the park.

### 3.8.2 Agglomeration effects

The existence of HOST Park for more than 40 years, the 335 people currently employed, and the involvement in many educational projects, not only for students but also for people that are already employed as well (Akamai Workforce Initiative), all indicate that a pool of skilled workers exists and is

growing. There are some challenges though when it comes to attracting and retaining certain employees.

When it comes to supporting industries and suppliers there are few examples at HOST Park. NELHA's isolated location and its policy impeded the emergence of this. The policy is now transforming to a policy that allows for the growth in supporting industries and suppliers. Based on information that is found and supported by information from interviews, it is concluded that at HOST Park there is a low level of knowledge sharing.

Concluding, the agglomeration effects at HOST Park are weak. There is some indication of a pool of specialised labour being created but information gathered and interviews indicate there are few supporting organisations and suppliers and that there is a very low level of knowledge sharing by the tenants.

### 3.8.3 Cluster governance policy

The preliminary set of requirements dictates a policy that allows for freedom for participant initiatives and a policy that focuses on creating an environment which is attractive for participants to do business in and to be attracted by. HOST Park partly satisfies this requirement.

Literature showed that a strict policy has a negative effect on the development of an EIP. The most likely negative effect that the strict policy at HOST Park had on the cluster development was most likely offset by the strong presence of other factors like the strong support by the State government and the availability of resources like natural resources and financial capital. The policy is now transforming to a far less strict policy than it used to be because the mentioned other factors are becoming weaker (e.g. less financial support). NELHA is now open for initiatives that are not using its resources directly. Some activities which were not allowed before are now allowed.

Currently NELHA is focused on creating the right environment by executing its master plan: HOST Park is an FTZ and an EZ; NELHA is master permitted, and it is creating six zones of use in which tenants that are performing the same types of activities are clustered. By doing this NELHA is setting the framework in which the tenants have freedom to operate. The requirement to be self-sustaining has caused these changes in the park policy.

### 3.8.4 Network activity

At HOST Park there is not that much network activity. Based on information that is found and supported by information from interviews, very few instances of knowledge sharing at HOST Park could be found. There are monthly events in which the tenants can participate. Tenants can also participate by submitting issues they want to discuss with the board of NELHA. For both opportunities for interaction tenant participation is very low. Tenants do not seem interested in participating in these events. It is positive though that these kinds of activities are organised.

Over the course of 40 years NELHA has developed many linkages with many types of organisations including educational organisations, tenant organisations, governmental organisations, the airport, and the local community.

### 3.8.5 Mutually profitable transactions

The tenants at HOST Park generally do not engage in mutually profitable transactions. They view each other mainly as competitors therefore there is very little collaboration between the tenants. On

few occasions tenants do collaborate (e.g. Keahole Point Association and SPF broodstock shrimp). But very little evidence on collaboration on marketing, resource sharing, asset sharing, knowledge sharing is found. This was confirmed in interviews.

### 3.8.6 Business opportunities

The opportunities for doing business were guided mostly by external events. The predecessor of NELHA was created in response to the oil crisis. Hawaii was and still is very dependent on oil. It is actually the most petroleum-dependent State in the US.

The renewable energy focus of the Government of the US (and the accompanying funds that are created for it) and the renewed focus of NELHA (HOST Park zoning, increased support, self-sufficiency, etc.) create opportunities for HOST Park and tenants. Federal funds might flow to HOST Park and its tenants, and the park's policy now allows for initiatives that were not allowed before.

### 3.8.7 Summarising HOST Park

The information that was collected shows that HOST Park is a diverse park with many different types of tenants. HOST Park has a long history and during its history the park could count on support by the Hawaiian government. The government has proven to be a very important partner.

During its history the park repeatedly had to reinvent itself. Three phases can be distinguished since the park was established and in each phase the park adapted to changing circumstances.

The information shows that some of the Preliminary Requirements were very important for the development of HOST Park. The availability of resources has been crucial for HOST Park. The tenants are mainly attracted to the park because it provides access to pristine seawater and because of the high solar irradiance. These resources allow for many different types of activities ranging from energy production to food production. Agglomeration Effects were not that important for the development of HOST Park. Table 6 summarises the assessment of HOST Park.

**Table 6 – Assessment of HOST Park using the Preliminary Set of Requirements**

| Requirements | Indicators |
|---|---|
| **1. Resource availability**<br>**High availability. Crucial for the development of HOST Park.** | Natural resources<br>Very high availability of natural resources |
| | Infrastructure<br>Very well developed |
| | Human capital<br>Sometimes challenging, not problematic |
| | Financial capital<br>Enough capital available, availability will decrease in the future |
| **2. Agglomeration effects**<br>**Low level. Not really important for the development of HOST Park** | Pool of specialised labour<br>Likely there is such a pool of specialised labour |
| | Supporting industries and suppliers<br>Very little evidence |
| | Knowledge sharing<br>Low level of knowledge sharing |
| **3. Cluster governance policy** | Strict policy; negative effects probably offset by high availability of unique resources and financial support; policy transforming to a more open one |

| | |
|---|---|
| | Many efforts to make it easier for the tenants to do business |
| **4. Network activity**<br>**There is network activity but there is room for improvement .** | Knowledge sharing<br>Low level of knowledge sharing; tenants are competitors |
| | Network events and activities<br>Efforts to have events; low participation |
| | Number of linkages and alliance<br>Many linkages with many types of organisations such as educational, tenant and government organisations, the airport, and the local community |
| **5. Mutually profitable transactions** | Few instances |
| **6. Business opportunities** | The opportunities for doing business were guided mostly by external events; expected that external events (importance of renewable energy, oil dependency, new Master Plan, self-sufficiency) will further guide the development of HOST Park |

# 4 Case 2: Biopark Terneuzen

This chapter provides information on the second case: Biopark Terneuzen in the Netherlands. The park will first be described. Then information collected from literature, reports (annual, audit, etc.), (organisation) web sites, news articles, documents, press releases, and interviews is presented. This information will be structured according to the Preliminary Requirements.

For this case Gijsbrecht Gunter, Maikki Huurdeman and Mark van Waes (Van de Bunt), and Henk van Latesteijn were interviewed. These interviews can be found in Appendix B1 (Gunter), Appendix B2 (Van de Bunt), and Appendix B3 (Van Latesteijn).

## 4.1 Description of Biopark Terneuzen

Biopark Terneuzen is an Eco-Industrial Park in the port area of Terneuzen. Terneuzen is a small town in the Province of Zeeland in the south-western part of the Netherlands (see Figure 7). The park is situated close to the border of Belgium and is connected via the Ghent-Terneuzen channel to Ghent, a Belgian town (see Figure 8).


Figure 7 – Location of Biopark Terneuzen in the southern part of the Netherlands (Biopark Terneuzen, 2015)


Figure 8 – Channel zone Ghent-Terneuzen (source: maps.google.com)

The story of how Biopark Terneuzen came about starts with a document by the Province of Zeeland that outlined the future plans for the Province. This document simply stated that the Province wanted to do something with clusters (see Appendix B2). Consultancy firm Van de Bunt was hired to study the possibilities to create such a cluster (see Appendix B2). People at Van de Bunt had many conversations with many people inside and outside the Province including companies in the channel zone, potato farmers, tomato farmers, and onion farmers (see Appendix B2).

The companies were not talking to each other despite of being located close to each other. Heros and Yara for example, are literally separated by a fence. Every company in the area had its own plans. Nedalco for example, was planning on building a factory for its ethanol. Van de Bunt then found out that there was an idea to use $CO_2$ from Yara, an already existing fertiliser company, in greenhouses that were to be developed yet (see Appendix B2). Based on the conversations with many parties in the area, Van de Bunt concluded that there were more possibilities in the area than creating just this single exchange (see Appendix B2).

Together with many companies in the area, some universities, the Province, the municipality of Terneuzen, and Zeeland Seaports a project was requested at TransForum to perform feasibility studies (see Appendix B2 & B3). The goal was to find out if it would be technically and economically feasible to create exchanges between the companies to make use of the opportunities. TransForum required collaboration between public organisations, private organisations, knowledge institutions, and NGOs in exchange for funds (see Appendix B3). The studies funded by TransForum concluded that it would be feasible to create multiple exchanges between the companies at the channel zone.

According to van Waes & Huurdeman (2009) three different ambition levels were formulated for the cluster and the economic impact of each of these ambition levels were studied. By means of plenary sessions with all the stakeholders (including the companies at the port of Terneuzen) the visions and ambitions were aligned and consensus was reached to create Biopark Terneuzen (van Waes & Huurdeman, 2009).

At first the Province took the role of getting the parties to work with each other. When Biopark Terneuzen started to form, the leading role was transferred from the Province to Zeeland Seaports (van Waes & Huurdeman, 2009). Zeeland Seaports is the logical organisation to manage Biopark Terneuzen as it already manages the port area (Biopark Terneuzen, 2015; van Waes & Huurdeman, 2009).

Biopark Terneuzen is not really a park with strict borders. Biopark Terneuzen is like an alliance, the name Biopark Terneuzen is just a label. It is rather an initiative that promotes and facilitates exploitation of synergies between geographically proximate companies (Biopark Terneuzen, 2015). This is achieved by creating linkages between companies and organisations that are already in the port and industrial area of Terneuzen (Biopark Terneuzen, 2015). Biopark Terneuzen is not an entity that is directing what the companies have to do. The companies themselves decide what they want to exchange with whom. The goals of the Biopark Terneuzen are to create jobs, to create new opportunities for doing business, to lower the environmental impact of the industry, and to create new revenue streams.

While the collaborations were in the making, the stakeholders in the Dutch part of the channel zone found out that at there were some initiatives by Ghent Bio-Energy Valley on the Belgium side of the border that had some overlap with the activities in Holland (see Appendix B2). It was agreed to work together with Ghent Bio-Energy Valley to put the Zone Ghent-Terneuzen on the map as The European centre for bio based economy. This initiative would be named Bio Base Europe. Bio Base Europe contains a Training Centre in Terneuzen and a Pilot Plant in Ghent. The remainder of section 4 will apply the Preliminary Requirements to Biopark Terneuzen.

## 4.2 Resource availability

### 4.2.1 Waste streams, by-products and other resource streams

In the beginning of the Biopark project when the idea emerged to exchange resource streams between companies, many studies were performed to find out if it would be possible to create such exchanges. There were many questions regarding for example technical feasibility, economic feasibility, and system reliability (van Waes & Huurdeman, 2009). Examples of questions that had to be answered are (van Waes & Huurdeman, 2009; TransForum, 2009):

- Does the $CO_2$ from Yara and Nedalco meet the quality requirements for use in greenhouses?
- Is there enough $CO_2$ available? Is any buffer capacity needed?
- Is there enough heat available?
- Which back-up systems are needed in case $CO_2$ and heat supply systems fail?
- Which type of biomass is appropriate for use in the fermenter?
- Is it possible to use water from other industries for irrigation in the greenhouses?

These studies showed that enough resources could be exchanged to make it all feasible economically. The following exchanges are taking place at Biopark Terneuzen by these companies (see Figure 9) (Biopark Terneuzen, 2015; Biopark Terneuzen, 2015):

- Yara delivers $CO_2$ and heat to Warm$CO_2$ and water to Heros
- Rosendaal Energy supplies water to Heros and biomass to the Biomass Power Plant
- Nedalco supplies biomass to the Biomass Power Plant
- Cargill supplies starch residue, water, energy and steam to Nedalco
- Warm$CO_2$ manages the distribution of $CO_2$ and heat to the greenhouses
- The biomass plant delivers water to Heros, electricity to Rosendaal Energy and the greenhouses, and heat and $CO_2$ to Warm$CO_2$
- The greenhouses supply biomass to the Biomass Power Plant
- Heros exchanges water with the greenhouses

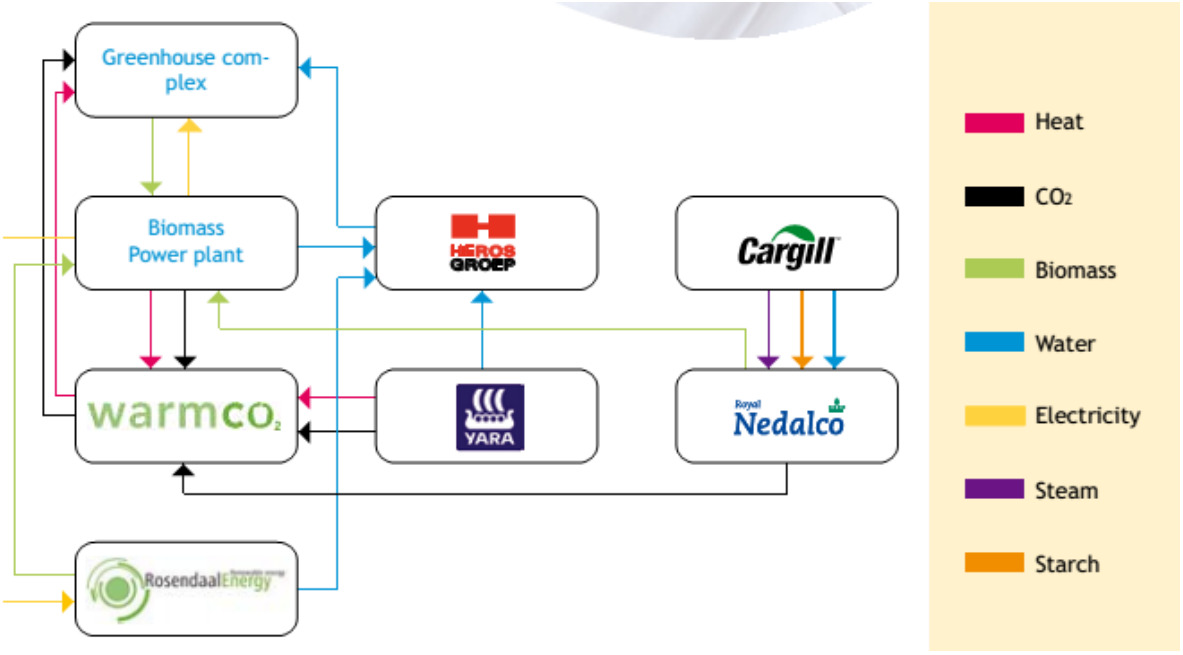


Figure 9 – The linkages and exchanges between the companies at Biopark Terneuzen (Biopark Terneuzen, 2015)

### 4.2.2 Infrastructure

A distinction has to be made between on the one hand infrastructure in terms of roads, rails, waterways, and buildings and on the other hand the infrastructure to exchange resources. The infrastructure in terms of roads, waterways, rails, buildings, etc. was well developed before the concept of Biopark Terneuzen began to be carried out since 2007. Biopark Terneuzen was to be developed at an already existing port area with companies already in place. Accessibility is one of the most important features of a port. The port of Terneuzen is the third largest port in the Netherlands. Zeeland Seaports yearly handles more than 25,000 ships and vessels with cargo ranging from bulk to break bulk and containers (Biopark Terneuzen, 2015).

The infrastructure to make resource exchanges possible is a different story. Biopark Terneuzen is all about identifying and creating these exchanges. When research showed that the exchanges would be feasible, planning and construction of the greenhouses, plants, buildings, pipelines, etc. had to begin (Geertse, 2011; TransForum, 2009) & (Appendix B). Figure 10 shows an artist impression of the links

from Yara to the greenhouses. For this exchange, three pipelines had to be laid: one which delivers heated water to the greenhouses at a temperature of 87-90 °C, another that returns the water at a temperature of 40 °C, and a pipeline that delivers the $CO_2$ from Yara to the Greenhouses (see Appendix B1).

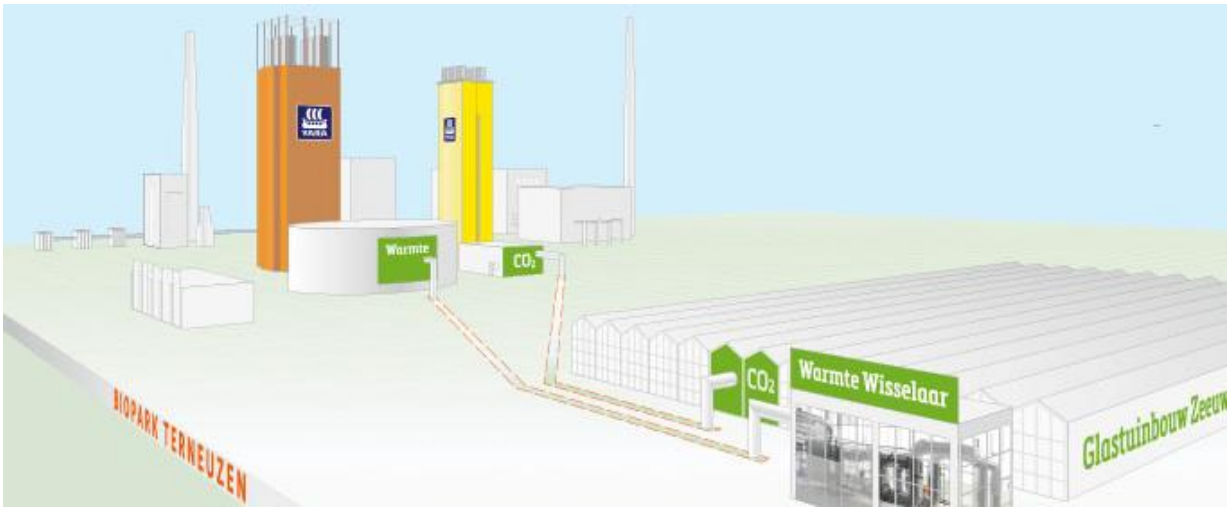


**Figure 10 – WarmCO$_2$ manages the supply of heat and CO$_2$ from Yara to the greenhouses (source: www.warmco.nl)**

The exchange of heat and $CO_2$ between Yara and the greenhouses is managed by WarmCO$_2$. WarmCO$_2$ is a company that was established especially for this reason (see Appendix B). It was established as a separate joint venture to manage the transfer of heat and $CO_2$ so that the companies could focus on their core businesses (see Appendix B1 & B3).

The total cost of the infrastructure was close to €80 million (see Appendix B1). Attracting funds for the construction of the infrastructure for the exchanges was the responsibility of the companies themselves (see Appendix B). Funds were attracted from the market and from organisations such as SenterNovem (now Rijksdienst voor Ondernemend Nerderland (RVO)), ABN AMRO, and the Department of Infrastructure and Environment (Rijkswaterstaat Leefomgeving, 2015) & (Appendix B1 & B2). Figure 11 shows the laying of the pipelines for this link.


**Figure 11 – laying of the pipelines needed for the exchanges managed by WarmCO$_2$ (Source: www.warmco.nl)**

The companies were prepared to invest in the infrastructure because of the direct benefits for their businesses. The supply of heat and $CO_2$ to the greenhouses for example, saves the greenhouses 90% of energy compared to traditional greenhouses and the amount of $CO_2$ emissions it saves is equivalent to the emissions of 35,000-50,000 households (Rijkswaterstaat Leefomgeving, 2015; Geertse, 2011) & (Appendix B1). Warm$CO_2$ guarantees that heat and $CO_2$ are delivered to the greenhouses (WarmCO2, 2015). There are back-up systems which kick in in case of peak demand or failures (van Staalduinen, 2008).

### 4.2.3 Human capital

Compared to the rest of the Netherlands, the Province of Zeeland has a low number of highly educated inhabitants (Bakker, van Gorsel, Kooten, P.C.J., & van Sprundel, 2012). 26% of the labour force in Zeeland is highly educated (in Dutch: WO or HBO) compared to 34% in the Netherlands (Bakker, van Gorsel, Kooten, P.C.J., & van Sprundel, 2012).

In the Netherlands the percentage of higher educated people is growing (Leufkens & Souren, 2011) and is above the EU average (Hilderink & Harbers, 2014). The percentage of highly education people is also growing in Zeeland (see Figure 12). The level of education is rising and since 2010 the number of higher educated people is higher than the number of people with a low level of education (Bakker, van Gorsel, Kooten, P.C.J., & van Sprundel, 2012). Most of the people in Zeeland have a medium level of education.

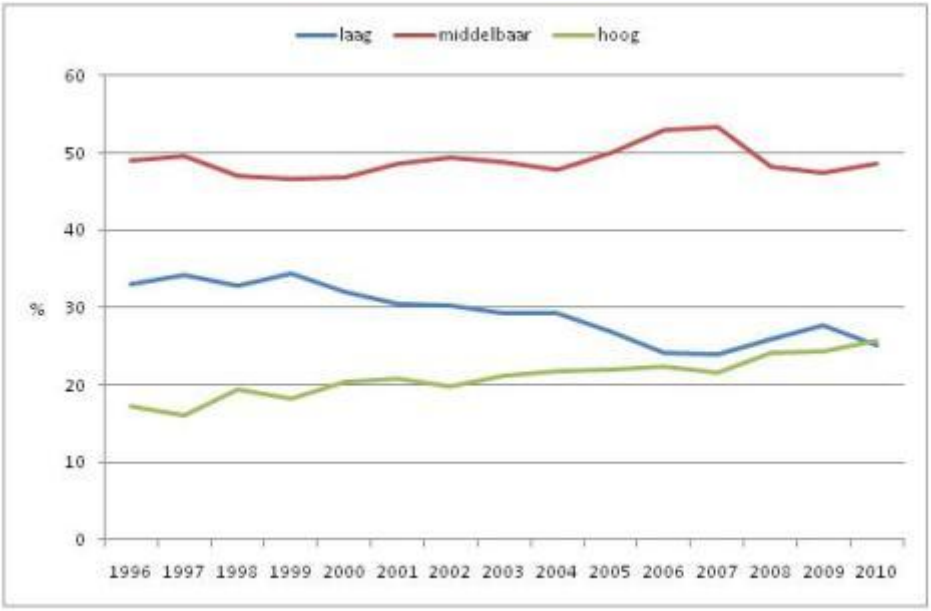


**Figure 12 – Level of education of Zeeland's workforce from 1996 to 2010 (Bakker, van Gorsel, Kooten, P.C.J., & van Sprundel, 2012)**

The process industry provides the highest number of jobs and revenues in the municipality of Terneuzen (van Waes & Huurdeman, 2009). There are approximately 250 companies at Zeeland's ports (Geertse, 2011). Together the ports have more than 15,000 employees which is 18% of the total jobs in Zeeland or 11% of the total jobs in all the ports of the Netherlands combined (Geertse, 2011; Zeeland Seaports, 2015).

The medium do high level of education of the majority in Zeeland and the fact that the ports already have more than 15,000 employees or 18% of the total jobs in Zeeland indicate that there is enough

human capital available. Even more, the development of Biopark Terneuzen is supported by the local governments because of the project's potential to contribute in retaining jobs and revenues in the region (van Waes & Huurdeman, 2009). The greenhouses created approximately 800-1000 new jobs (see Appendix B1).

Attracting employees as a result of developing Biopark Terneuzen was never an issue for the established firms because they did not need more people (see Appendix B). After the exchange was created and automated, it was business as usual for the companies. At Yara for example, an engineering firm was hired on a project base to create and to automate the exchanges (see Appendix B1). The adjustments to the plant were made during plant maintenance and after that it was business as usual (see Appendix B1).

### 4.2.4 Financial capital

At Biopark Terneuzen the firms themselves decide to invest to create the exchanges (see Appendix B). Zeeland Seaports facilitates and connects. The companies choose to participate because of the benefits for the business (see Appendix B2 & B3). When these companies choose to participate, they make the investments. The exchanges are thus actually mainly business decisions.

The benefits for companies are clear: implementing the exchanges leads to significant cost savings or create revenues (see Appendix B2 & B3). That is the primary reason the companies are prepared to invest in these initiatives (see Appendix B2 & B3). The benefits for the environment are important but secondary benefits.

The needed capital is attracted from the market. The fact that many exchanges were created indicates that the business cases for the exchanges were strong enough to attract investments and subsidies. Dutch bank ABN AMRO made investments which made it possible for Warm$CO_2$ to create the needed infrastructure (Rijkswaterstaat Leefomgeving, 2015). The infrastructure for the exchange of $CO_2$ and heat between Yara and the greenhouses already amounted up to €80 million.

Other sources of funds are subsidies (Rijkswaterstaat Leefomgeving, 2015). There are Dutch and European subsidies available for coupling streams (WarmCO2, 2015). Warm$CO_2$ for example, received funds from Multi Utility Providing (MUP). MUP is a concept that focuses on making port areas sustainable by identifying opportunities for exchanges, by organising supply and demand regarding these exchanges and by organising an underground infrastructure for these exchanges (WarmCO2, 2015). MUP itself receives European subsidies (WarmCO2, 2015).

## 4.3 Agglomeration effects

### 4.3.1 Creation of a pool of specialised labour

A pool of specialised labour is created by experience and by training. The port of Terneuzen exists for a long time. It started to develop after two railroads to cities in Belgium were constructed, one to Ghent (1896) and the other to Mechelen (1871) (Zeeland Seaports, 2015). After WWII the port of Terneuzen developed very quickly; subsidies were used to attract new industries and companies such as Philips, Ovet, Elopak, Air Products and Broomchemie located in the area (Zeeland Seaports, 2015).

History and activities at port area has "given rise to a large, skilled workforce, which is continually increasing thanks to the region's excellent technical schools and training centres" (Biopark Terneuzen, 2015). In multiple settings attention is paid to training. At the greenhouses of Biopark

Terneuzen there is a greenhouse for educational purposes (Geertse, 2011). People with different backgrounds are trained here to be able to work in greenhouses.

Bio Base Europe is another example of a setting where special attention is paid to training and education. Together with Ghent Bio-Energy Valley, Biopark Terneuzen created Bio Base Europe (Biopark Terneuzen, 2015). Bio Base Europe has the ambition to create the largest bio based cluster in Europe (Zeeland Seaports, 2015). For this purpose it has developed a state-of-the-art research facility in Ghent and a training facility in Terneuzen (Biopark Terneuzen, 2015). The facility in Ghent is the Bio Base Europe Pilot Plant which operates at tonne scale (Biopark Terneuzen, 2015). The purpose of this pilot plant is to optimise and test the feasibility of industrial application of new biotechnological processes before commercialising them (Biopark Terneuzen, 2015; Zeeland Seaports, 2015; Geertse, 2011).

The facility at Terneuzen is the Bio Base Europe Training Centre. It is "a centre for education, network and exhibition that promotes development of a sustainable bio based economy" (Biopark Terneuzen, 2015). Process operators are trained at the Training Centre. A process operator has to do at least 15 trainings annually (see Appendix B2). There are 800-900 process operators throughout the plants at Biopark Terneuzen (see Appendix B2). Huge amounts of trainings have to be given so the companies decided to work together on this (see Appendix B2). This training centre ensures specialised workers are being created (Zeeland Seaports, 2015). Specifically, this centre trains process operators and windmill technicians for the biotech and chemical industry (Geertse, 2011) & (Appendix B2).

Biopark Terneuzen also works together with an ROC: a regional educational centre which offers medium level education (see Appendix B3). This collaboration ensures that the curriculum at the ROC can change according to the input from the companies and that in the future the companies get people with needed skills (see Appendix B3). The companies also offer internships to the students of the ROC (see Appendix B3).

Judged on the long history of industry activities in the area, the amount of people that work in the channel zone, the training at the greenhouses, the collaboration on the training that the process operators receive, and the collaboration with the regional educational centre it could be argued that there is a pool of specialised labour in the area. The group of 800-900 process operators that is active in the region could actually be considered a pool of specialised labour.

### 4.3.2 Supporting industries and suppliers

Examples of supporting industries and suppliers are: consultancy firms, patent law firms, financial institutions, research facilities, and suppliers of intermediate inputs and industry-specific goods (Head, Ries, & Swenson, 1995; Stuart & Sorenson, 2003). Very little evidence can be found on these types of organisations emerging at Biopark Terneuzen as a result of the creation of the cluster. Indeed, multiple interviews such as Huurdeman & van Waes (see Appendix B2) and van Latesteijn (see Appendix B3) pointed out that supporting industries and suppliers did not really emerge yet.

Warm$CO_2$ might be considered a company that is literally supporting the cluster. It did not exist prior to Biopark Terneuzen but rather emerged as result of the creation of Biopark Terneuzen. However, Warm$CO_2$ was needed to actually perform the exchanges of resources. In that sense it is not considered a supporting industry. It is performing a primary function in the cluster: it is performing the physical act of exchanging resources.

Other organisations supported the creation of links. ABN AMRO for example, invested in the infrastructure needed for the heat and $CO_2$ exchange. However, it was simply an investment decision. ABN AMRO or other financial institutions did not open an office at Biopark Terneuzen as the result of the cluster being created. Supporting industries might emerge in the future.

### 4.3.3 Knowledge sharing

At Biopark Terneuzen there is definitely knowledge sharing going on. The cluster is all about creating exchanges between companies. By definition these companies have to share knowledge. Without sharing knowledge about their systems it would not possible to find out if the exchange of resources would be possible in the first place.

The content of the knowledge that is being shared ranges from technological to general knowledge depending on the setting in which knowledge is being shared. According to Gunter (see Appendix B1) knowledge is being shared on three levels: First, there is bilateral knowledge sharing between the companies that are exchanging resource streams. Companies discuss what is currently realised, how energy efficient it is, and discuss how new businesses can be developed (see Appendix B1).

Second, there is knowledge sharing between companies in the region (see Appendix B1). Companies in the region started to talk to each other because of the Biopark Terneuzen project. The companies had questions such as (see Appendix B1): are there more exchanges possible? Which processes does this company have? What challenges are there at this company? What are future challenges? For years people would drive past other companies in the region without knowing what the companies were doing. Biopark Terneuzen facilitates this type of knowledge sharing.

Finally, knowledge is diffused to anyone interested. Biopark Terneuzen organised lectures for which inspirational speakers would be invited (see Appendix B1 & B3). The content of these lectures would be inspired by developments in the region or national developments.

Another setting in which knowledge is being shared is the Maintenance Value Park in Terneuzen. The Maintenance Value Park is an initiative that runs parallel with Biopark Terneuzen in which contractors and suppliers share knowledge about preventive maintenance programmes, discuss issues, and develop innovations together (see Appendix B1).

## 4.4 Cluster governance policy

Biopark Terneuzen is a public limited liability company[5] (see Appendix B3). This organisational form creates some distance between Biopark and the regional governments' politics which allows Biopark Terneuzen to operate as a business. The role of Biopark Terneuzen is to promote and facilitate the exploitation of synergies between the companies by organising close collaboration between companies (TransForum, 2015; Biopark Terneuzen, 2015). These companies often vary in size and culture (TransForum, 2015; Biopark Terneuzen, 2015). The most important activities of Biopark Terneuzen are to identify and bring together the various partners to collaborate (TransForum, 2015). These partners can discuss their views on the options and see if they can reach an agreement. Biopark Terneuzen supports these partners in the ways it can. For example, by pointing out possibilities for subsidies for the companies (see Appendix B1).

[5] In Dutch: 'Naamloze Vennootschap (NV)'. In this case: Overheids-NV

It is important to realise that Biopark Terneuzen is not a company; Biopark Terneuzen is the collaboration between the stakeholders in the area. The name Biopark Terneuzen is a label that is used for this collaboration (see Appendix B2). This label makes the collaboration recognisable and is convenient for marketing purposes (see Appendix B1 & B3). Biopark Terneuzen has no say about the individual companies; it is not higher in hierarchy (see Appendix B).

At Biopark Terneuzen, Zeeland Seaports has a connecting and stimulating role. It acts like a neutral organisation between the companies and guards the long term focus (see Appendix B3). As port authority this is a natural role for Zeeland Seaports to take up (see Appendix B1).

There is a lot of decentralisation at Biopark Terneuzen. Collaboration is not enforced; stakeholders collaborate because of the benefits for the firms. These benefits act as incentives to work together. Instead of forcing companies to work together, Biopark Terneuzen focuses on creating the conditions for collaboration: it identifies opportunities for creating linkages between firms and facilitates these linkages, it informs, and there is a strong focus on education (the Training Centre, the ROC, and Maintenance Value Park, see section 4.5.2 Knowledge sharing).

## 4.5 Network activity

### 4.5.1 Stakeholders

Table 7 lists and shortly describes the key stakeholders at Biopark Terneuzen. This is not intended to be an in-depth stakeholder analysis. This section merely describes the key stakeholders. This section then continues by providing more information on1 selected stakeholders.

**Table 7 – Description of Biopark Terneuzen key stakeholders**

| Stakeholder | Description/objective |
|---|---|
| **Project owners** | |
| **Biopark Terneuzen** | Biopark Terneuzen is an initiative that started in 2007. The organisation promotes and facilitates the exploitation of synergies between the companies by identifying possible linkages and organising collaborations. |
| **Zeeland Seaports** | Zeeland Seaports is the port authority of the ports of Terneuzen and Vlissingen. It is responsible for managing the ports and the surrounding areas. It is also project developer at Biopark Terneuzen. |
| **Yara Sluiskil** | Yara Sluiskil is a producer of fertilisers and a few chemicals. It is situated at the port area since 1929. Yara supplies heat and $CO_2$ to the greenhouses. This exchange is managed by Warm$CO_2$. |
| **Warm$CO_2$** | Warm$CO_2$ is a joint venture between Zeeland Seaports and Yara. Since 2009 it delivers heat at a temperature of 87-90 $^oC$ and $CO_2$ from Yara to the greenhouses (van Staalduinen, 2008). |
| **Heros Ecopark Terneuzen** | Heros is a recycling company that recycles wastewater, scrap metal, and multiple other waste streams. Heros housed Lijnco Green Energy and Electrawinds Green Fuel on its terrain in addition to its own recycling businesses (Heros Sluiskil, 2015). Lijnco manages the fermenting plant, Electrawinds produced biodiesel from animal fats (Heros Sluiskil, 2015). |
| **Nedalco** | Nedalco is a producer of bio-alcohol from plant material. Nedalco was acquired by Cargill (Cargill, 2015). The acquisition was completed in 2011 (Cargill, 2015). |
| **Rosendaal Energy / Electrawinds Green Fuel** | Rosendaal Energy built and exploited the biodiesel factory at Terneuzen. The plant started production in 2008 but Rosendaal Energy went bankrupt in 2009. The plant was acquired and operated by Electrawinds from early 2013 until this company also went bankrupt in early 2015. Now buyers are being searched for to take over plant assets. |
| **Cargill** | Cargill is an international food processing company. In Zeeland it produces starch, |

| | |
|---|---|
| | thickeners, sweeteners, and alcohol. |
| **Glastuinbouw Zeeuws-Vlaanderen** | Glastuinbouw Zeeuws-Vlaanderen is the name of the greenhouse complex in Zeeland. It receives $CO_2$ and heat from nearby industries. A total of 300 ha of greenhouses is being developed in the area. |
| **Governments** | |
| **Province of Zeeland** | Province in the south-western part of the Netherlands. |
| **Municipality of Terneuzen** | Terneuzen is a small city in the Province of Zeeland, close to the border with Belgium. Terneuzen is connected to Ghent by the Channel Ghent-Terneuzen. |
| **Municipality of Ghent** | Ghent is a city in Belgium, close to the border with the Netherlands. Ghent is connected to Terneuzen by the Ghent-Terneuzen Channel. |
| **Knowledge institutions** | |
| **Wageningen University and Radboud University** | These Dutch universities were involved in the research project supported by TransForum. The universities performed research projects to answer the research questions of the participants in the Biopark Terneuzen project. |
| **Various** | |
| **TransForum** | TransForum was a hands-on innovation programme with a focus on the Dutch agricultural sector (see Appendix B3). From the start it was decided that TransForum would be active for just 6-7 years. The programme was ended in 2011. TransForum received €30 million from the private sector and €30 million from the government (see Appendix B3). With this budget it selected innovating projects to support. |
| **Van de Bunt Adviseurs** | Van de Bunt is a medium-sized consultancy firm. The firm was hired by the Province of Zeeland to find out what the possibilities were to develop a cluster in Zeeland. Together with 15-18 other parties it filed a project proposal at TransForum. Van de Bunt acted as project leader and process manager during the project at TransForum. |
| **Bio Base Europe** | Bio Base Europe is a joint venture between Ghent Bio-Economy Valley and Biopark Terneuzen. It is an open innovation and education centre for the bio based economy and consists of a pilot plant in Ghent and a training centre in Terneuzen. The training centre is used for education purposes. The 800-900 process operators at the channel zone at Terneuzen receive their training at the training centre (see Appendix B2). |

#### *4.5.1.1 Biopark Terneuzen*

Biopark Terneuzen identifies opportunities to create linkages between the companies. The organisation facilitates the exploitation of synergies and organises collaborations. Biopark Terneuzen has a board in which four public organisations are represented and one member who represents the companies (van Waes & Huurdeman, 2009). The reasoning behind this ratio is that public organisations focus more on the long term and continuity of Biopark Terneuzen compared to the short term focus of private organisations (van Waes & Huurdeman, 2009).

#### *4.5.1.2 Zeeland Seaports*

Zeeland Seaports is the project developer at Biopark Terneuzen (TransForum, 2015). The park aligns with Zeeland Seaport's objectives to contribute to the regional employment and to incorporate sustainability in regions under control of Zeeland Seaports (van Waes & Huurdeman, 2009). The objectives of Biopark Terneuzen are to create jobs, to attract new businesses, to reduce the environmental impact and to create revenues (van Waes & Huurdeman, 2009; Dutch Port Guide, 2007). Biopark Terneuzen aligns with Zeeland Seaport's objectives to contribute to the regional employment and to incorporate sustainability in regions controlled by Zeeland Seaports (van Waes & Huurdeman, 2009).

During the development of Biopark Terneuzen, Zeeland Seaports took the leading role and shared information about the project to the participants, the (local) governments, the stakeholders in the area, and NGOs (van Waes & Huurdeman, 2009). The Province of Zeeland and the municipality of

Terneuzen did not have the ambition to lead in Biopark Terneuzen and besides, they each have a saying in Zeeland Seaports (van Waes & Huurdeman, 2009). Therefore they did not have problems with Zeeland Seaports taking the lead in Biopark Terneuzen.

This leading role by no means says that Zeeland Seaports had any power over the companies. It merely says that Zeeland Seaports actively tries to identify opportunities and tries to connect organisations with each other in the Biopark Terneuzen setting.

#### *4.5.1.3 The companies at the channel zone*

Table 7 mentions many of the companies that are involved in Biopark Terneuzen. There are many successful exchanges between the companies (see Figure 9). The objectives of the parties involved in Biopark Terneuzen are to create jobs, to attract new businesses, to reduce the environmental impact, and to create revenues. The most important reasons for these companies to collaborate are to cut costs and to generate revenues (see Appendix B2 & B3). The secondary reason is that there are also important environmental benefits associated with the collaboration.

As mentioned in section 4.2.2 Infrastructure for example, the supply of heat and $CO_2$ to the greenhouses saves the greenhouses 90% energy compared to traditional greenhouses and the amount of $CO_2$ emissions it saves is equivalent to the emissions of 35,000-50,000 households (Rijkswaterstaat Leefomgeving, 2015; Geertse, 2011) & (Appendix B1).

#### *4.5.1.4 Government*

Several governmental bodies are involved in Biopark Terneuzen. The Municipality of Terneuzen, the Province of Zeeland, and the Municipality of Ghent are the key ones. The Province of Zeeland initiated a study by Van de Bunt Adviseurs that eventually lead to the development of Biopark Terneuzen.

The main reasons for the governments to support Biopark Terneuzen are to create jobs, to retain jobs, and to create economic growth in the region. At the Province of Zeeland and the neighbouring Province of West-Brabant many people were losing their jobs in recent years. Cigarette company Philip Morris closed a factory in August 2014, Thermphos (November 2012) and Zalco (December 2011) went bankrupt, and companies in the health care industry laid off many employees (Omroep Zeeland, 2015). Although these examples all happened after the development of Biopark Terneuzen was initiated, they really explain why the Province of Zeeland is still focused so much on creating jobs and economic growth. The Province of Zeeland created an action plan called ‘Actieplan Economische Structuurversterking’ to counter the effects of these bankruptcies and closures.

#### *4.5.1.5 Knowledge institutions*

The universities were mainly involved in the TransForum project in the beginning of Biopark Terneuzen. Possible links were identified and the knowledge institutions provided the needed knowledge to determinate if it would be feasible to create these links.

#### *4.5.1.6 Various*

The goal of TransForum was to find out how to transform the Dutch agricultural sector into a sustainable agricultural sector. There were three types of projects at TransForum: innovation projects, scientific projects, and knowledge projects (TransForum, 2015).

Biopark Terneuzen was an innovation project that was supported financially by TransForum. TransForum had very strict project selection criteria: requests for support were restricted to a maximum of 1 A4, project owners were required to pitch the project to a team of project directors, and collaboration in the project between private companies, governments, knowledge institutions, and NGOs was required(see Appendix B3).

### 4.5.2 Knowledge sharing

See 4.3.3 Knowledge sharing

### 4.5.3 Network events and activities

There were multiple networking events at Biopark Terneuzen where speakers were invited to give lectures (see Appendix B3). There were for example, lectures about benefits of collaboration in clusters and about innovation in general (see Appendix B3). Companies and relations were invited and these events had many attendees (see Appendix B3).

Nowadays less of these events are organised. The development of Biopark Terneuzen is in a different phase now (see Appendix B3). At first everything was new and there were no exchanges yet. Now, Biopark Terneuzen is established and the focus is different (see Appendix B3). The main events now are the New-Year receptions and other meetings (see Appendix B2).

### 4.5.4 Linkages and alliances

As Figure 13 shows, there are many exchanges at Biopark Terneuzen. The whole project depends on creating linkages for exchanging water, heat, $CO_2$, biomass and electricity. In order to create these linkages these companies had to collaborate with each other. According to TransForum's Evaluation of Biopark Terneuzen "Organisational and juridical structures (loose network structures, daughter companies, alliances) between parties have been implemented..." (TransForum, 2009). An example of such a juridical structure is Warm$CO_2$.

Warm$CO_2$ was created by piping company Visser & Smit Hanab, construction company Volker Wessels, Yara, and Zeeland Seaports to manage the exchange of heat and $CO_2$ between Yara and the greenhouses (van Staalduinen, 2008) & (Appendix B3). In the beginning the project had some setbacks. The companies were having costs while the projected revenues were not coming in yet (see Appendix B3). This made Volker Wessels leave this joint venture (see Appendix B3). Currently Zeeland Seaports owns an 80% stake of Warm$CO_2$ and Yara has the remaining 20% (see Appendix B1 & B3).

In the design phase of Biopark Terneuzen there were also linkages with knowledge institutions like Wageningen University and Radboud University (van Waes & Huurdeman, 2009). These knowledge institutions supplied the knowledge to find out what was feasible in the Biopark project.

From all the exchanges and connections showed in Figure 13 (Figure 9 repeated), the involvement of the governments, and the involvement of the knowledge institutions it can be concluded that there are many linkages at Biopark Terneuzen. The connections between the companies are not simple one-to-one connections. Heros for example, is connected to the biomass plant, the biodiesel factory, the greenhouses, and to Yara. Another example of a one-to-many connection is Zeeland Seaports' connection to all of the parties in the Biopark project. As mentioned before, Zeeland Seaports acts like a neutral organisation between the companies and guards the long term focus (see Appendix B3).

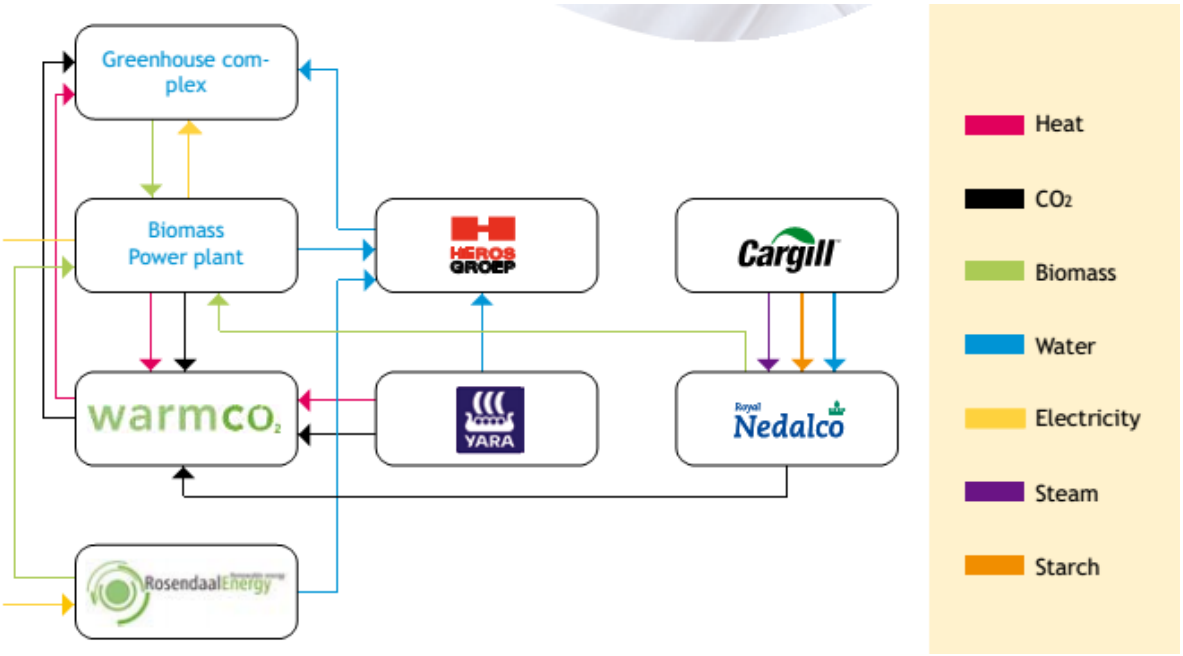


**Figure 13 – The linkages and exchanges between the companies at Biopark Terneuzen (Biopark Terneuzen, 2015). This figure is Figure 9 repeated.**

There are not that many alliances but Biopark Terneuzen is considered an alliance which is of course a very important one. Warm$CO_2$ is the most important joint venture. Currently there are no other significant joint ventures because it is not really needed (see Appendix B). Warm$CO_2$ was established because it was needed; the companies wanted to focus on their core businesses (see Appendix B1 & B3). Constructing and managing linkages was not the core business of these companies. It was a logical decision to create a separate entity to manage the exchange of heat and $CO_2$ between Yara and the greenhouses.

## 4.6 Mutually profitable transactions

Biopark Terneuzen is built on mutually profitable transactions. That is the whole point of Biopark Terneuzen. In this case the transactions involve the exchange of heat, $CO_2$, biomass, water, electricity, steam, and starch. The companies are willing to collaborate because the transactions are beneficial for both the supplying side and the receiving side:

- Yara finds a use for their $CO_2$ and supplies it to the greenhouses. Yara has to worry less about the emission of $CO_2$.
- The greenhouses need $CO_2$ for growing crops and have a source of pure $CO_2$ nearby. The greenhouses also use heat from Yara which leads to considerable energy cost savings.
- Several companies supply waste water to Heros. Heros then treats this water and supplies it to the greenhouses. The companies get rid of waste water in an environmentally sound way, Heros has more business transactions, and the greenhouses have a source of water.
- Cargill supplies water, steam and starch to Nedalco (now part of Cargill). Cargill gets rid of waste or by-products and Nedalco has a nearby source of resources.

According to Henk van Latesteijn – former CEO of TransForum – there are three reasons for the companies to collaborate (see Appendix B3):

1. The companies save costs and/or create revenues by exchanging resources.

2. Engaging in these transactions has significant environmental benefits.
3. The environmental benefits of these transactions have a positive impact on the reputation of the companies. The companies at the channel zone produce chemicals, are engaged in heavy industrial activities, emit polluting materials, have dangerous processes, etc. Being involved in these kind of activities is often considered dirty and dangerous by people living in the vicinity of such industries and by NGOs. The Biopark Terneuzen initiative lowers the environmental damage and gives the whole area a ´greener´ image. The better image gives the companies a 'license to produce'.

## 4.7 Business opportunities

The idea of exchanging resource streams in the area is not completely new. Many of the companies in the area already existed years before the Biopark initiative was started. Yara for example, is located at the channel zone since 1929 (see Appendix B1). The most important reason for Yara to create a plant in the area was to use certain gases from a cokes factory that was already located in the area for Yara's own processes (see Appendix B1). Since the 1960s Yara decided to use natural gas for its production processes instead of the gases from the cokes factory (see Appendix B1).

How the modern wave of resource exchanges started was described in the Description of Biopark Terneuzen (section 4.1). It was explained that consultancy firm Van de Bunt was hired to study the possibilities to create a cluster in Zeeland. Van de Bunt talked with many companies in the area. During these talks multiple opportunities were identified (van Waes & Huurdeman, 2009):

- In the Netherlands there was a need for new locations for greenhouses because of the growth of the sector and because greenhouses at some other locations were being closed.
- Greenhouse complexes produce $CO_2$. There was a need for climate neutral greenhouses.
- In Europe the fertiliser industry agreed to find sustainable solutions for the $CO_2$ waste streams.
- Agricultural companies in the region produce multiple waste streams. This created a potential for new markets that utilise these waste streams.
- In recent years there was a strong increase in manure production in the region. Fermenting this manure could produce biogas and fertilisers.
- In the EU there is a policy of mixing normal fuels with biofuels. Activities in a cluster could produce biofuels.

There was already an idea that maybe it was possible supply $CO_2$ that was being emitted at Yara to greenhouses (see Appendix B2). This was just an idea, there were no greenhouses yet. With this idea and the opportunities in mind, Van de Bunt realised that more exchanges could be realised (see Appendix B2). Together with the companies in the area is was decided to apply for funds at TransForum to perform feasibility studies to find out if these opportunities could be seized (see Appendix B2). The studies showed that indeed multiple exchanges could be realised.

Everybody became enthusiastic: plans were made, ambitions grew, and many projects were proposed (see Appendix B3). Hundreds of hectares of greenhouses, a biomass power plant, and a biodiesel plant would be constructed. Waste water, $CO_2$, steam, heat, starch, and biomass would be exchanged. In the end, the exchange of resources, waste streams, by-products, etc. proved to be

important business opportunities that resulted in cost savings, revenues, reduction of waste, job retention, and new businesses. The business opportunities gave a renewed impulse to the area.

Not all projects went according to plan at Biopark Terneuzen. The development of the exchange between Yara and the greenhouses took many years to develop. In the end it was completed but many more hectares of greenhouses were planned initially (see Appendix B3).

A bigger example is the biodiesel plant developed by Rosendaal Energy developed the biodiesel plant at Biopark Terneuzen. The plant operated for a few months with approximately 30 employees until Rosendaal Energy went bankrupt. The economic crisis was cited as source of the problems in addition to high start-up costs and unfavourable market conditions for biodiesel (Provinciale Zeeuwse Courant, 2010; RTL Nieuws, 2009). The planned production capacity was never reached because of start-up problems (RTL Nieuws, 2009). Also, national policy changed and because of this Rosendaal Energy received less subsidies (see Appendix B2). Their business case did not fit with the new situation (see Appendix B2). A financial injection by investors in addition to the €75 million that was already invested could not prevent Rosendaal Energy from going bankrupt (Provinciale Zeeuwse Courant, 2011; RTL Nieuws, 2009).

The British company Goes on Green bought the biodiesel facility in September 2011 (Provinciale Zeeuwse Courant, 2011). Then in late 2012 Belgian company Electrawinds took over the plant from Goes on Green (Product Board for Margarine, Fats and Oils, 2012). Production started in early 2013 after the plant was renovated and adjusted (Biofuels Journal, 2013). Then in early 2015 Electrawinds went bankrupt. This time a too large supply of biodiesel in the market and downward pressure on sales prices were cited as sources of the problems (Bareman, 2015). The plant was losing money since production restarted and millions of Euros had to be added yearly (Bareman, 2015).

The fermentation plant and Bio Base Europe Training Centre also have financial problems. Over 2012 and 2013 the Training Centre had a deficit of €530,000 (van der Werf, Bio Base Trainingcentrum Terneuzen blijft geld kosten, 2015). In the later years there was a deficit of €80,000 (van der Werf, Bio Base Center werkt aan terugdringen tekort, 2015).The bio base exposition part of the Training Centre is the main cause of this deficit. But the centre has to keep up this exposition until 2018 in order to comply with the conditions that came with accepting some European subsidies (van der Werf, Bio Base Center werkt aan terugdringen tekort, 2015).

Even though not all projects are going according to plan, many people consider Biopark Terneuzen to be a success because nowhere in the Netherlands there is such an atmosphere which has resulted in resource exchanges on such a large scale (see Appendix B). There are more examples in the Netherlands of locations in which companies exchange resources but not on this scale (see Appendix B).

The most important achievement at Biopark Terneuzen is the atmosphere of seizing opportunities that is currently present. Companies are now willing to collaborate and take advantage of business opportunities. Yara for example is experimenting with new ways to purify waste water using algae (see Appendix B1 & B3). Other companies are interested in using the algae that grow from this process for their own businesses (see Appendix B1 & B3). As long as this enthusiasm remains, new business opportunities will be developed.

## 4.8 Evaluating Biopark Terneuzen

Biopark Terneuzen is now assessed using the above information. The assessment uses qualitative, subjective estimates which are made robust by and supported by information collected from literature, documents, reports, and from interviews with people involved in the project. Biopark Terneuzen is a relatively new collaborative effort. The initiative is all about creating linkages between organisations in the port area of Terneuzen. The organisations in the area exchange multiple resources. Many different types of organisations are involved including companies, governments, the port authority, and knowledge institutions.

Biopark Terneuzen is created in an area that already exists for many years. The port area has a well-developed infrastructure with many roads, buildings, utilities, rail ways and water ways. Some of the Preliminary Requirements were important right from the start of the project. There were enough resources available for example, for the exchanges to be economically feasible. The resources were also of good enough quality for the project to be technically feasible. New infrastructure had to be developed to enable the exchange of resources. Other Requirements such as Agglomeration Effects were of less importance for the development of Biopark Terneuzen.

The initiative has created a new energy in the area. Many companies show enthusiasm and a collaborative spirit. The exchanges have many benefits such as increased revenues, lower costs, new ways to treat waste, and lower levels of pollution which also improves the image of the area. Table 8 summarises the assessment of Biopark Terneuzen.

Table 8 shows how Biopark Terneuzen holds up when compared to the Preliminary Requirements. The same method is used by Rabelloti, Giuliani, & Alexander (2014) for the assessment of clusters in the Caribbean. This research project applies the same format:

- Gather empirical evidence
- Analyse evidence along Requirements
- Assess each dimension based on analysis and judgement by people directly involved in the case

### 4.8.1 Resource availability

Companies were operating in the area for a long time already before there were plans of creating Biopark Terneuzen. These companies produce waste streams and resource streams. Thorough research proved that enough streams of good enough quality were available to create many exchanges between companies.

The infrastructure in terms of accessibility, roads, buildings and waterways was already well developed before the Biopark Terneuzen initiative was carried out. The infrastructure to carry out the exchanges had to be developed. The companies and other parties invested in this infrastructure because of the financial and environmental benefits of the exchanges.

The level of education in the area is good. The majority of the people in Zeeland have a medium to high level of education. The port already employs 15,000 people which is 18% of the total jobs in Zeeland. One of the reasons for the Municipality and the Province to support Biopark Terneuzen is that it creates jobs; the greenhouses created approximately 800-1000 new jobs. This all indicates that there is at least a decent supply of human capital in the area. The creation of Biopark Terneuzen

did not increase the demand for employees at the firms that were already there before the Biopark Terneuzen project.

The creation of resource exchanges are treated as business decisions which reduce costs or create revenues. The needed capital is attracted from the market. The sources of financial capital are the companies, subsidies, and investments. The investments in the infrastructure for the exchange of $CO_2$ and heat between Yara and the greenhouses already amounted up to €80 million. The fact that this and other exchanges still was created despite the high amount of investments needed indicates that the business cases were strong enough to attract investments and subsidies.

Concluding, there was a high level of resource availability which made it feasible to develop Biopark Terneuzen. The availability of resources has been crucial for the development of the project.

### 4.8.2 Agglomeration effects

Although there seems to be some level of agglomeration effects, these effects did not play a huge role in the development of Biopark Terneuzen. There is a pool of specialised labour being created at Biopark Terneuzen. This is indicated by the long history of industry activities in the area, the amount of people that work in the channel zone, the training at the greenhouses, the collaboration between the companies on the training and education, and the collaboration with the regional educational centre. Additionally, knowledge sharing has been essential for the development of HOST Park (see 4.8.4 Network activity).

On the other hand, no examples of supporting industries could be found or could be mentioned by the interviewees. Together with the gathered information it is concluded that there are some agglomeration effects but these effects did not play a huge role in the development of Biopark Terneuzen.

### 4.8.3 Cluster governance policy

Biopark Terneuzen definitely satisfied this requirement. The policy used to govern Biopark Terneuzen has been crucial to get the participants to actively participate. At Biopark Terneuzen there is a high level of freedom for the companies to work on own initiatives and there is decentralised decision making. The companies themselves decide if they want to work together. The name Biopark Terneuzen is a label that has been put on the voluntary collaboration between the stakeholders in the channel zone. Biopark Terneuzen is not higher in hierarchy; it cannot force companies to collaborate. It rather identifies and facilitates opportunities for creating linkages.

Biopark Terneuzen is focused on creating the right conditions for the companies to grow. A lot of attention is being paid to creating a highly skilled labour force, education, and connecting demand with supply.

### 4.8.4 Network activity

At Biopark Terneuzen there is a high level of network activity. This is crucial because the cluster is based on collaboration en resource exchange. Knowledge sharing is definitely happening at Biopark Terneuzen on a large scale. Not only technological knowledge that is needed to create exchanges is being shared. Companies are also finding out what other companies in the region that are not directly linked are doing. This is actively stimulated by Biopark Terneuzen by organising events. Knowledge sharing was absolutely essential for the development of Biopark Terneuzen.

In the beginning there were many events, now there are few. This is attributed to the different phase Biopark Terneuzen is in. Before, the initiative had to be developed yet. Now it is established and the focus is different.

There are many linkages between the companies in the area and with Zeeland Seaports. There are also linkages to organisations and universities outside the area. These linkages are needed to establish the exchange of resource streams. Biopark Terneuzen is actually an alliance and Warm$CO_2$ is a joint venture. There are not that many other alliances but it this case it is not necessary to have more joint ventures or alliances. Warm$CO_2$ was established out of necessity.

### 4.8.5 Mutually profitable transactions

Biopark Terneuzen is created on mutually profitable transactions they are the core of the concept. The amount of these transactions is very high. The exchange of resources benefits both the receiver and the supplier. The benefits include: increased revenues, lower costs, lower emission of polluting material and a better image for the whole region.

### 4.8.6 Business opportunities

Business opportunities were initiated by the Province and by consultancy firm Van de Bunt. These parties were looking for opportunities to develop a cluster in the area and uncovered opportunities to create resource exchanges. The companies were brought together and plans to exchange more resources were created. The reasons to create these resource exchanges included extra income, lower costs, lower pollution, and a better company image. The project has resulted in an enthusiasm to develop more resource stream exchanges. This enthusiasm is also making companies develop innovative processes thus creating more business opportunities.

### 4.8.7 Summarising Biopark Terneuzen

Biopark Terneuzen is a relatively new collaborative effort. The initiative is all about creating linkages between organisations in the port area of Terneuzen. The organisations in the area exchange multiple resources. Many different types of organisations are involved including companies, governments, the port authority, and knowledge institutions.

Biopark Terneuzen is created in an area that already exists for many years. The port area has a well-developed infrastructure with many roads, buildings, utilities, rail ways and water ways. Some of the Preliminary Requirements were important right from the start of the project. There were enough resources available for example, for the exchanges to be economically feasible. The resources were also of good enough quality for the project to be technically feasible. New infrastructure had to be developed to enable the exchange of resources. Other Requirements such as Agglomeration Effects were of less importance for the development of Biopark Terneuzen.

The initiative has created a new energy in the area. Many companies show enthusiasm and a collaborative spirit. The exchanges have many benefits such as increased revenues, lower costs, new ways to treat waste, and lower levels of pollution which also improves the image of the area. Table 8 summarises the assessment of Biopark Terneuzen.

**Table 8 – Assessment of Biopark Terneuzen using the Preliminary Set of Requirements**

| Requirements | Indicators |
|---|---|
| **1. Resource availability** | **Waste streams, by-products and other resource streams** |
| **High availability. Crucial for the** | Plenty of resources and waste streams to make the project |

| | |
|---|---|
| **development of Biopark Terneuzen** | feasible economically and technically |
| | **Infrastructure**<br>Highly developed port infrastructure. Additional infrastructure needed. |
| | **Human capital**<br>Good level of human capital available |
| | **Financial capital**<br>Sufficient level of capital; investments were business decisions |
| **2. Agglomeration effects**<br>**Some agglomeration effects. Not crucial for the development of Biopark Terneuzen.** | **Pool of specialised labour**<br>There is a pool of specialised labour present |
| | **Supporting industries and suppliers**<br>Very few<br>**Knowledge sharing**<br>High (see Network activity) |
| **3. Cluster governance policy** | The policy at Biopark Terneuzen allows for a high level of freedom and is focused on creating the right condition. The governance policy has been crucial to get the participants to participate actively. |
| **4. Network activity**<br>**High level of network activity** | **Knowledge sharing**<br>High level of knowledge sharing |
| | **Network events and activities**<br>There are events, especially in the beginning. Seems to be declining. |
| | **Number of linkages and alliances**<br>Many linkages; alliances are created when needed |
| **5. Mutually profitable transactions**<br>**High amount; crucial for the development of the park** | **Number of mutually profitable transactions (e.g. knowledge sharing, resource exchanges, asset sharing)**<br>Many mutually profitable transactions; core of the Biopark concept |
| **6. Business opportunities** | The business opportunities were guided by collaboration between the participants |

# 5 Analysis of Results Case Studies

This chapter compares the information from HOST Park to the information from Biopark Terneuzen. The aim is to find out if the Preliminary Requirements adequately describe which factors should be paid attention to when developing a resource exchanging business park. Therefore the results of the case comparisons are compared with the Preliminary Set of Requirements. The Preliminary Set is then revised. This chapter then ends with presenting a Revised Set of Requirements.

## 5.1 Comparing HOST Park with Biopark Terneuzen

This section compares the results of both cases with each other. The evaluations of HOST Park and Biopark Terneuzen are combined and the similarities and differences between the cases are then explained criterion by criterion.

### 5.1.1 Resource availability

Table 9 – Comparing Resource availability at HOST Park and at Biopark Terneuzen

| Requirement | HOST Park | Biopark Terneuzen |
|---|---|---|
| **1. Resource availability** | **Natural resources**<br>Natural resources are the most important resources at NELHA. The access to warm and cold quality seawater and the high solar insolation are the most important reasons that tenants locate at HOST Park. | **Waste streams, by-products and other resource streams**<br>The companies at Biopark Terneuzen already existed before initiatives for resource stream exchanges were started. In their production processes these companies produced streams that could be used at other companies. Thorough research proved that enough streams of good enough quality were available to create many exchanges between companies. |
| | **Infrastructure**<br>The infrastructure is well developed. The seawater distribution system is one of the most important part of the infrastructure. State funds were used to develop the initial infrastructure. Small repairs and maintenance are covered from operational funds. For larger infrastructural projects funds are requested from the State which are not always granted. There is plenty of pumping capacity left; more seawater can be pumped up than currently needed. | **Infrastructure**<br>The infrastructure in terms of accessibility, roads, buildings and waterways was already well developed before the Biopark Terneuzen initiative was carried out. The infrastructure to carry out the exchanges had to be developed. The companies and other parties invested in this infrastructure because of the financial and environmental benefits of the exchanges. |
| | **Human capital**<br>Attracting and retaining technicians is a challenge because the location is isolated compared to the rest of the world and also compared to the rest of the island. This problem is addressed by attracting employees from all over the world and by investing in local education. The government is also doing its part by removing and changing regulations that act barriers for employment.<br>Even though attracting certain employees is challenging, the numbers show that a | **Human capital**<br>The level of education in the area is sufficient. The majority of the people in Zeeland have a medium to high level of education. The port already employs 15,000 people which is 18% of the total jobs in Zeeland. One of the reasons for the Municipality and the Province to support Biopark Terneuzen is to create jobs; the greenhouses created approximately 800-1000 new jobs. This all indicates that there is at least a decent supply of human capital in the area. The creation of Biopark |

| | | |
|---|---|---|
| | significant amount of people on the Island of Hawaii are employed by NELHA and its tenants. Execution of the Master Plan will even create more employment. | Terneuzen did not increase the demand for employees at the firms that were already there before the Biopark Terneuzen project. |
| | **Financial capital**<br>There was enough financial capital available to support the development of the cluster over the years. The State Government has played a very important role in providing funds. It kept supporting NELHA because of the positive economic impact of it and because of the jobs that are created with the park.<br>More recently NELHA started to focus on being self-sufficient. It receives fewer funds from the Government. The organisation has to be more creative to ensure that there will be enough funds available in the future. | **Financial capital**<br>The creation of resource exchanges are treated as business decisions which reduce costs or create revenues. The needed capital is attracted from the market. The sources of financial capital are the companies, subsidies, and investments. The infrastructure for the exchange of $CO_2$ and heat between Yara and the greenhouses already amounted up to €80 million. The fact that this and other exchanges still were created indicates that the business cases were strong enough to attract investments and subsidies. |

Both of the clusters have a high availability of resources. The clusters differ in the types of resources that these clusters have available. HOST Park has high quality cold deep seawater and warm surface seawater in abundance in addition to a high solar insolation. It also has a very well developed distribution system for getting the seawater to the tenants. The key resources at Biopark Terneuzen are the waste streams and the by-products that the companies at the Canal Zone produce. The infrastructure to distribute the current resource streams is constructed after agreement was reached to exchange the resource streams. If other resource streams are to be exchanged between companies the infrastructure has to be upgraded or new infrastructure has to be constructed.

HOST Park has some challenges in attracting and retaining technicians. These challenges are not problematic and are actively managed. Higher level positions are less challenging to fill up. Biopark Terneuzen did not have big challenges with attracting employees. The Biopark project did not create a need for extra employees at the firms that were already located at the Canal Zone. The greenhouses did need employees, but attracting people was not a problem for these companies. Both clusters employ significant amounts of people when compared to the regions the clusters are situated in.

Both clusters have access to financial capital but it is organised different in each case. The Government of Hawaii supports HOST Park financially because of the positive financial impact of the park and because of the jobs that the park creates. The Government's stance has changed though; it demands HOST Park to be more self-sufficient, which means fewer funds are provided. Because of this NELHA is changing the way it is governing HOST Park from a top-down approach to an approach that allows for more freedom for the tenants.

Biopark Terneuzen does have a strong partner (Zeeland Seaports) but Zeeland Seaports' role is different than just sponsoring the project. The funds that are needed to develop the resource stream exchanges are obtained through investments. If there is no solid plan, there will be no investment.

### 5.1.2 Agglomeration effects

Table 10 – Comparing Agglomeration effects at HOST Park and at Biopark Terneuzen

| Requirement | HOST Park | Biopark Terneuzen |
|---|---|---|
| **2. Agglomeration effects** | **Pool of specialised labour**<br>The existence of the park for more than 40 years, the 335 people currently employed, and the involvement in many educational projects, not only for students but also for people that are already employed as well (Akamai Workforce Initiative), all indicate that a pool of skilled workers exists and is growing. There are some challenges though when it comes to attracting and retaining certain employees. | **Pool of specialised labour**<br>The long history of industry activities in the area, the amount of people that work in the channel zone, the training at the greenhouses, the collaboration on the training that the process operators receive, and the collaboration with the regional educational centre all contribute to a pool of specialised labour being created. |
| | **Supporting industries and suppliers**<br>There are few examples of supporting industries and suppliers. NELHA's isolated location and its policy impeded the emergence of this. The policy is now transforming to a policy that allows for the growth in this dimension. | **Supporting industries and suppliers**<br>No examples of supporting industries could be found or could be mentioned by the interviewees. |
| | **Knowledge sharing**<br>Very few instances of knowledge sharing at HOST Park could be found. Based on information that is found and supported by information from interviews, it is concluded that at HOST Park there is a low level of knowledge sharing. | **Knowledge sharing**<br>Knowledge sharing is definitely happening on a large scale. Not only technological knowledge that is needed to create exchanges is being shared. Companies are also finding out what other companies in the region that are not directly linked are doing. This is actively stimulated by Biopark Terneuzen by organising events. |

There are weak agglomeration effects at HOST Park. Weak agglomeration effects at a location usually means that firms obtain few extra benefits from locating their business at that location. In this case however, the access to quality deep seawater, surface seawater, and the high solar insolation truly are unique selling points for HOST Park. These are the most important reasons that people locate their business at HOST Park not the agglomeration effects. If a company needs these resources, HOST Park is a great place to locate the business at as there are few alternatives.

At Biopark Terneuzen the indicators of agglomeration effects are somewhat stronger. Besides having access to resource streams, locating a business at Biopark Terneuzen gives a company access to knowledge that is actively being shared by the companies. The Biopark initiative has to exist longer to really see if a pool of specialised labour will be created.

### 5.1.3 Governance

Table 11 – Comparing Governance at HOST Park and at Biopark Terneuzen

| Requirement | HOST Park | Biopark Terneuzen |
|---|---|---|
| **3. Governance** | **Description of policy: top-down strict vs. freedom and decentralisation; focus on creating right environment?** | **Description of policy: top-down strict vs. freedom and decentralisation; focus on creating right environment?** |

| | | |
|---|---|---|
| | The cluster governance policy at NELHA is transforming from a strict policy to a policy that allows for freedom for initiatives of the tenants. It is still top down, but it is far less strict than it used to be. NELHA is open for initiatives that are not using its resources directly. Some activities are now allowed which were not allowed before.<br>Currently NELHA is focused on creating the right environment by executing its master plan: HOST Park is an FTZ and an EZ, NELHA is master permitted, and it is creating six zones of use in which tenants that are performing the same types of activities are clustered. By doing this NELHA is setting the framework in which the tenants have freedom to operate. The effort to be self-sustaining has caused these changes in the policy. | At Biopark Terneuzen there is freedom for the companies to work on own initiatives and there is decentralised decision making. The companies themselves decide if they want to work together. The name Biopark Terneuzen is a label that has been put on the voluntary collaboration between the stakeholders in the channel zone. Biopark Terneuzen is not higher in hierarchy; it cannot force companies to collaborate. It rather identifies and facilitates opportunities for creating linkages.<br>Biopark Terneuzen is focused on creating the right conditions for the companies to grow. A lot of attention is being paid to creating a highly skilled labour force, education, and connecting demand with supply. |

There are important governance differences between the cases. HOST Park displayed a top-down policy that did not allow for many different types of activities. Pressure from the government lead to changes in the way park was managed. NELHA has to become less dependent on State funds and has to generate more revenues. Now there is also Master Plan with a clear strategy and vision for the future. This plan allows for more types of activities and also contains a zoning plan in which similar activities are grouped together in these zones. NELHA is going from a strict governance to governance that allows for more freedom for the tenants and that focuses on creating the right conditions for the park to grow.

The way Biopark Terneuzen is governed allows for a lot of freedom and decentralisation. At Biopark Terneuzen there is no hierarchy, the companies themselves decide to develop resource stream exchanges or not. There is a very collaborative spirit from the start. Companies realised that participating in the project yielded many benefits.

Both clusters focus on creating the right conditions. Biopark Terneuzen is all about identifying opportunities and facilitating not about enforcing collaboration between the companies. At the cluster there is a focus on training the employees and on connecting demand and supply. HOST Park made it easier to do business: the park is a Foreign Trade Zone and an Economic Zone which has cost benefits for the tenants locating at the park.

### 5.1.4 Network activity

**Table 12 – Comparing Network activity at HOST Park and at Biopark Terneuzen**

| Requirement | HOST Park | Biopark Terneuzen |
|---|---|---|
| **4. Network activity** | **Knowledge sharing**<br>(see Agglomeration Effects) | **Knowledge sharing**<br>(see Agglomeration Effects) |
| | **Network events and activities**<br>There are monthly events in which the tenants can participate. Tenants can also participate by submitting issues they want to discuss with the board of NELHA. For both opportunities for | **Network events and activities**<br>In the beginning there were many events, now there are few. This is attributed to the different phase Biopark Terneuzen is in. Before, the |

| | | |
|---|---|---|
| | interaction tenant participation is very low. Tenants do not seem interested in participating in these events. It is positive though that these kinds of activities are organised. | initiative had to be developed yet. Now it is established and the focus is different. |
| | **Number of linkages and alliances**<br>Over the course of 40 years NELHA has developed many linkages with many types of organisations including educational organisations, tenant organisations, governmental organisations, the airport, and the local community.<br>However, there are not many formal alliances in the form of for example an overarching network in which every stakeholder is involved. | **Number of linkages and alliances**<br>There are many linkages between the companies in the area and with Zeeland Seaports. There are also linkages to organisations and universities outside the area. These linkages are needed to establish the exchange of resource streams.<br>Biopark Terneuzen is actually an alliance and Warm$CO_2$ is a joint venture. There are not that many other alliances but it this case it is not necessary to have more joint ventures or alliances. Warm$CO_2$ was established out of necessity. |

There are huge differences between the levels of network activities at the clusters. At NELHA there is a very low level of network activities. There are very few examples of knowledge sharing because companies don't really work together. There is low participation of companies in events and activities. NELHA has itself many linkages with the tenants and with other organisations but there are few formal alliances that are formed with the purpose of developing and strengthening the park.

At Biopark Terneuzen network activities are actually necessary. The cluster is about collaboration between the companies. Network interaction is needed by definition otherwise there can be no exchange of resource streams. Companies share knowledge on multiple levels, participation in events was high (it seems that fewer events are being organised now), and the number of linkages are very high. Biopark Terneuzen itself is an alliance of the stakeholders. Biopark Terneuzen scores high on network activities.

### 5.1.5 Mutually profitable transactions

**Table 13 – Comparing Mutually profitable transactions at HOST Park and at Biopark Terneuzen**

| Requirement | HOST Park | Biopark Terneuzen |
|---|---|---|
| **5. Mutually profitable transactions** | **Number of mutually profitable transactions (e.g. knowledge sharing, resource exchanges, asset sharing)**<br>The tenants as HOST Park view each other mainly as competitors. There is very little collaboration between the tenants. On few occasions tenants do collaborate (e.g. Keahole Point Association and SPF brood stock shrimp). But very little evidence on collaboration on marketing, resource sharing, asset sharing, knowledge sharing is found. This was confirmed in interviews. | **Number of mutually profitable transactions (e.g. knowledge sharing, resource exchanges, asset sharing)**<br>Biopark Terneuzen is built on mutually profitable transactions. The exchange of resources benefits both the receiver and the supplier. The benefits include: increased revenues, lower costs, lower emission of polluting material and a better image for the whole region. |

Biopark Terneuzen and HOST Park also differ on this Requirement. The number of mutually profitable transactions between tenants at HOST Park are very low while at Biopark Terneuzen the number is very high. This is because of the very different 'core businesses' of the clusters. HOST Park is about distributing seawater to the tenants. The tenants at HOST Park do not have to work together which most of them don't. They focus on their own businesses.

The companies at the Canal Zone have their own businesses as well. Yara for example, does totally different things than what Cargill does but in the setting of Biopark Terneuzen the companies choose to work together to realise the exchange of resource streams. They choose to do that because they realise that exchanging resource streams is actually beneficial to both parties. Biopark scores very high on the number of mutually profitable transactions.

### 5.1.6 Business opportunities

**Table 14 – Comparing Business opportunities at HOST Park and at Biopark Terneuzen**

| Requirement | HOST Park | Biopark Terneuzen |
|---|---|---|
| **6. Business opportunities** | **Description of how business opportunities guided the development of HOST Park**<br><br>The opportunities for doing business were guided mostly by external events. The predecessor of NELHA was created in response to the oil crisis. Hawaii was and still is very dependent on oil. It is actually the most petroleum-dependent State in the US.<br>The renewable energy focus of the Government of the US, the accompanying funds that are created for it, and the renewed focus of NELHA (HOST Park zoning, increased support, self-sufficiency, etc.) create opportunities for HOST Park and tenants. Federal funds might flow to HOST Park and its tenants, and the park's policy now allows for initiatives that were not allowed before. | **Description of how business opportunities guided the development of HOST Park**<br><br>Since the possibilities to exchange resource streams was uncovered as opportunities to create extra income, to cut costs, lower pollution, and to create a better company image, there is an enthusiasm to develop more resource stream exchanges.<br>This enthusiasm is also making companies develop innovative processes thus creating more business opportunities |

At HOST Park the opportunities for doing business were mostly guided by external events. The combination of the oil crisis in the 1970s, Hawaii's dependency on oil and the access to the unique natural resources led to the development of HOST Park. At first there was a focus on renewable energy (OTEC). A second phase at HOST Park started when it was realised that the seawater held more economic value and could be used for more than OTEC. Few other activities than OTEC were then allowed. The third phase started with the Government demanding NELHA to be self-sufficient. The organisation created a Master Plan with its vision and a zoning plan. NELHA is also changing the way it is governing the park.

Biopark Terneuzen is an initiative that is developed in an existing industrial area. Many activities such as alcohol production, fertilizer production, recycling, and starch production were performed in the area. These processes create by-products and waste products. In this case to exchange these resource streams are business opportunities which create extra income, cut costs, lower pollution, and create a better image for the entire area. There is a lot of enthusiasm among the participants. The companies are actively looking for more ways they can collaborate and exchange resources.

## 5.2 Assessing the Preliminary Set of Requirements

This section compares the results of the cases to the Preliminary Set of Requirements. Looking at the results, is the Set of Preliminary Requirements adequate to determine how to successfully develop a cluster?

### 5.2.1 Resource availability

The importance of resource availability was confirmed in both cases. Not every resource needs to be in place to the same extent for a cluster to be able to develop. But a cluster cannot develop if not enough employees can be attracted, if there is no access to financial capital at all, or if there are no resources that serve as input for the business operations.

The resources are location specific: some locations have might have an abundance of certain resources and others might have other types of resources in abundance. HOST Park for example has its seawater as most important resource and Biopark Terneuzen has the by-products and waste products.

The cases show that there needs to be access to financial capital, human capital, and infrastructure to enable to utilise other resources. The resources that hold economic potential will depend on the location and will determine the nature of the cluster. At HOST Park financial capital, human capital and the infrastructure is used to enable the tenants to use the seawater. At Biopark Terneuzen financial capital, human capital and the infrastructure is used to enable the companies to use by-products and waste products.

### 5.2.2 Agglomeration effects

Weak agglomeration effects were present at HOST Park. At Biopark Terneuzen the effects were not weak but also not strong. Agglomeration effects do not seem crucial for the successful development of a cluster. The reason is that resource availability seems to be the most important driver for companies to locate somewhere, certainly in the beginning as a pool of specialised labour and supporting industries and suppliers take time to develop. At HOST Park for example, the availability of the seawater is its unique selling point and the companies do not really need to share knowledge. The availability of quality deep and surface seawater is the most important reason that the tenants locate at the park.

### 5.2.3 Governance

Analysis of the cases shows that the governance policy at a cluster does not necessarily have to allow for a lot of freedom. The policy at HOST Park was pretty strict in allowing certain types of activities. It worked because HOST Park has unique resources and is supported financially by the Government. NELHA did not depend that much on the tenants financially.

Since the Government demands NELHA to be self-sufficient the policy is changing. NELHA now depends more on the success of the tenants and allows for more freedom for initiatives. NELHA still takes the decisions at HOST Park but it is more open for input from the tenants than before.

At both clusters the governance policy did focus creating the right environment for companies to do business by removing barriers (HOST Park), by focusing on creating a skilled workforce (Biopark Terneuzen), and by focusing on education (both clusters).

### 5.2.4 Network activity

The importance of a network depends on the nature of the cluster. For a cluster where the participants depend strongly on each other it is very important to have a lively network with a lot of interaction between the tenants. Such a network allows for knowledge sharing and allows cluster participants to discover opportunities for doing business.

For a cluster where there is no dependency between the cluster participants network activities are less important. Sometimes participants even think of network events and interactions as distractions as was the case at HOST Park.

### 5.2.5 Mutually profitable transactions

Mutually profitable transactions are a form of business opportunities. Some clusters have these transactions as business opportunities. In that case collaboration becomes important as well as network activities.

Other clusters are not based on mutually profitable transactions. These clusters use other business opportunities to develop and network activities are not needed to discover business opportunities.

### 5.2.6 Business opportunities

The business opportunities are driven by the available resources in the region and on external factors. Changing external factors determine how the cluster develops over time.

There are multiple ways to seize business opportunities depending on the resources and on the external factors. Mutually profitable transactions are a way to take advantage of business opportunities.

### 5.2.7 Discussion

The Preliminary Set of Requirements supposedly describes the factors that need to be addressed when developing a cluster. But the above discussion shows that both cases do not fully satisfy the Preliminary Set of Requirements. There were mixed results on agglomeration effects, governance, network activities and mutually profitable transactions. But the availability of resources and business opportunities proved to be important in both cases.

Even though the cases do not fully satisfy the Preliminary Set of Requirements, they both do exist in real life. That means that the Preliminary Set of Requirements does not align with reality. The set needs to be adapted using the results from both clusters. Based on the results the following changes need to be made to the Preliminary Set of Requirements:

- The crucial resources financial capital, human capital and infrastructure are needed to unlock the potential of other resources independent from the location
- Agglomeration effects are not crucial for the start of a cluster and are therefore removed from the Preliminary Set of Requirements. Agglomeration effects can be important, but in later phases. In the start-up phase access to resources is more important.
- Mutually profitable transactions are a form of business opportunities and should be included in that requirement.
- The importance of network interactions depends on the situation. If there is little need for cluster participants to collaborate with each other, network interactions are not important.

On the other hand, if the cluster is based on collaborations and resource exchanges, network interactions are of great importance.

- It is not necessary to have a cluster governance policy that allows for a lot of freedom for its participants. Whether the governance policy allows for freedom and decentralisations depends on the combination of requirements at that cluster.
- Finally, from the interviews it became clear that a vision is needed to excite and attract people to work together to realise the cluster.

These changes lead to the following Revised set of Requirements (not in order of importance):

1. Compelling vision
2. Availability of critical resources
3. Fitting park governance policy
4. Business opportunities
5. Fitting level of network activity

## 5.3 Revised set of Requirements

This section explains the Revised Set of Requirements step-by-step.

### 5.3.1 Compelling vision

There needs to be a strategy document containing a compelling vision. The vision is used to gather support for the creation of a cluster. What has been made clear at the case studies is that firms participate out of self-interest. The more the vision satisfies this self-interest, the harder the firms are willing to work to realise this vision.

The vision needs to be supported by (local) governments, businesses, society (NGOs), and knowledge institutions. If these groups do not support the development of the cluster time, money, and energy will possibly be wasted in battles against each other.

A way to get support from multiple groups is to define the vision broad enough to allow multiple groups to translate the vision into their own values (de Bruijn & ten Heuvelhof, 2008). A broad vision allows for multiple groups to find something in the vision they agree with (de Bruijn & ten Heuvelhof, 2008).

### 5.3.2 Availability of critical resources

One of the most important criteria is access to critical resources. There should at least be access to human capital, financial capital, and infrastructure to enable companies to make use of other resources at the location. The feasibility of plans should be tested. The amount and type of resources that are used as input for business processes (production) are location specific and will, together with the business opportunities, determine the nature of the cluster. It will for example determine if there will be local production, processing, export, or exchange of resources.

### 5.3.3 Fitting park governance policy

The governance at a cluster should focus on creating the right environment for the companies inside a cluster to do business. This means attention is paid to things like creating a skilled workforce, removing barriers for doing business, creation of demand and markets, competition, and education. The point is that if the companies are confronted by too many barriers for doing business they will have difficulties to survive in the market and the cluster itself will have difficulties surviving.

How strict the governance policy should be depends on the configuration of the cluster. For example, if the cluster is based on unique resources and the park authority controls it, and if the park authority is financially independent from the companies in the cluster, a strict top-down governance can work. If the park authority is financially dependent on the cluster participants there should be more freedom for the participants to decide which activities they want to undertake. In other words: the more resources the cluster management controls, the more power it has. The more power the cluster management has, the stricter the cluster policy can be.

### 5.3.4 Business opportunities

The business opportunities are determined by the available resources in the region and by external factors. The available resources and business opportunities determine the type of businesses and nature of cluster. They will determine if the cluster is about production, resource exchange, processing, exporting, etc. Mutually profitable transactions are a form of business opportunities.

External factors have a lot of influence on the cluster. For example, changing government policy on subsidies, global developments (embargos, war, etc.), rising oil prices, and new governmental policies on green energy can lead to bankruptcy of businesses or can create business opportunities. Changing external factors shape the business opportunities which determines how the cluster develops over time.

### 5.3.5 Fitting level of network activity

The importance of network activity is highly dependent on the need for collaboration between the companies in the cluster. If the companies need to collaborate with each other for example because the cluster is based on exchanging resources, then it is important to have many network activities. On the other hand, if the companies in the cluster do not have to collaborate with each other at all, they will not engage in network activities. The dimensions of network activities are knowledge sharing, network events, and formal linkages and alliances.

### 5.3.6 Multiple combinations of Requirements possible

A multitude of combinations of these Requirements are possible which allows for different parks to emerge. That explains that HOST Park and Biopark Terneuzen are very different from each other: different combinations of Requirements can be identified at these clusters.

At HOST Park the oil crisis and the dependency on oil were the external factors that, in combination with the favourable location to pump up cold seawater (available resources at the location), led to the development of HOST Park. NELHA, the organisation governing HOST Park, received funds from the Government to develop the infrastructure that was needed to distribute the seawater.

The resources at HOST Park are so unique that the tenants locate their business at the park mainly because of these resources. They do not have many other options if they want to obtain these resources. NELHA was financially independent from the tenants since it received funds from the government. These two factors made it possible for NELHA to successfully apply a strict policy at the cluster. NELHA did focus on creating the right conditions: it is master permitted and HOST Park is an Economic Zone and a Free Trade Zone.

The tenants at HOST Park rarely collaborate with each other. They consider each other as competitors. Therefore there are very few network activities in which these tenants participate.

At some point the Government decided that NELHA should become self-sufficient (external event). Because of this NELHA is depending more and more on the tenants for generating revenues. NELHA redefined its focus with its Master Plan and is allowing more types of activities on HOST Park. The tenants are also given opportunities to participate in the decision making process (for example in setting the price for the seawater).

This example really shows how the combinations of Requirements work to create and shape the development of a resource sharing business park. The development of Biopark Terneuzen can also be explained using the Requirements. But a different combination of Requirements led to a different park.

## 5.4 Summarising

HOST Park and Biopark Terneuzen were compared with each other. Both parks showed the importance of resource availability. Not all resources were equally important but there were some crucial resources in each case.

Both cases showed a low importance of agglomeration effects. It is possible that that becomes more important in later phases. The availability of unique resources at HOST Park makes the park attractive enough and compensates for the low level of agglomeration effects. At Biopark Terneuzen the agglomeration effects were somewhat stronger. However, the initiative is relatively new; it is possible that agglomeration effects will play a more important role in the future to attract organisations.

Comparing both cases showed that different types of policies can work depending on the situation. HOST Park's development succeeded while the park had a top-down policy with little freedom for the tenants. It worked because the park management was relatively independent from the tenants. Now it the park becoming more dependent on the tenants and is adapting its policy to allow for more freedom for the tenants. Biopark Terneuzen had a bottom-up approach from the start as the companies themselves were the drivers of the initiative.

The parks differed on the level of network activity and on the importance of mutually profitable transactions. The business opportunities were case specific.

The Preliminary Set of Requirements was then compared with the results from the cases. The results showed that the Preliminary Set of Requirements was not adequate enough to prescribe how a resource sharing business park could be developed successfully. Some requirements needed further specification and other requirements were not as important as described.

Comparing the cases to the Preliminary Set of Requirements led to the following insights:

- There are crucial resources independent on the location: financial capital, human capital and infrastructure are needed to unlock the potential of other resources
- Agglomeration effects are not crucial to get a resource sharing business park of the ground
- Mutually profitable transactions are a form of business opportunity
- The importance of network interactions depends on the situation
- The level of freedom and decentralisation that the park governance policy should allow for depends on the combination of requirements at that park

- A vision is needed to excite and attract people to work together to realise the business park.

Based on these learning points the Revised Set of Requirements is proposed. This Set prescribes the following five requirements:

1. Compelling vision
2. Availability of critical resources
3. Fitting governance policy
4. Business opportunities
5. Fitting level of network activity

These Requirements should describe the conditions that are needed for the successful development of a resource sharing business park. They should be present from the start or if possible, they should be developed. Infrastructure for example is considered a crucial resource. It should be developed as it is almost never present from the start.

# 6 Validation of Revised Requirements

This chapter discusses the validation of the Revised Set of Requirements. The Revised Requirements are presented to and discussed with experts. These are people who have seen the development of a cluster from up close. Their input will be used to create the Final Set of Requirements.

The outline of this chapter is as follows. First the experts are introduced. Then their opinions and remarks about the Revised Set of Requirements is discussed. Finally a Final Set of Requirements is presented.

## 6.1 Introducing the Experts

The Revised Set of Requirements is discussed with four experts: Gijsbert Korevaar, Jenny Crone, Peter Geertse, and Henk van Latesteijn. A PowerPoint presentation was sent to all of the experts to explain what this research project is about and to present the Revised Set of Requirements. The slides were used to guide the interviews.

Gijsbert Korevaar is a teacher and researcher at the faculty of Technology, Policy and Management at Delft University of Technology and teaches about Industrial Symbiosis. One of the courses he teaches is about clusters specifically.

Jenny Crone is the Director of Warm$CO_2$, one of the most important projects at Biopark Terneuzen. She is involved in the project since April 2012 and is the Director since December 1$^{st}$, 2013.

Peter Geertse is Commercial Manager at Zeeland Seaports, the port authority of the ports of Terneuzen and Vlissingen. He is also General Manager of Biopark Terneuzen which he referred to as "a platform of companies in the Canal Zone who are engaged in making their production processes more sustainable."

Henk van Latesteijn is founder of Value Mediation Partners, a consultancy firm that facilitates collaboration between organisations. Henk van Latesteijn was General Manager at TransForum, an organisation that operated from 2005 to 2011 with a focus on sustainable development of the Dutch agricultural sector.

## 6.2 Discussion of the Requirements

In this section the most useful comments by the experts are discussed criterion by criterion. For each requirement a table containing the description of requirement and the remarks by the experts are presented first. Then these remarks are discussed.

### 6.2.1 Compelling vision

| There needs to be a strategic document with a vision which multiple parties can agree on. This vision needs to be attractive enough to draw support from governments, companies, knowledge institutions and societal organisations. The more the vision aligns with the individual parties, the harder they are willing to work on realising it. The vision will depend on the situation and the number of participants should be manageable. | |
|---|---|
| Gijsbert | There is a distinction between partners that participate in creating a cluster and clients |

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| Korevaar | who just are in the cluster. The compelling vision would be useful in the former. In the latter you would have a business plan instead. |
| Jenny Crone | I think that is correct. That should be the base.<br><br>[When commenting on another requirement:]<br>The ambition level should also be reasonable. Large projects are already complicated financially. Huge risks are introduced by making a project technologically advanced in addition. There should be a healthy, reasonable ambition level. |
| Peter Geertse | The strategic document with a vision should not only be written down. It should also be executed. There needs to be a participant who takes the initiative and gets things done. Many collaborations remain collaborations on paper because nobody is taking the initiative. Many projects have bled out like this.<br>It is true that support has to be gathered from governments, businesses, knowledge institutions and societal organisations. |
| Henk van Latesteijn | I agree and I would add that the parties need to develop this strategic document collectively. It should not be written by a third party for others to use. They would not be committed. In my experience a strategic document is a living document. It changes along the way. The vision needs to be developed collectively and should take into account the key values of the key stakeholders |

The experts generally agreed that this should be a requirement and that support from multiple stakeholders increases the chances of a successful development of a cluster. They added useful remarks to improve this requirement. It should be made clear that the vision described in the Revised Requirements is different than a business plan. The vision is used to get multiple actors together in the very beginning of the project to develop the cluster.

Peter Geertse made a very important remark about this criterion. The strategy document should not only be written; it indeed needs to be executed. This seems logical but apparently there are many strategy documents on shelves which are not being executed simply because there is no one who takes the initiative to execute it. For the same reason many collaborations remain collaborations on paper and are not really put into practice. There needs to be a participant that can get things done and that takes the initiative to put things in practice.

Jenny crone made a remark that fits here while discussing another requirement. Her remark was that agreement should be reached on the technological ambition level. There is the temptation to only use the most advanced technologies in projects but that introduces huge risks and adds to the complexity of the project. The technological ambition level should be reasonable and attainable. This can be integrated in the comments Henk van Latesteijn made: an agreement can be reached collectively on the technological ambition level while reaching an agreement on the vision collectively.

### 6.2.2 Availability of critical resources

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| There need to be enough resources available to do company activities with (e.g. to use as input in business process). At least employees, financial means, and infrastructure should be available. These resources enable to use other resources depending on the cluster and the type and amount of resources. Plans need to be technically and financially feasible. Examples of resources are: raw material, by-products, waste streams, infrastructure, skilled workers, capital, and knowledge. | |
| **Gijsbert** | It is not clear if these are conditions or just points that should have some attention. |

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| **Korevaar** | Should all these conditions be satisfied before the development of a cluster or should these points just receive attention? What if, for example, people want to develop a cluster but there is no infrastructure yet? |
| **Jenny Crone** | What is important is that continuity is guaranteed. Problems often arise from this. The resources should be there now but they also should still be there during the lifetime of the project. The reason is that investments are very high. In the case of Biopark Terneuzen the pipelines cost about €1 million/km. There is a long pay-back time and therefore the resources should be available for a long time. Subsidies are often needed to cover some of the costs. |
| **Peter Geertse** | The infrastructure is the hardware (roads, rails, pipelines) but there has to be logistics to use the infrastructure. Logistics should be added to financial capital, human capital, and infrastructure as essential resources. Logistics is everything transport, storage but also data related. Companies have to keep track of stock, flows, and planning. In an industrial cluster in a port area, companies will not perform logistics themselves. This has to be organised. |
| **Henk van Latesteijn** | Henk van Latesteijn agrees with this requirement and adds that if one or more of those resources are not available from the beginning, they should be developed. This is not always easy as it takes considerable time to create adequate levels of for example education or infrastructure depending on the current level and desired level. |

A couple of recommendations are derived from the remarks of the experts. The first recommendation is to add to this criterion that the resources at a cluster should be available for the lifetime of the projects. They should at least be available long enough to earn back investments. A solution must be found in case the investments will never be earned back entirely. Subsidies to cover the gap between revenues and investments might be a solution.

Second, possibilities to develop human capital, financial capital and infrastructure should be studied if they are not available sufficiently at a certain location. For example, if not enough employees are available at the location it might be possible to bring in employees from the larger area. The development of missing but needed resources should be taken into account in the plans as it adds to the complexity of the project and might introduce huge investments.

Third, logistics should be organised as Peter Geertse commented that companies usually don't do that themselves.

### 6.2.3 Fitting park governance policy

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| The cluster governance policy should be focused on creating a good business environment (e.g. remove barriers, connect parties, create demand and supply, create competition, education, and training of employees).<br>The strictness of the governance policy will depend on the configuration of the cluster. Strict governance could work if the park has unique resources and if the park management is financially independent of the cluster participants. If there is financial dependency on the participants, governance which allows for freedom for company initiatives would be more appropriate. | |
| **Gijsbert Korevaar** | Gijsbert Korevaar agrees that clear agreements should be reached on how the park should be managed. If that is not clear the cluster will not be successfully developed. It should be clear what the responsibilities are and who decides about the cluster management policy. Just like the vision, the policy should be developed collectively.<br>The term business environment is confusing. Outsiders cannot interfere with internal company policies. Business climate would be better words in this case. |

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| | [When commenting on another requirement:]<br>There is a danger of abuse of subsidies. Subsidies could be granted with which a project can be executed and is stopped later. In that case money is not earned by executing a project but by attracting subsidies. I would add business creation as a requirement to subsidy requests. |
| **Jenny Crone** | This requirement is correct. Here risks are changes in the policy. Investments are so high that projects can fail if the cluster management policy changes. People should realise that the policy needs to be there for the long term. |
| **Peter Geertse** | I agree<br><br>[When commenting on another requirement:]<br>Trust and a cooperative attitude were crucial for the successful development of Biopark Terneuzen. The companies had a cooperative attitude and trusted Zeeland Seaports which acted as a neutral party between the companies. If two companies have to collaborate they will always distrust each other in the beginning. The process will speed up greatly if there is a neutral party in between that guides the collaboration. If nobody takes the lead nothing will happen. |
| **Henk van Latesteijn** | Governance is also about creating trust. That should also be part of the cluster governance. A cluster is essentially about sharing risks. That can be done financially but it can also be done by organising relations between companies built on trust. |

The experts generally agreed on this requirement. Multiple comments will be used to improve this requirement. The first is that it should be clear on how the park is going to be managed (e.g. who is responsible for what and who decides about the governance policy). Second, the policy should be consistent and should be developed for the long term as a governance policy that keeps changing creates risks for the cluster participants.

Third, collaboration will fail if participants don't trust each other. This should be taken into account by for example developing a vision collectively or by organising informal interactions in which people from different companies get to know each other.

Finally, there should be a focus on business creation. There are numerous examples in which funds or subsidies were used to perform a project and that at the end no business was created. This criterion should include that project proposals should have a focus on creating lasting businesses.

### 6.2.4 Business opportunities

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| Business opportunities are mainly influenced by external developments and available resources. A cluster will adapt according to opportunities. Examples of external developments are national subsidy policies, national energy policies, and global events (e.g. wars, embargos, and volatile energy prices).<br>The available resources and business opportunities will also determine the type of cluster activities, e.g. production, export, processing, exchange of resources. Mutually profitable transactions are one of the many types of business opportunities. |

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| **Gijsbert Korevaar** | It is obvious that a cluster can only develop if there are business opportunities. But I can understand that it is mentioned explicitly. |
| **Jenny Crone** | Again, there are risks. External developments can also make a project fail. There is a long time between the drawing table and execution in big projects. The longer it takes, the higher the risk of something happening in between. Business opportunities can |

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| | also be risks. For example, if a participant cancels investments or plans because the company wants to pursue other opportunities. A project would be more feasible if it grows step-by-step. In this way experiences from subprojects can be used for the next subproject. The larger a project is, the more different it will be in real life. Not everything can be drawn and calculated. |
| **Peter Geertse** | I have no remarks on this. |
| **Henk van Latesteijn** | Business opportunities are not only guided by external developments. Collaboration between cluster participants could also create business opportunities. |

Business opportunities are an obvious requirement. It should be noted that business opportunities and external developments are also potential risks. A subsidy policy change might create opportunities for businesses by creating funds, but there are also cases in which changes meant fewer subsidies would be available.

Another risk is that in larger projects there is a lot of time between the drawing table and the execution of the plans. That means that there is more time in which external developments could kill the project. A step-by-step approach should be used for large projects. Experience that is built up in one step can be used in the next.

### 6.2.5 Fitting level of network activity

| This requirement depends on the need for collaboration between the cluster participants. If the main focus of a cluster is to create exchanges, there is a need for many network interactions in order to uncover and realise these exchanges. Network interactions are far less important at clusters in which participants mainly compete with each other and have an internal focus. In these cases network activities can even be considered as distractions. Indicators of network activity are: knowledge sharing, network events, formal alliances, etc. | |
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| **Gijsbert Korevaar** | I generally agree with this requirement if the network activity goes beyond normal bilateral producer-supplier relations and includes things as knowledge sharing and events. However, to convince companies is not easy. Technology companies are mainly focused on the technical part when collaborating. They never take the initiative to do more than is really needed when collaborating. |
| **Jenny Crone** | Collaboration is easiest if companies are not competing. Within a cluster there are companies from different industries. These companies have different backgrounds and have different stakes. The differences need to be bridged. Companies need to understand each other's stake. Different industries react differently to conflicts or problems. Disruptions in a supply line can be critical for one while at the same time non-critical for another. So differenced need to be bridged, otherwise there will be no proper collaboration. Also, there will be no collaboration without a central initiator. |
| **Peter Geertse** | Companies have to be willing to collaborate and to share knowledge about for example, their energy needs and cost structure. Companies are secretive about this but if this information is not shared there will be no resource exchanges. |
| **Henk van Latesteijn** | If there is no collaboration there is no cluster. If the participants are only competing that would not be a cluster. Than what is the purpose of the companies for being there? Co-location does not necessarily create a cluster. I do agree with the mentioned indicators of network activity. |

The underlying vibe of the comments is that it is very difficult to get companies to collaborate. For successful collaborations the companies have to share more information than strictly necessary

knowledge (e.g. more than just technical information). Companies might be reluctant to share some types of knowledge but collaborations will only happen if there is willingness to collaborate and if there is willingness to share knowledge. It might be needed for companies to share knowledge about energy needs or cost structures for example. Overall trust was mentioned as most important criterion for collaboration.

Collaborations do not just emerge, they has to be initiated. Someone has to take the initiative in order for actors to collaborate. Stakeholders need to invest in understanding each other and differences between companies with different backgrounds and identities need to be bridged in order to have proper collaboration. The companies need to understand each other's stake.

### 6.2.6 Other remarks

Generally speaking, the experts agreed with the importance of each of the Requirements. Henk van Latesteijn commented that the Revised Set of Requirements was a great improvement from the Preliminary Set of Requirements. The experts believe that the Revised Set of Requirements is a useful set for developing a resource sharing business park if some of the remarks are included. Using these requirements contributes to the successful development of a cluster. Success is not guaranteed as it depends on many factors including coincidences.

When these requirements are used, each requirement has to be elaborated on in the specific context it is used in. For example, does this vision gather enough support? What are the stakes in this case? Are these plans technologically feasible? Or as was mentioned earlier: in a port area, logistics have to be taken into consideration in the resource availability criterion. The Requirements become sharper when they are applied.

The intended user of this set would be the initiator of the project: someone who sees opportunities for a cluster and wants to initiate it. This could be a landowner, a project developer, a civil servant, etc. Using this set increases his chances of success.

The Revised Requirements discusses five separate aspects. In some cases it could happen that there is some overlap. For example if a strategy document with a vision is produced, it could be possible that this document covers other requirements such as cluster governance or business opportunities.

## 6.3 Final set of Requirements

Using the discussion in the previous section, the Final Set of Requirements is now presented.

### 6.3.1 Compelling vision

There needs to be a strategy document containing a compelling vision. This is a living document that needs to be developed collectively. The vision is used to gather support for the creation of a cluster. Firms participate out of self-interest so the more the vision satisfies this self-interest, the harder the firms are willing to work to realise this vision.

This vision needs to be executed. There needs to be an actor that takes the initiative and puts things in practice. The vision needs to be supported by (local) governments, businesses, society (NGOs), and knowledge institutions. If these groups do not support the development of the cluster time, money, and energy will possibly be wasted in battles against each other.

The vision should describe a win-win situation to gather support. Another way to gather support from multiple groups is to define the vision broad enough to allow multiple groups to translate the vision into their own values (de Bruijn & ten Heuvelhof, 2008). A broad vision allows for multiple groups to find something in the vision they agree with (de Bruijn & ten Heuvelhof, 2008).

The parties should also agree on the technological ambition level. Actors should realise that using only the most advanced technologies adds to the complexity of the project and introduces huge risks. The technological ambition level should be reasonable and attainable.

### 6.3.2 Availability of critical resources

One of the most important criteria is access to resources. There should be enough resources available to make use of businesswise. These resources should be available for the lifetime of the projects or at least long enough to be able to earn back the investments. Subsidies could be used to cover the gap between revenues and investments.

There should at least be access to human capital, financial capital, and infrastructure to enable companies to make use of other resources at the location. If these critical resources are not available sufficiently at the location, possibilities to develop these should be studied and included in the plans as it adds to the complexity and costs of the entire project. In addition logistics need to be organised.

The feasibility of plans should be tested. The amount and type of resources that are used as input for business processes (production) are location specific and will, together with the business opportunities, determine the nature of the cluster. It will for example determine if there will be local production, processing, export, or exchange of resources.

### 6.3.3 Fitting park governance policy

The roles and responsibilities at a cluster should be clear. Agreement can be reached by developing the cluster governance policy together. The policy should be stable as a constantly changing policy introduces risks and uncertainties. This process should also be used to build trust among the participants. Trust is crucial for the successful development of a cluster.

The cluster governance policy should focus on creating the right environment for the companies inside a cluster to do business. This means attention is paid to things like creating a skilled workforce, removing barriers for doing business, creation of demand and markets, competition, and education. The point is that if the companies are confronted by too many barriers for doing business they will have difficulties to survive in the market and the cluster itself will have difficulties surviving.

Grants and subsidies are often used to perform projects without having business creation in mind. In the end money is spent once and efforts are done without having a lasting effect. It is therefore important that project proposals have a focus on creating lasting businesses.

How strict the governance policy should be depends on the configuration of the cluster. For example, if the cluster is based on unique resources and the park authority controls it, and if the park authority is financially independent from the companies in the cluster, strict, top-down governance can work. If the park authority is financially dependent on the cluster participants there should be more freedom for the participants to decide which activities they want to undertake. In other words: the

more resources the cluster management controls, the more power it has. The more power the cluster management has, the stricter the cluster policy can be.

### 6.3.4 Business opportunities

The business opportunities are determined by the available resources in the region and by external factors. Collaborations can also uncover business opportunities. The available resources and business opportunities determine the type of businesses and nature of cluster. They will determine if the cluster is about production, resource exchange, processing, exporting, etc. Mutually profitable transactions are a form of business opportunities.

External factors have a lot of influence on the cluster. They not only create opportunities but are also potential risks. For example, changing government policy on subsidies, global developments (embargos, war, etc.), rising oil prices, and new governmental policies on green energy can lead to bankruptcy of businesses or can create business opportunities. Changing external factors shape the business opportunities which determine how the cluster develops over time.

The business opportunities can sometimes lead to large projects. In large projects there is a lot of time between the drawing table and the execution of the plans. This introduces risks since there is more time in which external developments could damage or kill the project. A step-by-step approach should be used for large projects. Experience that is built up in one step can be used in the next.

### 6.3.5 Fitting level of network activity

The importance of network activity is highly dependent on the need for collaboration between the companies in the cluster. If the companies in the cluster do not have to collaborate with each other, they will not engage in network activities. The more important it is to collaborate with each other, for example because the cluster is based on exchanging resources, the more important it is to have many network activities. Network activities are knowledge sharing, network events, and formal linkages and alliances.

For successful collaborations the companies have to share more information than strictly necessary knowledge (e.g. more than just technical information). Companies might be reluctant to share some types of knowledge but collaborations will only happen if there is willingness to collaborate and if there is willingness to share knowledge. It might be needed for companies to share knowledge about energy needs or cost structures for example.

Collaborations do not just emerge, they has to be initiated. Someone has to take the initiative in order for actors to collaborate. Trust is absolutely crucial collaboration between organisations to happen. Stakeholders need to invest in understanding each other and differences between companies with different backgrounds and identities need to be bridged in order to have proper collaboration. The companies need to understand each other's stake.

### 6.3.6 Instructions for using the Final Set of Requirements

The Final Set of Requirements is used by elaborating on each requirement in the specific context it is used in. For example, does this vision gather enough support? What are the stakes in this case? Are these plans technologically feasible? How long is this type of resource guaranteed on this location? Is it feasible to develop the needed infrastructure? Or should logistics be added to the critical resources in this case? The Requirements become sharper when they are applied.

A successful resource sharing business park is not guaranteed by using these criteria. Applying these requirements contribute to the successful development of a resource sharing business park. Success depends on many factors including coincidences.

The intended user of this set would be the initiator of the project: someone who sees opportunities for a resource sharing business park and wants to initiate it. This could be a landowner, a project developer, a civil servant, etc.

The Final Set of Requirements discusses five separate aspects. In some cases it could happen that there is some overlap. For example if a strategy document with a vision is produced, it could be possible that this document covers other requirements such as cluster governance or business opportunities.

## 6.4 Summarising

This goal of this chapter was to see if the Revised Set of Requirements were useful in practice. For this purpose this set was presented to four experts with field experience in business park development. First the experts were introduced and their backgrounds was explained. Then the requirements were presented to them and they gave their opinion about them. The experts interviewed to validate the Revised Set of Requirements are Gijsbert Korevaar, Jenny Crone, Peter Geertse, and Henk van Latesteijn. Table 15 lists the most important remarks of the experts.

**Table 15 – Remarks/additions of the experts on the Preliminary Set of Requirements**

| Requirement | Remarks/additions |
|---|---|
| **Compelling vision** | • The strategy document with the vision should not only be written down. It should also be executed. Apparently many of these documents end up on shelves and are not executed.<br>• Agreement should be reached on a reasonable and attainable technological ambition level. |
| **Availability of critical resources** | • These resources should be available long enough to be able to earn back investments<br>• If resources are not immediately available at the beginning of a project, possibilities should be studied to develop these critical resources<br>• Logistics should be organised since not all companies do that themselves |
| **Fitting park governance policy** | • Roles and responsibilities should be clear to every party that is participating in the formation of a business park. It should be clear how the park is going to be managed.<br>• The policy should be stable and should be developed for the long term as an unstable policy introduces risks<br>• Trust is an important condition for collaboration<br>• There should be a focus on business creation |
| **Business opportunities** | • Business opportunities are also potential risks |
| **Fitting level of network activity** | • Collaboration does not just happen. Especially between competitors and companies from different industries or with different backgrounds. Companies have to be willing to collaborate and have to be willing to invest in getting to know each other. Trust is a very important condition for collaboration. |

The Set of Requirements were then adapted to include these remarks which created the Final Set of Requirements. According to the experts using this set of requirements greatly increases the chance of successfully developing a resource sharing business park. When these requirements are applied, each requirement has to be elaborated on and has to be made specific to the case. The intended user of this set is the initiator of the project. For example, a civil servant, a project developer, or a landowner.

# 7 Conclusions

This chapter uses the research findings to answer the Research Questions from Chapter 1. First the central Research Questions are repeated and answered. Then the final sections discuss the relevance of this research, the weaknesses and suggestions for further research.

## 7.1 Key Findings

The objective of this research project was to develop a set of requirements for the successful development of resource sharing business parks. The following main research question was derived from this objective:

*What is a coherent Set of Requirements for the successful development of resource sharing business parks?*

Several sub-questions were formulated which together answer the central research question:

1. Which factors are required for the successful development of resource sharing business parks according to literature?
2. To what extent do the factors for the successful development of resource sharing business parks found in literature correspond with the factors that were identified in the cases?
3. Is the set of requirements adequate to successfully develop resource sharing business parks?

In the studied articles and literature no coherent set of factors that describe how a resource sharing business park can be successfully developed can be found. Multiple researchers have their own views of what they consider to be requirements for the development of such business parks. In this research the most important requirements in the relevant literature were gathered. The factors were then compared and grouped, resulting in the Preliminary Set of Requirements:

1. Resource Availability
2. Agglomeration Effects
3. Cluster Governance Policy
4. Network Activity
5. Mutually Profitable Transactions
6. Business Opportunities

Two cases were selected to find out to what extent the factors described in the Preliminary Set of Requirements was used in real-life cases. The cases showed that:

- Agglomeration effects were not crucial for these cases to emerge
- Mutually profitable transactions should be considered as an example of a business opportunity
- The importance of network activities depended on the need for collaborations
- The cluster governance policy indeed should focus on creating a good environment for doing business by for example, removing business barriers or by facilitating and initiating collaborations between companies

- A strategy document containing a vision for the development of the cluster should be developed to gather support from businesses, knowledge institutions, governments, and society

These learning points were then used to create the Revised Set of Requirements. This Revised Set was presented to four experts to find out if this set serves the purpose of developing clusters successfully. Their input improved and generally affirmed the importance of the individual factors. The result of their input is the Final Set of Requirements which contains the same requirements as the Revised Set but with an improved description to reflect the input from the experts.

*The Final Set of Requirements for the successful development of resource sharing business parks:*

1. Compelling Vision
2. Availability of Critical Resources
3. Fitting Park Governance Policy
4. Business Opportunities
5. Fitting Level of Network Activity

The conclusion of the experts was that a successful development cannot be guaranteed by using this set. Too many factors play a role in the development of clusters, including coincidences. But what this Set of Requirements does well is that it greatly increases the chance of the successful development of a resource sharing business parks. Concluding, the Final Set of Requirements answers the main research question as it provides a coherent Set of Requirements for the successful development of resource sharing business parks.

## 7.2 Relevance

As mentioned before, a coherent set that describes requirements for the successful development of clusters cannot be found in the studied literature. Frequently researchers would mention a few things that they would think are important for the development of a cluster. A scientific base for their recommendations (or tips actually) seemed to be lacking. This research addresses this by taking the first steps in developing a set of requirements based on comparing literature with two existing cases.

The requirements for the successful development of resource sharing business parks can be used by initiators of such projects including landowners, project developers, and civil servants. It will give them support by bringing order in the chaos of everything that is important in resource sharing business park development. But what the user needs to understand is that the successful design of such a business park cannot be guaranteed. Almost every interviewee cited plain luck as a factor that contributed to success. What is possible is to increase the chance of success.

## 7.3 Weaknesses

The strength of this study lies in the approach that is used. Scientific literature was used to draw up the first set of Requirements. Significant improvements were made by comparing the Requirements with results from two cases. Opinions by experts were then used to further improve the Requirements.

This approach also creates a weakness: two cases might be too few cases to base conclusions on. But for this project it was not feasible to do more case studies as creating the Set of Requirements and measuring some components proved to be time consuming. The usefulness of the outcomes was increased by the selection of two very different cases. The feedback of the experts was generally positive which gives confidence regarding the usefulness of the Final Set of Requirements.

Other weaknesses of this research stem from the formation of the Preliminary Set of Requirements. To be very precise, the first central Research Question should be: Which factors are important for successfully developing a resource sharing business park according to literature ***according to me***?

First, a selection of literature has been made. This selection determines which factors are included in the selection process and which are excluded. Second, choices have been made in selecting and grouping factors. Other people might make other choices.

What has been a challenge throughout this research is the unambiguous measurement of the Requirements in the case studies. How to measure the resource availability? How to determine unambiguously what kind of cluster governance policy is at work at a cluster? How to measure agglomeration effects unambiguously? Some Requirements had sub dimensions but objective measurements still remained a challenge. It was attempted to reduce this problem by finding information from official documents as much as possible and by comparing that to the judgment of people directly involved in the cases.

Another weakness is the danger of bias while validating the Revised Set of Requirements. Many of the experts were somehow connected to Biopark Terneuzen. Biopark Terneuzen is very different from HOST Park. Collaborations and resource exchanges are far more important at Biopark Terneuzen for example. This bias was taken into consideration as much as possible while processing their remarks.

## 7.4 Further Research

This research project should be considered as an explorative study. In this learning process a better picture is created about the complexities and components that are met during the development of a cluster. The next steps are to go in depth in every step that was used in this research:

- Use more literature and challenge the grouping of factors that was chosen in this research
- Compare the Requirements to many more cases to see if the Requirements hold for more types of clusters
- Present the Requirements to far more experts

Another recommendation for further research is to study why unsuccessful resource sharing business parks failed. This study did not take factors that lead to failure of clusters into account. How does this approach differ from approaches used in failed initiatives?

These proposed actions challenge the Set of Requirements. A more robust Set of Requirements is created with every iteration.

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# Appendix A – Interviews HOST Park

## A1 – Interview Laurence Sombardier

**Q: Can you introduce yourself?**

My name is Laurence Sombardier. Now I am Chief Marketing Officer at NELHA. I have been at NELHA for 9 years. Before I worked at a Mera Pharmaceuticals which is one of the about 40 clients of NELHA.

NELHA is a state agency that runs the park. I had various different functions mainly on the administrative side. NELHA has 16 employees which is a small group. I wear different hats: I do a lot of the contracts, lease proposals, marketing … I was interim director for a few months before the current director came on board.

**Q: Imagine there is an empty piece of land that in the end needs to be filled up with companies. Where do you start?**

That's a broad question. There are lots of ideas. I will summarize them in main points. One initial thing is to decide what type of work you want to have done. Have a little bit of a focus. At NELHA the focus is energy and marine sciences. Even that is big umbrella. Quite a lot can happen underneath that. But that is the general focus: green economic development sustainability based on energy and marine sciences.

There are also basic things you are going to have to look at. You are starting with a blank piece of land, so depending on where you are you are going to have some land use issues that you are going to need to take care of. In Hawaii there are environmental concerns you need to address: land use, land zoning… It is important to start that early on. We have environmental impact assessments that covers many of the uses. NELHA is master permitted for a variety of different applications. It makes the park attractive. It saves time for tenants. You don't want your tenant to go through that process.

**Q: Do you consider HOST Park to be a success? Why?**

Yes we believe so. And it's not something we are touting. We had a couple of economic impact statements in 2010 and 2013. We went from an economic impact to the state of $90 million in 2010 to $120 million in 2013. The clients of park contribute $5 million to state taxes. The park provides 600+ jobs including indirect jobs (multiplier).

**Q: To what do you contribute this success, this increase of $30 million in three years?**

There has been expansion of some the businesses. We are in the business of economic development. So some businesses fail and some businesses do well. Some businesses that are doing well have expanded. There was a recession in 2008-2009. To some extent you are seeing a rebound from that. Much of the increases have to do with new businesses coming in and those that are existing that have been doing well have been expanding. A lot of the economic impact is increased construction and increased capital investments. And we think that's going to translate to increased revenues and number of jobs down the line.

**Q: Which factors contributed to the successful development of HOST Park?**

There's going to be a combination of factors. It was a visionary park in the first place. It was before its time, before the whole concept of renewable energy was really fashionable. In the 1970s they were looking at that here.

There also has always been political will here to make this happen. The state has put in more than $100 million to develop the park. Financially there needs to be some government assistance to get things rolling.

The pay-back, the Return On Investment is very good. It's been worth to the state to invest in NELHA. Other factors would be that there are multiple compatible areas. When they developed it at first there were looking at OTEC. Then there were other compatible areas, secondary uses for that water like aquaculture, food production, green sustainable construction (SWAC). So multiple compatible areas which allowed the park to develop over the years.

When energy was not such a hot topic and there was not so much funding anymore it went more into food production. It's allowed the park to adapt a little bit while maintaining its ocean science focus.

**Q: Are these factors specific to HOST Park or are they universal**

I think those factors could be applied to other types of parks and other clusters for sure.

**Q: Back to my first question about the empty piece of land…**

And your infrastructure is going to be important. That's going to be the next things you are going to look at. If you are developing a blank piece of park, you have to arrange it so that it's accessible, that your utilities are in the right place. We're a little bit unique in the sense that one of our utilities is seawater. Not all parks are going to have that. But you can think of seawater as another utility like fresh water or electricity. All those utilities you need to think that out properly and arrange your access in a way that makes sense.

**Q: What other activities do you perform when you start, when you have this vision that you want to develop a cluster?**

We might have a situation that might be different for others but we actually have a Master lease for property that's here. We basically lease from the Department of Land and Natural Resources (DLNR). Then we further sublease from that. So we are in a sense a landlord. That is main activities for anyone managing a park, that role of landlord. Basically managing who goes where, managing lease rates... It's an aspect that is really important because if it's a park that is going to be self-sufficient, which we are, we don't depend on the State for operating funds, then you need to have a structure that not only helps and benefits the clients here so that they can grow their businesses but that also allows the park to be self-sustaining. So running the park like a business. Even though we are a state agency we have to have that approach. I think any successful park would probably want to have that approach. Because you can't depend on government funds for ever. Things change, the government can decide to fund other things… We believe it's a good idea to run a park like a business. That is one of the important activities. And because we are an ocean park we also act as a utility for ocean seawater. So we really have these two functions which are equally important and go hand in hand.

**Q: About self-sufficiency. I understood that the State government was pushing for self-sufficiency 1990s. Is that a recent thing or was there focus on self-sufficiency before that?**

In the beginning all of the operating funds were coming from taxpayers. It was basically general state funds, a budget, was allotted to NELHA. In beginning there weren't too many clients, so there is a need at first for some support as park grows.

We are about halfway developed in our development cycle. There is about 20 years of development left to go time wise and geographically. Now we are able to be self-sufficient. The whole self-sufficiency thing started in late 1990s that people started to talk about it. But it's really in years 2000s that it really started happening. We are now self-sufficient since 6-7 years.

When I say self-sufficient I am talking about operating fund. So that's the day to day operations. We do get yearly CIP which are capital investment funds for capital investment projects. Those are for things like building roads, designing infrastructure, expanding our seawater system. They have to do with implementing that infrastructure that are needed to continue developing the park. And for major repairs. We had a couple of pipelines that needed repairs and that's what our CIP funds have been used for.

**Q: CIP funds?**

It is the way the state Hawaii is structured. There are different types of funds. The CIP funds is something that you request on a project base annually. You submit proposals for CIP and they get either accepted or denied. We think that those are going to be decreased [the CIP funds] but it has helped over the years.

*Here I presented and explained the Preliminary Set of Requirements*

**Q: What are your first thoughts about these requirements?**

In order of importance?

**No**

I would agree with all of them. For different clusters there might be a different order. In our particular case resource availability is huge. Most of our clients are here because of the unique resources which would be either our seawater availability or even the fact that were are essentially in a desert with high solar irradiation. So we have natural resources that are really important for all of our business. Without those the clients would not be here. It's that simple. So that's hugely important for us.

Another one that's hugely important is the policy. Create a perfect environment or at least an environment that can help people get started and grow. That one is definitely hugely important.

The opportunities to do business. Of course. You want to be able to sell you products. If you could sell your products locally that's great. But we are also close to the Pacific. That can be disadvantage but it could also be seen as advantage in the sense that we're close to Asia. There are a lot of visitors from Asia. There are a lot opportunities to do business with Asia. So it goes both ways.

Collaboration… I agree that that is important, for some businesses more than others. For example some businesses are direct competitors. On occasions work they together and on occasions they compete for the same customers. We think that that is really healthy. An example that we have here is shrimp broodstock. Several companies do SPF which is Specific Pathogen Free shrimp. They are basically shrimp that are certified disease free. The Park overall has a very high biosecurity policy and within each business as well. That has allowed these businesses to develop these shrimp that are sold as broodstock (they are the mommas and the poppas). They are not sold food, but they are sold to be the start of a shrimp farm elsewhere. Typically in South East Asia. In South East Asia shrimp farms have issues and diseases. They are routinely whipped out by diseases. The shrimp that come from NELHA are disease free and allows them to start up.

40% of a certain type of shrimp that you find in stores come from South East Asia actually come from broodstock that come from NELHA. So it's an important industry that developed. It's kind of a niche industry but it's an important one.

So all these companies are basically competing. But by the same token by them all being located here it's well known in the industry that NELHA broodstock, whatever the company established here at NELHA, is a high value product. So it's branded and marketed as such. There are a couple of niche industries like that that are coming out of our park.

**Q: You asked me about priority of the requirements. Would the specific case define the priority?**

...right. Depending on the type of cluster and park there may be somewhat different priorities. For example, agglomeration effect has been a challenge for us because we are in the middle of nowhere. We are kind of far away from everything. Shipping is expensive, we don't have a university right next to us… We do have a community college but we are not like the Bay Area in San Francisco where you've got a Silicon Valley developing, where you got universities close by… a whole bunch of things that can support that cluster and that industry. We don't have this kind of support. We had to develop… not in vacuum, but we did not have that kind of support.

So it is important, but if what you're developing is unique enough, it is still doable. By establishing ourselves we hope to start agglomerating others around us. So we're kind of the seed right?

**Q: So is it happening (agglomeration)?**

Yes there are certainly more industries that are marine based that are happening here. We are in a pretty small area though. Our park is 870 acres. There are a couple of other businesses that have established themselves that have established, not in our park, yet that are marine based. That's a good thing, but we're not even close to the Silicon Valley equivalent.

On the Big Island two areas really on the science and technology side: astronomy and ocean science. Most of what goes on here is tourism, service industry, and construction. Astronomy is sort of faced with the same thing. They are world known just like we are world known for the type of work that happens with deep seawater. But there's a lot more work to be done to really get to that conglomeration type of concept.

**Q: If I have this start-up company at NELHA and if I need investments, isn't that hard to get at NELHA?**

We have a couple of initiatives at the moment. We got $3 million from the EDA, basically from the federal government, to renovate one of the buildings that we have here. That building is going to serve as an incubation for new start-up projects. The idea is that they would have some outdoor space and at the same time would be able to have office space that they can bring customers and investors to.

Until now that has been limited. With these initiatives that we have in place that will increase the amount of support that we can provide to start-ups. We are also working with a sister agency that is the High Tech Development Corporation. That's a State agency. They run the SPIR grants which are small business grants. They also can provide business services. They're going to help us and have a presence here to provide those types of services to start-up business. So we're going to be increasing amount of support. People had to go to Honolulu which is on a different island to get some of those services.

**Q: How do you explain then that so many companies are successful at NELHA with so little support?**

Sheer perseverance for some of them. The fact that you don't have support does not mean you cannot be successful. It just means it might take you longer. One of our successful companies is Cyanotec Corporation. They are a public company and they have $30 million annual sales revenue. It's a company that is doing really well and expanding. That company has not always been that successful and has it taken 20 years to get there. There's a good chance that their development could have been accelerated with the right type of support but the fact that they did not have that support didn't mean that they did not have a good project and weren't able to become successful eventually.

**Q: Which aspects that are not mentioned by me would you consider to be really important?**

There needs to be an overall plan, a Master Plan which is created on how this is going to come together. I don't know if it should be considered as factor or that it would be something that brings everything together. But it's

pretty important. We went through various different stages and not always did we have a clear direction. We do have one now but it took a while to find itself. I think an important factor in the success would be to have a strong Master Plan right off the bat. A Master Plan is more than a vision. A Master Plan would be more detailed: What are u going to do where? How to attract the various people? How are you going to make this financially viable in the long run?

In our particular case, because we are on the self-sufficiency path, one of the things that our Master Plan addresses is the economic development. The idea is to develop something on the retail side like selling products that are produced on the park. That would be an economic driver and a source of revenue that allows to support projects that are more on a pre-commercial and riskier side. That's an example of something that would be in a Master Plan. The type of approach that you are taking to the whole development.

**Q: So how come NELHA survived so long without such a clear Master Plan?**

We are supported for a long time. We're supported by State funds.

**Q: Are there any other aspects that important that are not mentioned?**

Marketing type of aspects. How are people going to know about your cluster? That is important to accelerate the success of park and your clients. The success of park and success of individual clients are tied together. If the park is successful it will trickle down to clients because you are giving the clients a lot more exposure than they would otherwise. And if the clients are successful the park is going to be more successful as well. Whatever successes you do have, you want to be able to advertise those in the proper trade journals, the proper readings, and etcetera.

**Q: Any more factors?**

Those are all that I can think of right now.

It's easier once you have the snowball effect. So if you have a lot of interest already. What's critical is how do you develop that initial spark, how do you develop the initial interest. Right now we have enough of an existing group of successful companies that that is going to and has been attracting other companies. But you´re looking at a blank piece of land. How do you spark that interest? The marketing strategy is going to be hugely important in the beginning. How to get these businesses? What makes your park special? Why would they come at this park as opposed to an existing one? What differentiates your cluster from what already exists?

**Q: How do you actually attract tenants?**

We have the advantage of being established already. Anyone who knows about deep ocean water probably knows about us. That is one advantage that we have.

We go to conferences, we make presentations, not as much as we should, but it's growing. We are letting be known that this is a good place to do certain types of projects. There is a lot of word of mouth because we are unique. It might be different for tech parks, computer based type of projects and software development… There's quite a bit of those all over the world so with those, maybe you would have a different approach and would probably not rely on word of mouth.

**Q: Does time play a role in shifting the importance of factors?**

There probably is an evolution of types of things you're going to work on as you are developing the park. That said, some of them are... for example agglomeration effects: to some extent you're considering whether you have universities or national labs close by, whether you already have a vibrant economy in that particular

sector. Those things take time to build. Some of these aspects you have to be working on them all the time but you are not going to see results for a while.

But I'd say you need to work on all of them as you go and as you develop the park. You can't you say "Right now I am going to work on resource availability and forget the rest until I get that squared away." It does not work that way. It's more like everything has got to come together. If you can throw a lot of money and a lot people at this early on to get everything developed faster than you would probably be better off as far as developing a park quick. But most people don't have that luxury. Most people have a limited amount of funds and have to make a decision.

All of those things are important. That's the problem. Your resources are important, your infrastructure is important… Clearly nothing is going to happen unless the infrastructure is laid out with plans to build the whole thing out. You have to do that early on. You have to make sure that the policy is right. You cannot attract a company and say: "Oh wait you need to do this €50,000 study before you can even do anything." That person is going right away.

You don't have a choice with those things. There are things that maybe are less important. Maybe collaboration, but even then that might be a way to get companies working. At NELHA we have one company that might start growing seaweed for another company. That allows them to get through a rough passage. You want to make sure that those things can happen right from the start. You cannot say: "No I'm not going to help collaboration." Looking at the factors, I cannot really say that you can put one last. You have to work on everything and move forward on all fronts.

**Q: Is there a lot of collaboration going on?**

Some of the companies are competitors. There is some collaboration. Not as extensive as in a university environment where all the knowledge is completely free. A lot of companies have patents and trade secrets. You have to guard trade secrets very closely. A lot of companies are not too open to having visitors but some of them are not. The types of collaboration you see are some that I have expressed. For example, a company helping another on a type of grow-up situation with some information that they need.

Another example is a company that recently got approval to sublet from an existing desalination company. That company produces performs. Preforms are made of a type of plastic. These preforms get blown up into bottle form and filled with desalinated water. Until recently most of the companies were buying the preforms from the mainland, which costs a lot in shipping. Shipping goes by weight or by volume, whichever gives the most money. That company fabricates the preforms at NELHA. Now they can sell performs to the 4-5 desalination companies at NELHA as well as at the rest of the State of Hawaii. So that type of mutually beneficial type of set up or arrangement is not uncommon where businesses are producing services that help other businesses.

**Q: Is that an initiative of the company that was shipping these performs? Or from somebody who saw this and though: "Hey I can make a business out of this?"**

Probably a combination. Companies who were finding shipping costs excessive were very interested and this one company saw a business opportunity and decided that they would establish themselves.

**Q: Now I have a few questions about some of the individual factors. Can you say something about the availability of skilled people at NELHA?**

That is one of the challenges that the companies face. We don't have any educational programmes that are in the vicinity that would produce folks that have the types of skills needed for some positions here. It has been challenging but there has been progress made on the local community college. We've been working with local

community college to develop programmes and to establish curriculums for technicians. For example aquaculture technicians. It is definitely an important factor.

The higher level position are less challenging. People are willing to move over to Hawaii. If you're looking for a PhD in marine biology or microalgae expert… There is not really an issue with attracting that type of talent.

Retaining is sometimes an issue because people think of Hawaii as a paradise. But once you get here and you have to work, that dampens the whole outlook of paradise a little bit. But people always adapt to the island life. Sometimes retaining is an issue but generally attracting the PhD level types is not really an issue. It is more on the technicians' side. But it has not been an issue to a point that it would cause problems at the companies.

**Q: About the finances. So annually you have to apply for funds from State?**

Yes, think of it as special grant to do a special project. It has to be an infrastructure type of project. Not a general project, not something else.

We don't always get that. This year we may not get anything. It depends on what the State budget is and other plans of the State.

**Q: But do you always receive it when you apply for it?**

Not always. The majority we don't receive. We are occasionally successful of receiving funds.

**Q: Who pays for the infrastructure at NELHA?**

It is important that infrastructure is covered by government funds, at least the initial infrastructure that gives a head start to the whole project. After that, repairs and maintenance are covered from normal operational funds. But the initial upfront capital in order to plan, design and put in place the initial infrastructure is pretty important. State funds and some federal funds were used for the initial infrastructure. The state has put in over $100 million into this park since the 1970s.

**Q: Do tenants have any constraints for using the infrastructure?**

No. We have plenty of [ocean] water. If you would approach our design capacity then you would have to stick to the amount of water that you said you would be using. But now we have plenty of water.

We do have one constraint on freshwater because we use county freshwater. Cyanotech uses a lot of freshwater so we've exceeded the allotment for this area. So for another company that comes in that uses a lot of freshwater we have to find a way to supply that. So we do have that type of constraint and of course people have to pay the rate for the water. But I would not consider that as a constraint.

**Q: About the price of water. I understand that there was some conflict. NELHA was raising the prices because it needs to be self-sufficient and because of rising electricity prices. So NELHA was increasing the prices a lot and tenants were not happy about that.**

Before, the water was subsidised. People were paying a couple of cents when costs were about 15-20 cents to pump the water. That has changed over the years and it was painful for some folks who were used to having subsidised water and subsidised rents.

Now we have a break-even system which means that we don't make money on the deep seawater or surface seawater. It's at a rate of 20 cents/1000 gallons. Freshwater is $4/1000 gallons. So it is still at a very low rate even at the break-even level. We have surcharge. The surcharge handles the increases in electrical cost which we have no control over. It's been at the 20-23 cents for several years at this point.

**Q: How did that process go? It seems that it was unilaterally decided by NELHA.**

Yes I agree that it was a painful process. I wasn't there in early stages so I can't really speak as to what happened there. But there was a series of seawater analyses that were conducted as a result of the pain of raising prices. By the time I joined NELHA there was a seawater committee which included some tenant representatives and members of board of NELHA. The seawater committee looks at in-depth analysis and all the different costs in the seawater system and presents it to Keahole Point Association, the tenants association. The seawater committee works with the tenants association to come to an agreement on the seawater rate.

It really had to do with coming to agreement on the process because the seawater rate is what it is if it is a breakeven system. The process of establishing that cost is what the discussions were about.

At same time there were also some rental rate increases that were really painful. In retrospect it is hard for businesses to go from $100/acre to $500/acre. But if you look at that happening over 20 years, which is essentially what happened except that it didn't happen progressively, then it is not unreasonable. It could have been done in much smoother fashion.

**Q: What I found lacking is a network organisation in which everybody participates. So an organisation in which NELHA is represented as well as the tenants and in which decisions are made together. Would you say that is correct?**

There were those criticisms that were brought up. But from time that I have been involved there was a process that allowed for input from anybody who wanted to input. It lasted about 2 years.

We are going through another seawater analysis right now. We now have system can collect a lot more data and we are now able to do seawater analyses on 15 minute intervals as opposed to monthly intervals. We are continually working on that and are continually presenting that to the board. We had a KPA [tenants' association] meeting just a month ago. Only 4 people showed up but it was open to anybody who wanted to give input. Certainly in the last 8 years there was a process by which everybody could contribute to how seawater rates are calculated.

**Q: Is there any park management network or park network where everybody is represented that provides input on multiple issues and not just on water rates. Or is it more ad hoc networks in other cases?**

Possibly more ad hoc although we do have structured brown bag meetings on a monthly basis. We've been creating those as an opportunity for people from the park to meet. There are different topics at these meetings. Some of them are about NELHA and some of them are completely different topics that may be of interest or visiting scientists. The idea is that those provide an opportunity for people to network and to talk about the park in general. Our experience has been though that when you have start-up you have so much on your hands. You're so busy that you don't have not much time for things that do not have to do immediately with your own projects. So we're finding that many of the opportunities that we try to make available are not always taken up. On some of these meetings maybe twelve or a little bit more people show up while several hundreds of people are working at the park.

Also, some of the businesses are very different from each other. The desalination businesses have very different requirements, issues, and problems than people who are growing algae or the people that are growing shrimp. So there's not always a lot of overlap. That might be particular to our park than a different cluster. Like if you're doing software development, there may be more of an overlap and people may find more value in discussing their various issues.

## A2 – Interview Keith Olson

**Q: Can you introduce yourself?**

My name is Keith Olson. I started in 2007 at NELHA and in June I work 8 years at NELHA. In the past I worked as laboratory manager for the water quality lab, now I am Chief Science Officer at NELHA. I manage the environmental lab at NELHA and together with Laurence Sombardier I just implemented a SCADA programme (Supervisory Control and Data Acquisition programme) to collect all of the various variables on the seawater distribution system.

**Q: Do you consider HOST Park to be a success? Why (not)?**

HOST Park is a success. Executive Director Greg Barbour puts it best: At NELHA we turned lava flow, which has little economic value, to a 120 million dollar annual economic driver in aquaculture and green energy technologies.

**Q: Which factors contributed to this success?**

Three factors contributed to this success: persistence, luck and natural resources. Persistence because it took a long time to get NELHA where it is right now. The management, political will and the government stimulus all contributed. The initiative started in 1974 and the organisation is where it is today because of many people involved not giving up on the ideal of an OTEC facility and on aquaculture.

Luck contributed to the success of NELHA because the organisation would not exist if there was not the oil crisis in the 1970s. Finally, the resources are very important for the success of the park. At HOST Park deep seawater is pumped up easily and it can be supplied with a temperature from 5$^{o}$C to 20-25$^{o}$C.

*Here I presented and explained the Preliminary Set of Requirements*

**Q: What do you think of this set of Requirements?**

This set is fantastic. It captures very well what is going on at HOST Park.

**Q: Could you give your opinion on how each factor individually applies to HOST Park?**

*Resource availability*

Human capital and financial capital do not do very well at HOST Park. Human capital comes from other places. HOST Park is located in an isolated area. There is not a university around the way. There is a lack of education preparing people for the job at HOST Park. That is solved by bringing in people from around the world.

At HOST Park it is not like there are venture capitalists like in Silicon Valley. NELHA is just starting this kind of way. It was state funded and is now moving to self-sufficiency.

*Agglomeration effects*

A pool of ocean related specialised labour is definitely being created. Such a pool is created by experience and by people staying in the cluster when they jump jobs. They go from one organisation to another in the same cluster.

Supporting industries and suppliers are just beginning to be attracted. This is contributed to policy changes. In the past a company could only propose a project if they were using the water or solar insolent. The policy is changing slowly. For example, algae companies need $CO_2$ in addition to seawater. Previously $CO_2$ facilities would not be allowed. Now such facilities would be allowed.

Another example is that nowadays there is a company at HOST Park that makes the preforms for plastic water bottles for the companies that produce bottled water at HOST Park. This company would be considered a supporting industry or supplier to the other companies.

There is not a lot of technological spillover going on at HOST Park. Companies are located at HOST Park specifically for the resources, not to perform other activities. There is some collaboration on aquaculture things but that is hit and miss. A lot of times companies are competing and are not willing to collaborate.

*Policy*

There are some policy changes. Up to 5-7 years ago the policy was very specific that companies had to use the water or other resources. The policy may have been limiting. Things were not looked at in an open minded way. Today people are given opportunities to propose projects that may not have fit in the past. In the past the proposals had to fit a very narrow scope.

The policy changed because NELHA changed. When it was a government agency that was funded it was very strict in its policy. Now NELHA has to be self-sustaining. The organisation has to make money to sustain itself. It hast to take more risks in order to keep the facility going and it has to give people opportunities to propose projects that would not have been allowed in the past.

The policy is morphing from a strict, top-down policy to a more bottom-up, open minded policy. This is happening over the last 10 years as an effect of being self-sustaining.

*Network*

Networking between tenants is happening on a limited side. Networking at HOST Park is more peer to peer. There is no formal network of people that come together. We have been trying to do that over the last few years with for example, brown bag lunches. There were also other events at NELHA to bring the clients together to create an environment where people could discuss things and meet each other. But is has been hard because people do their work and go home. The people here have established businesses and are not looking for the next idea.

**Q: I would expect in a commercial setting that people would always be looking for business opportunities.**

Maybe it is Hawaii style. Big Island is very isolated. People tend to do what they do and that is what they do. It is more of a laidback style. People on the island make enough money to survive and are not looking aggressively for business opportunities compared to people on the mainland.

There are some examples however. Some companies use one company to sell their products and to process to products (e.g. fish). But it is not at the level that I would expect if I was in the mainland.

**Q: Is HOST Park isolated or is the island isolated?**

Both. When people think of Hawaii they think of O'ahu where about a million people are living on a small island. On Big Island there is a low population. Only 200,000 people live on the island. There are only 3 population centres and they are far apart from each other. NELHA is an out of town, remote location. So it is isolated, isolated, isolated.

**Q: And still you managed to get the park going?**

That's the lucky amazing part. Luck is that someone had the vision to place a park here where we have a low population centre and it has attracted talented, technical people from all around the world to make it work. We don´t have a college or centre of knowledge here.

I worked at Berkeley Lab next to Berkeley University. There, research is going on, people are collaborating and ideas are flying back and forth. It is part of that culture to have the ability to talk to highly educated people. We don't really have that here.

If you look at the northern part of Norway. If you put something over there on a fjord, would it be possible to attract the people, the talent and the investment over there?

The availability of resources is key. That is why, say an oil platform off of Scotland does well. Because of resources they can cluster together. It´s the resources that´s driving it, not the knowledge.

**Q: At NELHA, is there a network where everybody is represented?**

Yes. There is the Keahole Point Association, a client's association. The clients are also represented at the board of NELHA. Usually a report is received from Keahole client's association. This report contains issues, things the clients want to discuss, and input from clients to the board of directors. Most of the time there is nothing on the report, but sometimes there is input to the board. There are also two people sitting on the board since 3-4 years ago.

**Q: What about collaboration and business opportunities at NELHA?**

Knowledge sharing is hard since many tenants are competing with each other.

**Q: So how are business opportunities discovered?**

The discovery of business opportunities happens due to the entrepreneurial spirit of the people. Hawaii has many visiting people and many of these visitors have the desire to stay. They try figure out how to stay there. It is that desire to stay and based knowledge in marine sciences and alternative energies that results in discoveries of opportunities for doing business.

There is not a typical way people end up at NELHA. From a business point of view it does not make sense to stay in Hawaii: the taxes are high, there is a lot of regulation, it is difficult to do business, it is difficult to survive, and the costs of living are high.

**Q: What were the priorities of NELHA during the development of HOST Park?**

The mission statement captures the priorities:

*"To develop and diversify the Hawaii economy by providing resources and facilities for energy and ocean-related research, education, and commercial activities in an environmentally sound and culturally sensitive manner."*

The stated priority is economic diversification and the reason for the facility is for natural energy production. And because of the pipeline resources that were put down for the OTEC facility, the commercialisation of aquaculture and other ocean related sciences has happened.

The priority changed over time. In the early days the priority was energy. In 1974 there was the oil crisis and people realised that other sources of energy were needed. So that was the priority and that was what put the infrastructure in.

Then the oil prices dropped in the 1990s and during that period of time it did not make sense anymore to do OTEC research. So aquaculture carried the day because they were using the infrastructure for generation of food and other aquaculture products.

Then NELHA was mandated to be self-sustaining. That changed the priorities to making money, to keep jobs.

**Q: Which aspects that are not mentioned would you consider to be of absolute importance?**

That is hard to answer. Absolutely important today is the whole idea of self-sustaining.

**Q: Do you think application of this set would be enough to get a cluster going, to let a cluster emerge?**

I would think that what we really don't do that you have listed is the networking. It's really in the agglomeration. Clusters work best when you have synergies, a group of people that are doing similar stuff. An analogy: if you go furniture shopping, you will probably go to location where multiple furniture stores are clustered together. You're competing with each other for the same customer, but being in the cluster leads to more customers. And then there are probably synergies that could occur. Maybe the centre has one truck that delivers to everybody instead of each of the stores having a single truck. So there are economies of scale and synergies. It's all about net worth and bringing people together.

**Q: If you don't have the resources, the money and the time, how do you make it happen?**

It really starts with the vision. At NELHA someone had to come up with a vision and express that vision and see if he could get the network going with similarly thinking people. Then it was about finding the money and the resources to make it all happen. But it really started with the vision to put an OTEC facility here. Without that vision nothing would have happened. The vision would lead you to the resources.

**Q: How did the factors develop over time?**

It developed because of the vision and then the policy to make alternative energy more prevalent. Probably a network then occurred and that's probably in collaboration with universities and national labs. The resources were identified and facilities, money and capital were put in. Then agglomeration effects occurred after all that infrastructure was put in place.

Then came the idea that the water could have alternative uses other than energy creation. The policy had to change. This created the business opportunity for people to come in to create their own businesses using the resources and the infrastructure that was laid down.

**Q: Are there any phases that can be distinguished in the development of HOST Park?**

Three phases can be distinguished at NELHA. In the first phase the oil crisis created the seed money and capital to use the natural resources.

When the oil crisis dropped other opportunities were needed to keep the facility going. Aquaculture activities were being developed. The third phase started when NELHA was mandated to be self-sustaining. Since then it is managed like a private sector facility. In each of these phases the criteria you identified come in to play.

# Appendix B – Interviews Biopark Terneuzen

## B1 – Interview Gijsbrecht Gunter

**Q: Can you introduce yourself?**

My name is Gijsbrecht Gunter. I work at Yara for three years now. I participated in the development of Biopark Terneuzen and colleagues shared their experiences. I have a technical background. Before I worked at a development company which was closely involved in the development of Biopark Terneuzen. At Yara I am responsible for external relations and communications. I represent Yara nationally and in the region.

Yara is a Norwegian company. The Norwegian government is owner of 40% of the shares. Yara has production facilities and sales departments in 50 countries and sells its products in more than 150 countries (out of a total of 193 countries in the world). Sluiskil is one of the largest production facilities with an area of 150 ha.

I don't know if you know a lot about how fertiliser is made but fertiliser is made of natural gas. We create ammonia from natural gas. The main product groups that we create from ammonia are nitric acid, ammonia nitrate, and urea. $CO_2$ is a by-product of these processes. Part of the $CO_2$ is sold to companies like Coca Cola or to beer brewers and a large part of the $CO_2$ is used for the production of urea. Ammonia + $CO_2$ makes urea under certain process conditions.

Another part of the $CO_2$ goes directly to the greenhouses. One pipe is used for the $CO_2$ other pipes make a return trip. $CO_2$ and residual heat with a temperature of 90-87 °C goes to the greenhouses. After the greenhouses are heated the heat returns at a temperature of 40 °C.

**Q: Why did Yara decide to exchange heat and $CO_2$ with the greenhouses?**

Yara located in this area in 1929. Locating here was no coincidence. A cokes facility was already located here. The gas from the cokes oven served as an input resource for Yara. In the 1960s Yara switched to natural gas as input resource. The origin of the natural gas is mainly from the North Sea. A small part of it comes from Groningen. Already in 1929 there was symbiosis. That was the reason for Yara to locate in this area.

The same is happening today with heat and $CO_2$. We are reaching the boundaries of energy efficiency. First you look for solutions and opportunities within the boundaries of the firm. Then you look outside of the firm for opportunities to be more energy efficient from the perspective of sustainability. For a company it is a huge step to engage in activities outside of the boundary of the firm. Sustainability is the most important motive for this because of the concept of 3Ps: People, Planet, and Profit.

For us profit means that we try to maximise the valorisation of our product so we do something with the residual heat. For greenhouses it is a benefit because this residual heat is cheaper than the heat from natural gas.

People means that we create strong ties between the facilities and the region. We try to retain employment at Yara and we create new jobs in the greenhouses. Depending on the product, on average, a greenhouse creates 4-8 FTE/hectare which are 600-1200 jobs. For ease of use I will say 800-1000 jobs.

Planet for us means that in total this project has saved 135,000 tonnes of $CO_2$. It is the only location that uses both $CO_2$ and heat. If conventional solutions would be used there would be a pipe to the greenhouses for natural gas. 55,000,000 $m^3$/year would be needed which is equivalent to 35,000 households. That is 20% of the

households in the Province of Zeeland. So this project saves the amount of natural gas equivalent to the amount that 20% of the households in the Province of Zeeland would use.

**Q: I would expect that the most important reason for Yara would be profits, with a considerably important additional sustainability benefit …**

We don´t consider sustainability separately. There are profits in sustainability. We really believe in the concept of 3Ps.

**Q: How were the exchanges financed?**

You should ask Zeeland Seaports. They can tell you a lot more on the financing. This project took ten years to really take off. That is a learning point: these types of projects are not realised in a whiff. The zoning plans had to be adapted to allow development of greenhouses. Then there was a financial crisis and an EHEC [bacteria] crisis in the greenhouse sector which affected tomatoes and cucumbers.

Eventually Zeeland Seaports vouched for a large sum of money. The total investments for the infrastructure totalled to nearly €80 million, the pipelines were laid to enable exchanges, and a public limited liability company was created: WarmCO. Yara supplies to WarmCO and WarmCO supplies to the greenhouses. WarmCO deals with the greenhouses not Yara. Yara wants to focus on its core business of producing artificial fertilisers and industrial chemicals. We own 20% of the shares of WarmCO.

**Q: How does WarmCO get its financial means? Do the shareholders supply that?**

No. There is a lot of external financing in which Zeeland Seaports vouches for WarmCO.

**Q: What is the scale of knowledge sharing between the companies at Biopark Terneuzen?**

Knowledge sharing happens on multiple levels. The people from the greenhouses visit Yara and vice versa. We show each other what has been realised and we share information about energy efficiency. We also share ideas about how new business activities can be developed.

In a broader sense the project leads to a situation in which companies talk with each other. Questions are being raised such as: Are there opportunities to create linkages? Which processes does this company use? What are issues you come across? What are the challenges you face in the future? What are common challenges? Biopark Terneuzen facilitates this interaction. Now the companies interact with each other whereas before we would drive past companies without even knowing what they were about.

Knowledge sharing also happens in an even broader sense. Biopark Terneuzen for example, organises participation gatherings with inspirational speakers and sessions with interesting subjects. These activities are inspired by national and regional developments. Biopark Terneuzen tries to bring parties together. The goal is collaboration and strengthening of the cluster.

**Q: What are other ways in which knowledge transfer is facilitated?**

There are participation gatherings at the Training Centre or at the Pilot Plant. There are activities on smaller scale, between companies. These are bilateral activities about technical matter.

**Q: Are there more alliances or joint ventures besides WarmCO?**

There are certainly a couple in development but the only big one that is truly realised, with external parties, is WarmCO. Although Cargill acquired Nedalco. Nedalco was a bio alcohol factory next to Cargill. It used residual streams from Cargill to produce the bio alcohol. Cargill produces starch from grains.

There are new developments. DOW Chemical is taking the lead in creating a Smart Delta Resource initiative. The companies in this region use 25% of the Dutch natural gas. How can we operate more efficiently? So there are many developments but WarmCO has showed us that developments can take a long time.

**Q: And that wasn't expected?**

The first talks were in 1999-2000. Many things activities were performed concurrently. Especially policy developments and zoning plans developments. These are lengthy procedures anyhow. Especially if plans change in between.

**Q: How hard or how easy was it to attract skilled workers?**

Yara did not need additional people. The needed linkages for the exchanges at Yara were created in the factory. It is a full automatic system; no additional employees are needed for the supply of head and $CO_2$. The greenhouses did need additional people for harvesting for example. They need 4-8 FTE/hectare/year depending on the systems and on the crops.

**Q: You did need people to create the linkages for the exchanges right?**

Yes but that is project based. An engineering firm is hired, calculations are done, there is guidance from Yara, and when the plant shuts down for maintenance the project is executed. It is important to have enthusiastic people internally that want to work on these projects. People are very important for these kind of development.

**Q: What role does Biopark Terneuzen have?**

To us it is a platform in which you meet and interact with other companies from inside an outside of the region. It helps in realising innovations. Biopark Terneuzen facilitates for example by organising network events.

But Biopark Terneuzen is also a flag [label]. The developments in the region are done using the label of Biopark Terneuzen. It gives a certain entity to the activities and makes it possible to talk about it. It makes the activities recognisable. Biopark Terneuzen is easier recognised than an individual firm.

**Q: So there is no policy?**

Certainly at Biopark Terneuzen there is. Zeeland Seaports is actually the owner of Biopark Terneuzen and we participate in it. We do not interfere with the policy of Biopark Terneuzen as such. As a participant you have influence on the policy but we are not Biopark Terneuzen.

**Q: So the role of Biopark Terneuzen is to offer a platform and to connect people?**

Yes and maybe also help arranging funds and green deals and more. Biopark Terneuzen is managed by Zeeland Seaports. It is the natural party to manage Biopark Terneuzen.

**Q: What about supporting industries and suppliers? Did things change as a result of the development of the cluster?**

Yes but those are separate developments. For example the Maintenance Value Park at Terneuzen. That is an initiative in which contractors and suppliers: share knowledge about subjects like preventive maintenance programmes, discuss issues, develop innovations together, etc. Biopark Terneuzen is about linking waste streams and Maintenance Value Park is about maintenance.

**Q: Are these projects being developed in parallel?**

Yes.

**Q: Do you think Biopark Terneuzen is a success?**

Yes.

**Q: Why do you think that? I for example, understand that there are financial problems at multiple plants on the terrain of HEROS and at the Training Centre.**

The Training Centre was initiated by the government. They thought there would be a need for many bio process engineers and that they would need another type of education. That is not the case and we as company never said that.

The learning point here is that you should consult the market before you decide to develop something like that. But it will be fine. The Training Centre is broadening its scope and offers solutions to more fields than just the bio based economy.

At HEROS the biodiesel plant and the fermenting plant are both shut down. Each has its own reason. So be it.

On the other hand this is the only region in the Netherlands in which there is invested and things happen on such a large scale. Everybody who visits this area says that. Millions of euros were invested, linkages were created, you can actually see the exchanges, and we have a good track record. Which other area in the Netherlands have this? And more developments are in the pipeline. So yes there is definitely success. WarmCO had its problems as well because people had difficulties selling their greenhouses at other locations so that they could locate here. In 2018 eventually, the whole area of 150 hectares will be completely filled up. That I call success. Another success is the acquisition of Nedalco by Cargill.

There are also some smaller projects. At Yara we are treating waste water from our processes. Other companies are interested in the biomass that is created in the process of treating waste water. This is a €1 million project that will run for three years. That is why it is a success: people are communicating, new initiatives emerge, things are actually happening, and together we are going to a circular economy.

There were some failures as well, but that is inevitable. I don't know of any other area in the Netherlands where things are happening on this scale. Most of the time it is only talk, not doing.

**Q: Which factors have made this project successful?**

Mainly people

**Q: Why?**

Because if you don't interact with each other nothing will happen. You need to inform each other, there was trust, you need to know what issues there are, you need to think solutions for each other, and you need to think in opportunities.

What was important as well is the great location: there is a canal, there are roads, existing pipelines, and there is a diversity of non-competing companies which makes it possible to create linkages.

**Q: So it is the culture?**

Yes the culture in addition to the assets of the area itself: the infrastructure and the diversity of companies.

**Q: How did this culture emerge? Why here?**

People know each other, people trust each other… I don't know why.

**Q: Was there a certain approach?**

No it was mainly enthusiasm, openness, and transparency. It also helped that we weren't competitors. There was trust and sincerity.

**Q: To what extent is this generally applicable?**

It is applicable to any area that has a diversity of companies. In which there is enough trust to think about business cases together. Because eventually it goes from informing each other to business cases.

Eventually the economy is about sources and connections. Companies and stakeholders can be seen as the sources and Biopark Terneuzen helps creating connections. These need to be solid connections on the base of transparency and trust. If you can create that these sources grow and feed each other and clusters form. So this can be created elsewhere if there are sources and connections.

## B2 – Interview Van de Bunt

**I interviewed Maikki Huurdeman and Mark van Waes. I chose not to attribute remarks to them individually but rather to interview Van de Bunt as one entity.**

**Q: Can you introduce yourself?**

I will first explain how Van de Bunt got involved in the project. It all started with the Province of Zeeland. They had a vision for the Province of Zeeland and said: "We are going to do something with clusters." Clusters were starting to become fashionable. There were some initiatives. Then they hired Van de Bunt to explore the possibilities regarding clusters in the Province. We then conversed with many parties in Zeeland and close to Zeeland. We were investigation potential for clusters. The potato farmers were not interested and the tomato growers wanted to do something that included the cogeneration of energy and heat. For them it wasn't interesting to get their energy from elsewhere because they already had the needed equipment. We also investigated the onion growers.

During these interactions we stumbled upon a proposed linkage. Greenhouses were in development in the Province. They were thinking about getting the needed heat and $CO_2$ from the fertilizer plant of Yara. It was all plans, the greenhouses were not constructed yet.

Because of the conversations with other companies we had the opinion that more was possible. Heros was about waste water treatment, Nedalco was thinking about constructing another facility in the region for the production of ethanol, there was a factory for biodiesel… All of these were having their own plans. They were not seeing the connections yet. Heros and Yara for example, were located next to each other and did not know what each of them were doing. These companies were literally separated by a fence.

We mapped all of this out for the Province and told them there might be potential in creating more linkages than just between the greenhouses and the fertilizer plant. We then set up a project at TransForum Agro en Groen. Together with the parties in the area and with Wageningen University, Zeeland Seaports, and Frans Boekema of Radboud University we filed an application. TransForum required links between science, business, and municipality. The TransForum programme was intended to do science steered by requests from businesses.

The project was granted and 15-18 parties were participating and contributed time and capital. TransForum also added capital. The goal of the project was to investigate if linkages between the parties would be possible and feasible. For example: Would the $CO_2$ from Yara be suited for cultivation of tomatoes? Was it possible to feedback water? Those kind of questions.

The project ran for two years in 2005-2007. We were examining the feasibility of linkages and if the group could be organised. That was the start of Biopark Terneuzen.

**Q: How did you get these parties to file a request together? That is a lot of parties.**

Simple. It was lucrative for them. Of every euro they contributed they would get a return with a value of 2-3 euros because of the subsidy.

**Q: from the feasibility study itself or if the project would be realised eventually?**

From the feasibility itself. They did not literally receive cash. The universities were doing the research and they were paid for it. The companies could research let them research things like the feasibility of using the $CO_2$ from the fertiliser plant in the greenhouses. All they had to do was to pay their deposit in the beginning. They would not need to have to pay extra if they wanted something investigated.

There was a total budget of close to €400,000. About a third came from the companies and Zeeland Seaports and about two thirds from TransForum. So for every euro the companies put in they would receive something with a value of 2-3 euros. There was a positive return so they were willing to invest.

**Q: So would get knowledge first and if the project was going to be realised they would generate revenues?**

Knowledge yes. But if they would have wanted the research performed individually they would have to pay at least the same amount but probably more. It was favourable to join.

So close to €400,000 during two years. Then Biopark Terneuzen was created as organisation. The parties saw that a cluster could bring benefits so they created an organisation. Zeeland Seaports took over the leading role from Van de Bunt.

While we were creating this kind of bio cluster in Zeeland we found out that they were doing something similar in Ghent, Belgium. Eventually Bio Base Europe was created. Biopark Terneuzen is one of the founding fathers of Bio Base Europe. Ghent Bio Energy Valley is another founding father. Bio Base Europe is not about creating linkages. It a Pilot Plant in Belgium and a Training Centre in the Netherlands.

Van de Bunt was also involved in Bio Base Europe as driving force connecting parties with each other. We experienced the construction of the Training Centre and the Pilot Plant. Until six months ago Mark was interim director at the Training Centre.

**Q: What is the current status of Biopark Terneuzen?**

Linkages are realised, $CO_2$ and heat is flowing to the greenhouses, there is almost 250 hectares of greenhouses, water treatment linkages have been realised. Those are the most important physical linkages. There were fairly large amounts of investments in the range of €40-60 million. The Pilot Plant is running for almost five years now and they are now scaling up. At the Training Centre the large companies have become shareholders.

**Q: To what extent is Biopark Terneuzen a success?**

It depends on the criteria you use. If you look at the Netherlands, are there similar projects on this scale? Many times projects have stopped at the planning phase. At Biopark Terneuzen many linkages have been realised. If that is the criteria, then yes, it is a success.

Physical linkages have been created. The Training Centre, in which all companies do their personnel trainings, is a cooperative. Flemish companies have also joined and the Pilot Plant is running. In that sense the project is a success.

What is still a challenge is the collaboration between the Flemish and the Dutch. The borders seems to be a threshold for many things. Definitely for the way of doing business.

**Q: Do you have an example?**

The way we interact. There is much to tell about that, the cultural differences between the Dutch and the Flemish. The way this interview came about for example, is very Dutch. You look around, you call and ask if you can come by, we say yes, and now you're here. That is very Dutch. That would have been more difficult in Flanders. It would have been more indirect. First you would have looked for people who would know us and ask if they could introduce you to me. It would have been more networking. It would have been more indirect in the opinion of the Dutch.

**Q: What were the priorities during the development of Biopark Terneuzen?**

TransForum had some conditions: there had to be research, it had to be guided by demand from business… So the conditions were the priorities. We were also looking at the potential for the future but within the project there were things that we just had to do. When the project was finished we had more freedom. But a party that guides the collaboration was still needed. In this case that was Zeeland Seaports.

**Q: But what was the focus then?**

Well can you tell us something about the factors you have come across in literature?

**Q: I actually wanted to get your input without influencing it by saying what I found… I want to find out what are the conditions for the creation of certain clusters. Can you tell me something about available resources on site?**

In this case we looked at what was already there and what was planned like the bioethanol plant which eventually was not built and greenhouses. We looked for opportunities with the current resources and the planned resources.

**Q: Can you tell me something about the policy?**

In this case the Province wanted to know how the area could be made more attractive with clusters. We did some studies. The Province was the stimulating factor.

**Q: That was how and why things started. What is the policy at Biopark Terneuzen?**

Eventually Zeeland Seaports is managing Biopark Terneuzen. There is a lot that is written about clusters. Biopark Terneuzen is one of the few realised projects. The greenhouse complex at Wieringermeer looks a bit like this project but is much smaller. They were tweaking endlessly on a complex close to Venlo. A couple of clusters that are different are Brainpark Eindhoven and the old DSM site in South Limburg.

Policy makers want clusters and hope that if you do this and that that a cluster emerges. My conclusion is that it does not work like that. You have to have luck on certain things- there are many coincidences. The people believing that everything can be designed will not be happy with my remarks.

We've mentioned some conditions for creating a cluster. If I think back… a government that supports projects with funds like TransForum did is very important. Because without the funds from TransForum nothing would have happened. It is important that governmental organisations (not municipalities and provinces because they cannot do that much) like Zeeland Seaports are run like businesses. Such organisations can make things happen because they have the means. They can take decisions and are not trapped in a stance, State, city council and those kind of things. These organisations can play an important role.

Then you need the industry: parties like Van de Bunt, large industrials. DOW, for example, thought it was important to do something together and they have the resources to do something (the funds and the people).

You need facilitators that know how to connect people. You need to have an idea on how to create such a cluster because a cluster is not hierarchical. Van de Bunt had that role. You interact with each other without somebody directing the interaction. There is no boss. There needs to be something that makes these people want to work with each other.

You need little engines, people who tell the story over and over again, people who create opportunities for parties to come together, people who paint a picture. The funds help. The have to put in money but if the government puts in funds it lower the threshold.

What we did not succeed in is the collaboration between the Flemish and the Dutch. There is a collaboration but not an extensive one. At the New Year reception at Zeeland Seaport there were 500 people of which 10

Flemish people. You can actually see the towers of Ghent from Terneuzen! That's how close the two cities are located. At the New Year reception in the port of Ghent there were 2000 people of which 20 Dutch people. So the sides do not really interact with each other. That was more difficult than we anticipated. On paper there seems to be more collaboration than there actually is.

**Q: But why? I assume there are many benefits to collaboration between the Dutch and the Flemish in that area?**

Well, not that many. You have to look at the interests of the parties. Clusters as such do not really interest people. What is interesting is that companies have to train their employees. Well, they can now collaborate on that. What is also convenient is to collaborate in maintenance or in sustaining the regional educational centre. Those are direct and easy to spot benefits. In the collaboration between the Dutch and the Flemish there are no such direct and easy to spot benefits.

Eventually a collaboration emerged because otherwise there would be two pilot plants very close to each other, one on each side of the border. There would not be enough work to actually keep these two plants live. That was the initial reason to merge the plans.

So it is about interests: the training of employees, business benefits as the result of exchanging streams, if you want to experiment you don't need to go to Delft or Paris anymore since there is now a plant just around the corner. Those are in the first circle of direct interests. Basically parties ask: what's in it for me.

Then there is a larger second circle of interest: the idea that we should do something together. There it starts to get more ambiguous. If there is no first ring [of direct, clear benefits] then there will be no second [ring of indirect, somewhat ambiguous benefits]. The whole idea of "if we interact with each other we will see the added value" has to start with "what's in it for me". That's the role we play. We identify opportunities, we help in attracting funds. Many things were that practical.

Other parties such as politicians and governments are more about the visions. The visions help but are not enough. You really need companies that also want to put in practice.

**Q: How were the resource exchanges at Biopark Terneuzen created?**

It was all very practical. $CO_2$ was being emitted at Yara. European legislation demanded lower emissions. A solution was to transport $CO_2$ to greenhouses. Then they were thinking about the feasibility of creating greenhouses. They found out that greenhouses would fit very well in the land policies of Zeeland Seaports because they had land on which industries would not be developed on in the near future. Then feasibility studies were performed in the TransForum project: Is the $CO_2$ suited to be used in the greenhouses? What kind of pipelines will be needed? What kind of infrastructure will be needed? The exchange of resources turned out to be feasible and after the TransForum project was finished they realised it. The exchanges were not realised by Biopark Terneuzen but by the individual companies.

It is a myth that companies don't know each other and that civil servants will tell them how the companies should do it and that everything will turn up just fine. It doesn't work that way. Many times people know each other through informal contacts and use these informal contacts when needed.

**Q: What is the role of Biopark Terneuzen?**

Biopark Terneuzen is not a role. It is the result. Parties got together, did some things and put a label on it. That was also a condition set by TransForum to create an entity together.

**Q: And what role does Zeeland Seaports have in the whole story?**

They are the stimulator. At first we [Van de Bunt] were the motivators but Zeeland Seaports took over that role when Biopark Terneuzen emerged. They make sure that the companies keep interacting.

You can compare it with the formation of a governments. You have rounds. First you see if people like the idea. Then you see if you can acquire funds. It goes step-by-step. There is no grand design.

While Biopark Terneuzen was being created, Biopark Terneuzen was founding Bio Base Europe. Coincidentally people found out that there was a similar initiative on the other side of the border.

**Q: You were talking about €40-60 million worth of investments…**

Yes. These were investments to create exchanges. These investments were made by the companies themselves because of the direct benefits. These investments were not made by Biopark Terneuzen.

**Q: Were these companies considering other reasons besides business reasons?**

Not it was mainly for business reasons. It's very simple: Yara emits $CO_2$, European legislation tells them they cannot do that anymore, Yara looks for solutions. Yara also had cooling water that was flowing into the canal, they could not do that anymore, they thought about solutions and thought that that water might be usable for greenhouses. There were no greenhouses yet, so they were created.

So it has nothing to do with bio parks or clusters. It has to do with real problems companies deal with in which they look for opportunities to solve them together. There is no design. People think clusters are designs. "We design one and then it's created." It doesn't work that way. They emerge when they serve interests. A cluster is the end of a story, never the beginning.

**Q: Did supporting services and suppliers emerge as a result of the creation of Biopark Terneuzen?**

No. Actually, you might call Biopark Terneuzen a supporting service. Because of business reasons these exchanges came about. Because of these exchanges they are prepared to interact with each other under the label of Biopark Terneuzen. Maybe other projects will emerge but if those business reasons are not served they will not be prepared to interact.

**Q: But the companies really seem to collaborate now and there is also a focus on creating a bio based economy…**

Even that… Bio based economy is a marketing label to attract more of these types of companies. DOW has nothing to do with bio based; they make plastics. They participate because of the joint training. You might say Biopark Terneuzen is a marketing label.

**Q: I can imagine that if at a certain location companies see many activities around one theme that they would be attracted to that location…**

That is possible but again, that would be for business reasons. For example, a by-product of biodiesel production is glycerine. There are companies that locate close to biodiesel plants because of this glycerine. There are companies investigating options to move to the area. They will not move to be part of the bio based economy'. They will move because they need glycerine.

**Q: On knowledge exchange. Biopark Terneuzen connects companies on the basis of mutual benefits. Do the companies then start to share knowledge?**

Well everybody uses the label of Biopark Terneuzen for their own benefit. Zeeland Seaports uses it as a marketing tool to attract other companies to the area and to have a connecting role in the area. When the

companies come together and see what the possibilities something might emerge. But there is no design. There is no director or central boss. Things grow chaotically.

**Q: Is knowledge being shared based on self-interest?**

Yes. For example, there is collaboration at the Training Centre. But it was created because the companies recognised that they all trained their employees. The classes were half full. They recognised that if they would put everybody together during training they would save 30% of the costs. That is why they do it.

**Q: Are there any events to get the companies to talk with each other?**

More traditional gatherings like New Year receptions and meeting on practical matter. But there are not that many gatherings. Again, people would only participate out of self-interest. The board of Biopark Terneuzen meets twice a year.

**Q: What are new opportunities for Biopark Terneuzen? Are they done when all the possible exchanges are realised?**

There are no clear new opportunities. If you collaborate on training your employees it would be logical to consider other opportunities to collaborate. But there are no other clear new opportunities. The progresses is very incremental and practical.

Clusters are never arranged marriages, they are always love marriages.

You need to like and trust each other. There needs to be self-interest. Then you do something together.

**Q: What about alliances and joint ventures?**

Sometimes governments or subsidy givers require collaboration or the creation of an alliance for society's sake. Often is does not work. The alliance should serve the goals of the participants. If such an alliance would not serve a purpose there will be no commitment to make it into a success. Complementarity and free will are very important conditions.

**Q: Was that the case with WarmCO?**

WarmCO was created for practical reasons. Yara could have paid for and laid the pipelines. The greenhouses could have done it. They decided to do it together and created WarmCO.

**Q: Are there more examples of alliances or collaborations?**

Biopark Terneuzen itself is an alliance. Besides WarmCO there are no other alliances. But WarmCO was created for practical reasons.

If you just want to do a transaction between companies you don't need an alliance. In this case there was a need for an infrastructure. That is why WarmCO was created.

The Training Centre is a cooperative but it could also be considered as an alliance. Biopark Terneuzen is a foundation. These are all legal forms that are the result. It is never the goal in itself to create certain legal form.

**Q: How hard or how easy was it to attract new people?**

Not many new employees were needed. Yara just had an emission problem they needed solved. The owners of greenhouses are just entrepreneurs who need their employees. The biodiesel plant is an entrepreneur who needed his employees. Employees have not been an issue.

**Q: What kind of training does the Training Centre provide?**

An operator by law has to follow at least 15 training courses each year like a pilot, doctor, or nurse. That goes for every operator around the world. It is registered who did what training. People need to be able to deal with compressed air, to extinguish fires, etc. Together there are 800-900 operators in the area. That is a huge amount of training courses.

**Q: Can you tell me more about the financial troubles at the Training Centre?**

There are problems at one part of the Training Centre. The Centre has a couple of goals. One is to train and to educate. This part goes well. There is a new building of which rooms can be rented and that is going OK.

Another part of the Training Centre is an exhibition space. That exhibition was a condition set by the Province and by Zeeland Seaports. The costs of running this exhibition were underestimated. There need to be guards and guides. But nobody is prepared to pay for running the exhibition.

The reason to have the exhibition was to create interest in the bio based economy at kids so that they would choose technical education programmes. The goal is to ensure that there will be enough employees.

So there are many successes in this project but the exhibition is a real disappointment. There were try-outs and in no time 110 schools visited the exhibition. The problems are a case of short-sightedness at the stakeholders. It is about €150,000 annually. Companies want the Province to solve it and the Province is telling the companies that these are their future employees. They can't reach an agreement.

**Q: If I link it to what you said before, there is no clear self-interest?**

That's correct. At least not in short term. The benefits are so far into the future that they can't fix the situation.

**Q: There are also problems at the biodiesel plant…**

It's complicated. Three biodiesel plants were constructed. The one in Ghent is operational and doing well. There are problems at a Dutch plant. There was a huge restriction at customs. A large amount of cheap biodiesel was being imported from the US. Then the subsidies changed in the Netherlands and Rosendaal Energy's business case didn't hold anymore. The company went bankrupt. The company was then taken over by a Saudi organisation but they quit after a while. Elektrawinds was the next company that took over the plant. But that failed as well. I heard that Elektrawinds had problems in other parts of the company.

The problem is the governmental import, export, and subsidy policy. If you count on certain subsidies in your business case and that changes…

**Q: So that was Dutch policy? Not European policy?**

Yes Dutch policy. There is a different policy in Flanders, they work with concessions. One company won a concession in Belgium and they now can manage biodiesel in Belgium for three years. The Netherlands has an open market for biodiesel which makes the situation very difficult for the Dutch plant.

**Q: It is known in literature that clusters are hard to design. More often cluster emerge. Open policies in which participants have freedom work better than strict policies.**

Yes it's too bad for the policy makers. You cannot just create a cluster. Policy makers can help by giving funds. People like us [Van de Bunt] can knock on doors and gently push people in the right direction.

## B3 – Interview Henk van Latesteijn

**Q: Could you introduce yourself?**

I am Henk van Latesteijn. I was born and raised in Rotterdam. I am a biologist and I worked at Leiden University. After that I worked at the 'Wetenschappelijke Raad voor Regeringsbeleid' [WRR: Scientific Council for Governmental Policy] in The Hague. I've worked there for a long time. First as an environmental specialist and the last 5-6 years as assistant director of the WRR. After that I become director of one of the departments of the Department of Agriculture and I was head of strategy for 3 years. I then knew that being a civil servant was not something that fit with me. So when I was asked to become director of TransForum I left.

TransForum was a unique hands-on innovation programme focused on the Dutch agricultural sector. The drive for it was that we are talking about the need for sustainable developments and sustainable business models in agriculture for decennia. All of that talk had led to nothing. Now we wanted to actually do something. It sounds easy but it took a long time to finally get it off the ground. It was a public/private programme in which we received €30 million from the private sector and €30 million from the government. We then took six years to do what we did and had opportunities to do things that normally would not have been possible.

There were practical projects in which companies and other organisations would develop new businesses. We developed about 40 new businesses. We also had a scientific programme. We talked with many professors and found out that each had their own innovation theories. Each of them slightly different from the other. None of these theories were actually validated. They were just theories. I became a cynic. You are not going to change the world with that. So we started a scientific programme with six universities to work on all of these generic issues we would find in practice. It was difficult to convince scientists to participate but eventually we succeeded.

A third programme was a knowledge programme: we documented everything that happened at every practical project. We wanted to know what worked and what not. It seems logical but nobody is doing it. What people seem to do normally is to look for a place where their theory is validated.

Everybody is talking about the same project: Kalundborg over and over again. If everything heads in the same direction I become sceptical. We gathered many people from Erasmus University, VU University, and Wageningen University and put them at all of these projects as monitors and reflectors. These people would just sit and observe but we agreed that at some point these people could give feedback on what they had seen. At first the project owners were sceptical but later did not want to lose the researchers. It was clear from the start that it was very useful to have these monitors and reflectors.

**Q: What was the reason to have these monitor and reflectors?**

The reason was that we did not start with a theory. We could develop a theory and test it to see if it would hold. But the way we approached it was to just do it and see what works. We also wanted to keep track of things that did not work. Those are the most insightful things.

In Holland if you fail you're a looser. But in countries like the US if you failed they tell you better luck next time. So in Holland it means that if you just try hard enough you will succeed. And if you failed you just did something wrong.

We deliberately took the approach to have many projects and we expected upfront that half of them would fail. It was an innovation project, right. If many projects would succeed we would not be dealing with innovation. We would be dealing with business as usual.

**Q: Who created TransForum?**

A group of people from the private sectors, from governments, knowledge institutions, and social organisations. It took some years to get it off the ground.

**Q: Would they accept it if you told upfront them that half of all projects would fail?**

No we really had to convince them because it goes against every belief that people have.

I did TransForum until 2011 and in that year I founded Value Mediation Partners together with other people. We found out that if you want to start a big project you need to connect the values of people. If you don't do that the project will not become successful.

At Biopark Terneuzen for example, we did not start with the technical part. Instead we asked the entrepreneurs, Zeeland Seaports, the governments, and the Zeeland environmental organisation what they thought about the industrial park in the area. What was good? What was bad? How would you envision it? That way we found out that everybody liked the employment it brought but they also found it dirty and dangerous with all of the chemical companies doing complex stuff. But if you connect companies based on values you create an enthusiasm. We've done it with Biopark Terneuzen but also in every other project I did. If people do something because other people demand you to do it, you will never work harder than necessary and nothing great will happen.

**Q: Why does TransForum not exist anymore?**

From the start we said that it TransForum would run for six years. At TransForum we developed, we documented, we wrote books, and we published articles. We reached our goals and it would be of little use to keep sustaining the organisation.

**Q: Why didn't you start a similar organisation in a different field and what exactly is the difference between TransForum and Value Mediation Partners?**

I would really love to have a similar approach – to really have collaboration between knowledge institutions, governments, societal groups, and companies. But back when we were working on TransForum there was support for such initiatives. Now there isn't. Especially after the Lehman Brothers incidents everybody was saying that collaboration is the future. But I am not seeing that much collaboration. Value Media Partners is something different. It is a consultancy firm. If people want to work with us they will get an invoice.

**Q: What kind of projects does Value Media Partners work on?**

Similar projects. We work on cattle farming in the Netherlands which is a hot potato. We did a project in Detroit. Which is collapsing for 30 years now. In 1970 there were two million people living in Detroit. Now there are not even 600,000. Rich white people left and poor black people stayed. So you also have a race issue. People feel abandoned.

In Detroit there is little to no income and few shops. Some people in Detroit who don't want to leave collectively started an urban agriculture project as a support system. We helped professionalising the project. We organised trade markets, logistics, and scaling of production so that they could create income. It's going reasonably well.

**Q: How did Biopark Terneuzen come about?**

It started with Mark van Waes from Van de Bunt, a consultancy firm. He knew people at Yara and he had the idea in that area companies could exchange heat and $CO_2$. In that area there were large firms but not too many and these firms had complementarities. Mark got in touch with us to see if we wanted to create a project.

Because the way we worked was that we really checked if we wanted to do projects that people requested. We ran TransForum as a company not as a subsidy programme. It was our money and we decided which projects we would support we set the conditions. The first times that we said no to project people wanted to file complaints but we were not an organisation at which you could file objections.

**Q: So they thought it was a government service?**

Yes because most innovation programmes are government programmes. But those projects don't support the best ideas, they support the people who are good at securing funds, rent seekers.

We started with a phone and an empty office. We were thinking about how to put concepts in practice. An innovation funnel is great but how do you do that in practice? Eventually we created a method and people (Mark for example) would file projects at us and requested support. Subsidy seekers have the tendency to create these beautiful plans with bells and whistles with the goal of quickly securing funds. But I am not even going to read such plans. I just wanted them to pitch their project. If they wanted to include a description on paper they could but I told them that if they couldn't limit it to one A4 I didn't know if we would be the right partners for them. Because you would have to be able to explain the core of your project. Otherwise you are doing things that people are already doing. We wanted innovative projects. We would then discuss the plans with our team. After that we would engage the pitchers. It would be kind of like Dragons' Den.

People would have the greatest visions and beautiful stories. We would look for positive assumptions: the economy will grow, the energy price will do this… These assumptions are always beneficial for the project. Then we would ask them: what if two or three or four of these positive assumptions develop negatively? If people couldn't answer that we would tell them to go and figure that out first. That was the first step we would take to filter projects. So we took six years to do everything and one year to close shop. I think we received about 250 ideas of which we declined about 200 in the first rounds.

Mark had a great story, a great one A4 description, and his story held up. We then created a project team in which the project owner would be responsible for the project. In this case that was Zeeland Seaports. We advised them to involve people from societal groups in the project team because they would be needed eventually. More than that, if you can make it their project as well you will have support from unexpected corners. We also advised them to involve knowledge institutions.

We did that with all projects: include knowledge institutions, governments, societal groups and companies to innovate together. One of our tests was to see if along the way all these different kinds of parties would be still involved in the project. If not we would ask why. If that was a structural thing odds were that there was something wrong with the project. Odds were they were doing things that would generate resistance at certain groups. We certainly had projects we terminated because they were too focused on satisfying needs of one group. That is strict but if you don't do that every project will succeed but the results aren't good.

**Q: So if you focus on supporting innovative projects you accept that there will be failures?**

Yes. And by having the monitors at every project failures will not be for nothing. We learned tremendously from failures. You learn from failures, not from things that go well. You have to want to know what went wrong at failures and you have to document that. If you don't learn you will never adjust your own behaviour and you can only innovate if you are willing to change your own behaviour.

We had difficulties convincing people at for example, ministries and universities, of this thought process that it would be especially interesting to learn from mistakes. Real innovations come from small companies who have the guts to do it differently.

**Q: Do you consider Biopark Terneuzen to be successful?**

Partly yes, partly no. It was created with growth in mind. They were thinking about constructing 200 hectare of greenhouses in three years. With that in mind you estimate how much investments are needed. WarmCO was founded and just when everything started to get rolling the financial crisis began. Additionally the greenhouse sector was also having problems. One of the stakeholders of WarmCO wanted to quit and Zeeland Seaports stepped in to take over the shares. Organisations like that could do long term investments. Keeping the long term in mind is especially difficult for individual, publicly traded companies. When developing clusters you need parties with a long term vision otherwise it will not succeed.

**Q: How does that explain if Biopark Terneuzen is a success?**

Because there is this idea that we are going to create this and everybody is enthusiastic so in a few years we will have a beautiful park. But that didn't happen partly.

**Q: So certain parts of the projects were not actually realised?**

Yes. A third of the originally planned greenhouses is realised and some of the projects are just discusses. That has to improve.

What is successful is that according to Peter Geertse, manager at Biopark Terneuzen, there is a certain energy and motivation in the area which would have never been there if Biopark Terneuzen would have not been created. Till this day people from all over the world visit Biopark Terneuzen. But to Peter, Biopark Terneuzen is a mindset.

What is happening right now is that companies, individually, do things of which you wonder if they would have done it weren't it for Biopark Terneuzen. Yara for example, is working on state of the art water purification techniques. I think they wouldn't have done that weren't it for Biopark Terneuzen.

**Q: What do you think were the most important factors for the development of the park?**

That's a difficult question. I already mentioned a few. There are not too many companies so it is manageable. Governing bodies are involved (the Province and Zeeland Seaports) who are very active and who are willing to take risks. That is actually uncommon. The collaboration between Zeeland and Ghent in the Canal Zone also generated a lot of energy. People realise that they are part of an industrial cluster running from Zeeland to Ghent.

**Q: So it changed the mindset of people?**

Yes

**Q: To what extent are the factors that you've mentioned applicable to other locations?**

The model of collaboration, which we now also use at Value Mediation Partners, is applicable anywhere. If you don't have this approach in the first steps you should not take the next steps. But I see that happening everywhere.

With us, step one is going from I to We. It's no rocket science but you should do that. If you want to collaborate to establish a cluster you need to create a common vision first because your challenge is not my challenge. You need to interact to find out what that common vision is. You need to begin with finding this common vision. If you skip that and you find out later that parties have different ideas in mind about whet the final result should be, you have a problem. And this happens a lot.

You should also think carefully about the process and organise it. You shouldn't leave that to chance. Just like with project managers and project management tools, you need process managers and process tools. In process management the vision should be tested continuously: is it still right? The English say: "you have a

problem as given and a problem as perceived". I see that process management is often loosely organised but it should be organised very seriously. Forming of coalitions should be something you do in the third step. If you do that earlier there are no firm grounds for forming coalitions.

A cluster can only be created successfully if every participant is convinced that participation is better than staying out. That needs to be reaffirmed continuously. Because if there are no more benefits in participating the cluster will fall apart.

**Q: So it is about self-interest?**

If the cluster won't align with self-interest of the participants it will never work. The interesting thing is that this alignment is something entirely different for every participants. And that is the story about the process again. A civil servant at the Province might find other things important than an employee at a company. And the Director of the Zeeland environmental group might have other criteria. You need to understand that. In fact, you need to use that.

So the notions of process management can be used anywhere. What is also usable in other situations is that the scale was not too big at Biopark Terneuzen. The number of companies involved was not too large. The same approach would be much more difficult in the ports of Rotterdam and Amsterdam. There are many more companies that are doing what they do for a long time. They are internally focused. The hard part of clusters is the willingness of companies to share risks with other companies. You don't have full control over your company anymore. You have to have trust to decide to share risks.

All of the things that I've mentioned have an effect on that balance: am I willing to share risks with other companies? A company is only willing to do that if it truly understands the risks and the risk management and if he knows who he´s dealing with and if there is trust.

**Q: At Biopark Terneuzen, why were the parties willing to collaborate?**

Because they saw the added value of collaboration.

**Q: What added value?**

Waste costs money. By looking at alternative solutions they could turn their waste streams into revenue streams. It did not happen by itself: WarmCO was created, the collaborated, but eventually these companies understood the added value.

**Q: Isn't it because of the environment? The 3Ps?**

I can't think for others but I've been around long enough to understand that the environment itself is not a good enough reason. It helps though.

**Q: Then what is the most important reason to start collaborating?**

One, revenues. Two, the positive effect on your reputation. You sort of get a license to produce. The society is accepting your company. Three, the positive effects on the environment. This also effects the license to produce positively.

**Q: Can you distinguish phases in the development of Biopark Terneuzen?**

Yes in the beginning you talk a lot and you try to get people behind the idea. In this case Mark did that. Then there is a phase in which people are becoming very enthusiastic and plans are made larger than people can handle. That happened in this case. Originally, there were plans of many more greenhouses than what is actually realised.

Next is a reality check: the whole thing looks as if it will fall apart. Many projects actually do fall apart in this phase. In this case that didn't happen thanks to Peter Geertse of Zeeland Seaports and the CEOs of the companies who believed in Biopark Terneuzen.

**Q: There were many factors but what I understand from this is that it is about people…**

Of course. Everything is about people.

**Q: Does the phase also decide on which factor the focus is on?**

In the starting phase you have to have an exciting story to recruit people and what I mentioned before about values, from I to We, and the process.

Then you need perseverance. All of these kinds of projects always take longer than expected and are always more complex than expected. So you really need perseverance to deal with that.

**Q: To what extent is Biopark Terneuzen done developing?**

Much more can be done. Yara for example, is working on waste water treatment with algae. It is important for Yara to treat their waste water. Then business case is would be ok for them. But depending on the type of algae there could be some interesting revenue generating applications. The algae could produce certain substances or the algae could be sold. Sky would be the limit if you would keep thinking about this. The development is never done.

So the waste treatment is important for Yara but other companies are needed for the algae. This way you keep building on an ecosystem of companies. Theoretical fields like Industrial Ecology think that you could design concepts like Eco-Industrial Parks. But reality is always different. You can use some Industrial Symbiosis principles, but you cannot use a strict blueprint and planning. I don't believe that. What I experienced is that first companies come together and when they really see the added value of collaboration they start with the easy parts. They then take a step-by-step approach and build trust to do things that seemed hard initially.

**Q: Is it correct that the companies develop the infrastructure and not Biopark Terneuzen?**

But that is Biopark Terneuzen. Biopark Terneuzen is those companies. It is a collaboration between companies with the name 'Biopark Terneuzen'.

**Q: So Biopark is not an entity that is above all other parties and invests itself. The companies are Biopark Terneuzen.**

That's correct. And that is how it should be. You cannot have one company that directs everything. Individual companies would not accept that.

**Q: Did the companies finance it by themselves?**

They also had European subsidies which can be used for knowledge development. Often, these subsidies cannot be used to invest in pipelines. The companies have to do that themselves. But they can use European subsidies for engineering, conceptual planning, etc.

**Q: To what extent was it difficult or easy to recruit new employees for the Biopark Terneuzen?**

I have no idea.

**Q: I would think that if a new cluster is being developed that there would be a need for skilled workers…**

That is true. I did a project in China and that is a huge problem there. You can think of new projects but if you don't have people with skills or capabilities you can forget it.

The Chinese see labour as part of a machine. If you have protocols for every action you cannot do more than what is in the protocols. In China that works. But in Holland it doesn't. You need different skills and capabilities. At Yara for example, they need operators who keep thinking about the processes and opportunities for improvement besides operators who follow the protocols. You have to look for these types of employees.

**Q: Was it an issue at Biopark Terneuzen?**

No you have already have these people in the area.

Here Henk looked some documents on his laptop…

I recently interviewed Peter Geertse and according to him Biopark Terneuzen went from being a foundation to being a public company owned by governmental bodies like the Provinces, municipalities and a regional education centre [ROC]. They want education at these centres to be linked to the jobs in the area so they invest in that.

There are benefits to being a public company. Now they don't have to deal with a city council that changes regularly. No there is a supervisory board with professionals and less dependency on politics.

In the beginning Biopark Terneuzen was run by an innovation manager. He was constantly looking for new things which is important in the starting phase. Peter is running it differently. He is more like an operational manager, he has to keep things running. In this phase you cannot keep looking for new things.

The original stakeholders of WarmCO were Visser Hanab, Voker Wessels, Yara, and Zeeland Seaports. Volker Wessels is a construction company that wanted to construct the greenhouses. There were problems because things were moving slower than expected. The costs outpaced the incomes so Volker Wessels stepped out of it. Zeeland Seaports took over the shares. Now Zeeland Seaports owns 80% of the shares and Yara owns the remaining 20%.

And to answer another questions you asked before… One and a half year ago they were creating a new heat exchange company [Sloewarmte BV] between Total and Covra. It is similar to WarmCO. I think it is smart to create a separate company for that. Zeeland Seaports is stimulating these kinds of initiatives.

**Q: They are identifying and facilitating?**

Yes but very professional. That is why they wanted a supervisory board run by professionals instead of directors from political parties.

**Q: Now that Biopark Terneuzen is developed and exchanges are created, do you see supporting services and suppliers emerge?**

I don't think so…

**Q: On what scale is knowledge sharing taking place?**

I have no idea.

**Q: Is it taking place?**

Yes otherwise they couldn't have developed the project.

**Q: What kind of knowledge is being shared?**

In the beginning it was very broad. There were multiple research projects to support Biopark Terneuzen. There has to be knowledge sharing otherwise they could have not created WarmCO for example. The fact that they involved the ROC shows that they are also are sharing knowledge in the practical development phase of the project. Students of the ROC are offered internships at the companies and the curricula at the ROC is adapted so that the students get education that is useful in the area.

**Do you know about events in which companies can interact?**

There are few of them. If you look at the news section on the web site of Biopark Terneuzen you will find that it's empty. When I was involved in the projects there actually were events. I even visited a few.

These were networking events with speakers such as a professor from Ghent. He told about the added value of cooperation in clusters like these. I held a lecture about the value of innovation in general. Companies and acquaintances are invited so that they can see what is happening there is worth more than the sum of its parts. But lately there are fewer of these events.

**Q: Did people participate in these events?**

Yes these events were packed.

**Q: I would then expect them to continue…**

Yes but now that Biopark Terneuzen is here you might say that the mission is accomplished…

**Q: So you might say that this is a new phase?**

Yes, first you develop it. Now there is a structure and then you build on that.

**Q: Say you have an empty piece of land which you want to develop. How do you do that?**

First you have to create an ambition. At the same time you have to realise that the result will never be the same as the ambition. It is very dependent on the companies that will locate there. It is different than putting a mall somewhere. Malls have common features that you can use over and over again. If a company like Yara leaves an industrial ecology type park you have a big problem.

You can have great ideas about the final result but you need to realise that you will need large supportive industries that will decide what is going to work and what is not going to work. The key is to get these supportive industries to share business risks with other companies. That is the difficulty. I've tried it in China and it did not work. It was much too complicated.

**Q: What did you do in China and why did it fail?**

We tried to develop an agropark on an empty piece of land. About everything failed. The concept was about the sharing of resources and linking waste streams. It was a good location and mushroom growers wanted to locate their business on this park but they would have to use residual heat and other resource streams from other companies as input. The mushroom growers didn't want that because of the risks. If something went wrong at the suppliers they would be in trouble. They only wanted to join if there would be conventional cogeneration of heat and power to cover the financial risks. But then you lose all of the benefits of resource and heat exchange.

**Q: That seems logical to me that they wanted to cover the risks…**

Yes but if they would have done that at Biopark Terneuzen, there would never be heat exchange by Yara.

**Q: So why were they willing to take risks at Biopark Terneuzen?**

Because they established WarmCO and Yara could guarantee the supply of heat. Yara's plant already existed for years, WarmCO was created, the pipes were constructed, and the heat was being generated at Yara. It was all visible. If you have to develop all those things from scratch it is a matter of faith that everything will be done as promised. But in that case people think: if that doesn't happen I have a huge problem. So I will not participate.

If you look at Shell Pernis, that is not one single plant. But it is all Shell: one owner, one party responsible. If you have multiple entities with each its own risk perceptions and each its own investments it will be a lot harder. The technical part is not that big an issue. But to get people to say: ok, I am going to be dependent on supply from you… that is complicated.

I think with these kind of innovation project you need innovations on three tracks:

1. 'Hardware' which are heat exchangers and such. That is the easiest part. But everybody is always talking about this. Probably because it is the easiest part.
2. Then you have the 'software': knowledge, skills, competencies, etc. Because you can build a new machine, but you need to control those machines. You have to know what to do if a machine malfunctions. Or if something happens you have to know what to do. This part is already harder than the hardware part. How are you going to organise that.
3. The hardest part is the orgware. This is the organisation. Am I willing to share risks? Am I willing to work in an organisation structure that is entirely new? Am I willing to listen to somebody from the Biopark Terneuzen foundation while before I would just work with my own people from our management team? Orgware is the most complicated part. How about cluster governance? Who is owner of what? What if there are calamities? What about liabilities? This is very complicated. Organising this part, that is true innovation which determines the success of a cluster.

**Q: I don't entirely understand the example of the agropark in China. You've mentioned the risks. But the Biopark project also had those risks were. Why were they prepared to take risks in this case but not in China?**

What happened in China is that the government had this empty piece of land and they wanted it developed. They would lay the basic infrastructure like roads and lampposts. There companies interested in locating their business there. It was our job was to make sure that these companies would not locate their as individual firms but as part of an agropark. With that all the trouble started.

At Biopark Terneuzen it is the other way around. You already had companies in the area which were already creating waste streams. These waste streams cost money. Then there was the idea in turning these waste streams into revenues by supplying it to companies that wanted it. They were capable of establishing WarmCO and to finance it. You have a total different situation if you have to start from scratch. Because then you have to rely on promises that people are going to do their part.

The only way for the project in China to succeed was to accept that everybody would have their own backup system. But then what's the use of creating an agropark.

I do not know any example of a park like Kalundborg that was designed upfront and that was developed successfully. There were similar parks established in England but all of them failed. Self-organising parks succeed more often because in those cases companies really choose to participate and people understand why they participate.

It is about self-interest and trust. The hardware part is not interesting at all. The other two parts: the skills, competences, knowledge, and organisation are.