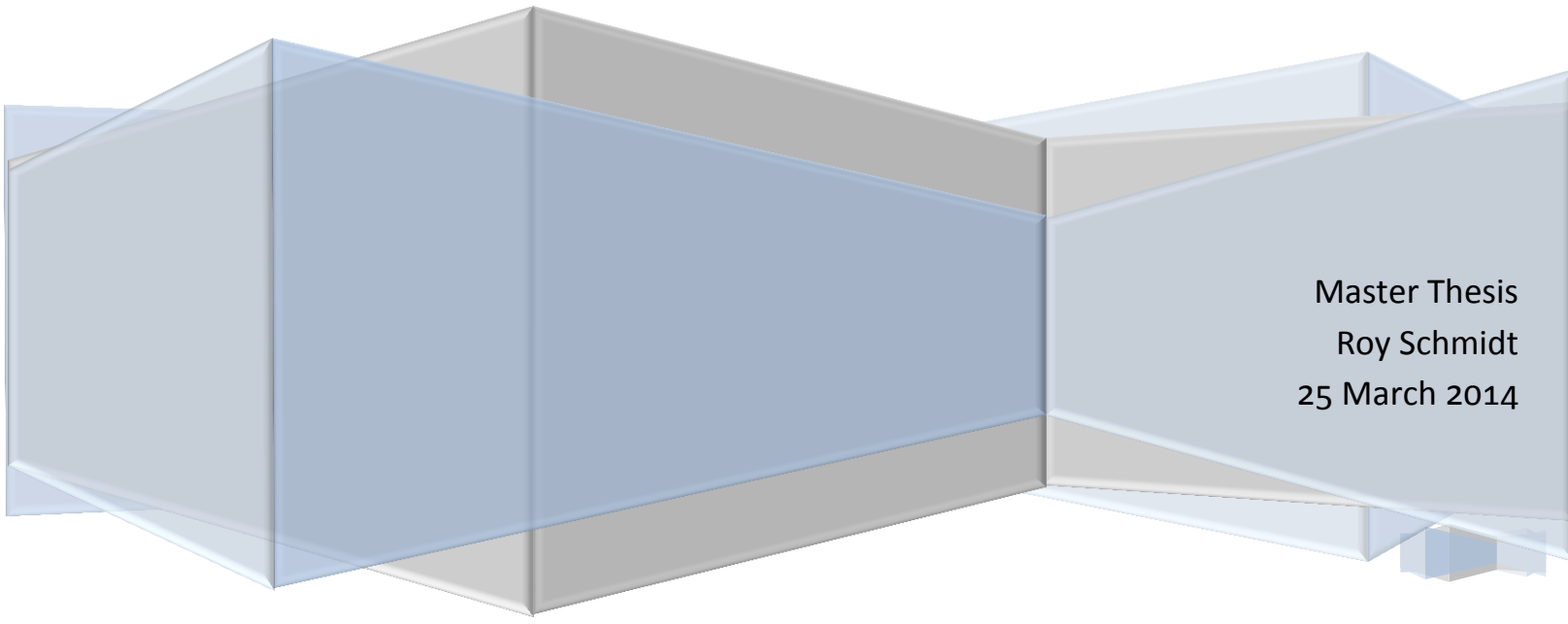
AN IMPROVED UNDERSTANDING OF SYNERGYPARK REALIZATION

Providing a Research on the Combined Use of Event Sequence Analysis and Interorganizational Network Analysis for Agriport A7



Master Thesis
Roy Schmidt
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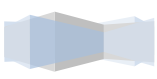

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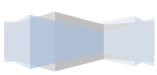

ABSTRACT

This thesis investigates eco-industrial park realization with an application of event sequence analysis and organizational network analysis. Eco-industrial parks seek to create more sustainable production and consumption systems. The exchange of waste, energy or (by) products between companies can enhance the sustainable development of an industrial park. The realization of eco-industrial parks can offer benefits for the involved companies, the environment and the social environment.

The reason for investigating the realization process more thoroughly is based on the fact that eco-industrial parks have risen in attention, however the realization is often a complicated process. It is perceived that interorganizational networks are an important factor in the realization process of an EIP. The presence of interorganizational networks offers the opportunity to exchange the resources for reuse. The realization and structure of networks belonging to the EIP can provide essential information about the realization of an eco-industrial park. Event sequence analysis offers the opportunity to identify how certain events influence the relationships and structure of networks of an eco-industrial park. Interorganizational network analysis can contribute by providing a visual- and statistical approach to analyse the network of an eco-industrial park.

Finally, both analysis tools are applied to a practical example: Agriport A7. The aim is to identify how a combination of the two analysis tools provides new insights in the realization of eco-industrial parks by examining the interorganizational networks.

Keywords Eco-industrial parks, event sequence analysis, interorganizational network analysis

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This research helped me to gain knowledge in the eco-industrial park domain and hopefully the information from this research can contribute to future research on eco-industrial park realization and the use of event sequence analysis and interorganizational network analysis.

Wageningen, March 25th, 2014

Roy Schmidt

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MANAGEMENT SUMMARY

Nowadays the world finds itself in increasing urbanization and rising populations, consequently the consumption levels and use of natural resources are growing. In order to counter the degradation of the natural resources a greater efficiency of resource use by companies is a key factor. Eco-industrial parks (EIPs) are suggested as a strategy to increase the efficiency of companies and realize environmental, economic and social benefits. The goal of an EIP is that companies collaborate in the management of environmental- and reuse issues in order to enhance their environmental and economic performance and finally increase the sustainable development of an industrial park. However, well-functioning, operational EIPs are scarce and there is lack of information on the realization process of EIPs. It is perceived that interorganizational networks (IONs) contribute for a large part to the realization of EIPs. The objective of this research is to contribute to an improved understanding of EIP realization with a focus on the role that IONs have in the process. The role and development of the IONs will be investigated by using two analysis tools: event sequence analysis (ESA) and interorganizational network analysis (INA). Furthermore, the analysis is applied to a practical example, Agriport A7, to test this method of analysis.
The objective of this thesis is investigated with the main research question: *"What contribution can the combination of event sequence analysis and interorganizational network analysis provide to an improved understanding of eco-industrial park realization?"*

This study starts with the theoretical background and states that IONs play an important role in EIPs. As EIPs are focused on the exchange of materials, goods and knowledge, interorganizational relations are necessary to make the exchange happen. In short, without the presence of IONs, it is impossible to realize an EIP. So, in order to better understand the realization of EIPs, the investigation of the IONs can provide essential information.

The methodological background describes that a combined use of ESA and INA could provide additional information on the realization of EIPs. The ESA is a desk study and offers the opportunity to identify crucial events that influence or effects the IONs. Certain events can positively influence the exchange of resources, but other events can decrease the exchange of resources. Next, the INA offers the opportunity to examine the consequences of certain events with a visual- and statistical approach. The aim of this combined use of analysis is to describe the realization of an EIP by investigating the IONs.

Subsequently, both analysis tools are applied to a practical example: Agriport A7. The ESA provided the research with five crucial events that influenced the IONs of Agriport A7. A remark should be made, that more events have occurred that influenced the realization of IONs at Agriport, however due to a lack of time the focus is on five particular events. Next, the INA provided a visual- and statistical examination of the consequences of the events on the IONs of Agriport. Based on the combined analysis ESA and INA, the conclusions for Agriport A7 presented that:

- An increase of companies at Agriport , does not necessarily mean an increase of the interorganizational relations.
- The revision of municipality development plans can have substantial influence on the interorganizational relations.
- External factors, such as the financial crisis, can negatively influence the creation of an ION.
- The realization of greater resource efficiency is achieved best in a homogenous group of actors.
- The inclusion of "true leaders" at an EIP take care that new ideas and opportunities are examined.

Referring back to the main research question the conclusion for this research indicates that a combined use of ESA and INA provides an increased understanding of EIP realization. IONs are important for the realization of an EIP, as they include the interorganizational relationships between companies where the exchange of resources can take

place. The ESA offers the opportunity to identify crucial events that influence the IONs, proceeding the INA visually and statistically analyzes what the consequences are of these events. Finally, the realization of IONs can function as an indicator that defines if how an EIP is realized. The more materials, goods and knowledge are exchanged, the greater the efficiency of an EIP can become. Concluding, the creation interorganizational relations and networks between companies to exchange resources can serve as an indicator on the development of an EIP.

LIST OF ABBREVIATIONS

CHC	Combined Heat and Clutch systems
ECW	Energie Centrale Wieringermeer
EIP	Eco-Industrial Park
ESA	Event Sequence Analysis
HA	Hectare(s)
INA	Interorganizational Network Analysis
ION	Interorganizational network
NSM	Narrative Sequence Methods
SNA	Social Network Analysis

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ANNEXES

INTRODUCTION

CHAPTER 1 INTRODUCTION

Chapter 1 offers the introduction to this research and the section starts with the background information. Next, the conceptual research design is explained and includes the research objective, research questions and the research model. Then the technical research design is discussed, which includes the research framework and the research strategy. The chapter finishes with the readers' guide.

1.1 BACKGROUND INFORMATION

Worldwide the consumption levels are growing and together with the increasing urbanization and rising population, the pressure on the existing levels of natural resources is growing. Greater resource efficiency by companies is a key factor in reducing the pressure on natural resources. Various strategies have been suggested to increase the efficiency of companies in order to realize environmental, economic and social benefits. The realization of eco-industrial parks (EIPs) is a strategy to improve resource efficiency and promote sustainable development (Tudor et al., 2007). An EIP is a community of companies seeking enhanced environmental and economic performance by collaborating in the management of environmental- and reuse issues. Due to the collaboration the companies can achieve a collective benefit that is greater than if the companies would individually optimized their own performance (Martin et al., 1996).

The realization of EIPs can have benefits in three domains. *First,* the companies that are present at an EIP have the opportunity to decrease their production costs by an increased material- and energy efficiency and waste recycling. Furthermore companies can cut their costs by sharing services at the park, for example shared waste management, environmental information, energy exchange and other support services (Koenig, 2005). *Second,* EIPs can have benefits for the environment (Koenig, 2005). EIPs offer the opportunity to reduce sources of pollution and waste. The environmental burden can be reduced with innovative approaches for clear production for example with energy efficiency, resource recovery and other environmental management methods and technologies. *Finally,* EIPs can contribute to society (Koenig, 2005). EIPs can be a powerful economic development tool for communities as they offer the opportunity to attract leading corporations to the park. Companies present on an EIP can become new clients for the regional business and also the park could provide new jobs in the area. The sum of benefits in these three domains is that sustainable development is not only beneficial for the environment, but can also deliver gains for companies such as cost reductions.
In recent years multiple attempts to create an eco-industrial park are undertaken, for example (Isakhanyan, 2010):

- Biopark Terneuzen, Zeeland, the Netherlands,
- Agropark Bergerden, Limburg, the Netherlands,
- Agriport A7, North Holland, the Netherlands and
- Kalundborg, Denmark.

The creation of EIPs depends on the realization of interorganizational networks between companies. The interorganizational networks provide the opportunity to exchange materials, goods and knowledge in order to enhance the sustainable development. Networks between companies are favorably focused on collaborations and relationships that result in a competitive advantage (Gulati et al., 2011).

Since 2000 EIPs have risen in attention in scientific research, however to derive at well-functioning and operational EIPs still seems to be a difficult task. It shows that the realization of EIPs and the role of interorganizational networks is still underexplored. This research explores how the investigation of IONs can help to better understand the realization process of EIPs. This exploration will be executed with a combined use of two analysis tools: event sequence analysis (ESA) and interorganizational network analysis (INA).

PROJECT LOCATION

In this research a practical example is used to apply the ESA and INA in order to get an improved understanding of the networks and finally the realization process of EIPs. The practical example in this research is called Agriport A7. Agriport A7 is located in the municipality Middenmeer, in the province North Holland, the Netherlands. This agro park can be divided into two parts; *first* there is a project location which is designed for large scale greenhouse growing. *Second*, a new business park is erected, where companies for road transport, packaging and production of (mainly) vegetables are active (Agriport A7, 2013). The clustering of large scale greenhouse facilities and the adjacent agribusiness park should enable the companies to achieve economic and environmental advantages. Agriport A7 will be used to apply ESA and INA in order to investigate if the combination of the tools can provide an improved understanding of EIP realization.

1.2 CONCEPTUAL RESEARCH DESIGN

Next, the conceptual research design is explained and includes the research objective, research questions and finishes with the research model.

RESEARCH OBJECTIVE

Given the large number of requirements that an investigation must meet, it is important to embed the subject of the investigation carefully into a broader context, but also delineate the subject from that broader context. The embedding and delineation take shape in the objective of the research (Doorewaard and Verschuren, 2005).
The aim of this research is to contribute to an improved understanding of EIP realization. Multiple studies have been executed on EIP realization, but this research focusses particularly on the role that IONs have in this realization process. In order to get grip on how networks develop and operate in realizing EIPs, the combination of ESA and INA, will be operationalized. Although the research is applied to a practical example, the research is a theory developing research. The research aims to contribute to new knowledge and theory on the combination of ESA and INA in order to understand the realization process of eco-industrial parks. This research builds upon earlier research of (Wubben and Isakhanyan, 2011) and (Saris et al., 2010) on networks at agro parks.

RESEARCH QUESTIONS

The aim of the main, - and sub research questions is to provide the only necessary information to accomplish this research (Doorewaard and Verschuren, 2005). The answers on the sub questions should together provide the answer to the main question. The objective states that this research tries to contribute to an improved understanding of EIP realization. To keep the research manageable a more specific research angle is chosen with the operationalization of two analysis tools on IONs to get grip on how networks develop and operate. This has resulted in the following main, - and sub question(s).

Main Question (MQ):

> *"What contribution can the combination of event sequence analysis and interorganizational network analysis provide to an improved understanding of eco-industrial park realization?"*

The associated sub questions (SQ) are:

- SQ 1. What is the relationship between eco-industrial parks and interorganizational network based on literature?
- SQ 2. What are the key variables of eco-industrial parks and interorganizational networks, based on the literature study, that realize the theoretical framework?
- SQ 3. What are the fundamentals of event sequence analysis and interorganizational network analysis?

SQ 4. What additional information does the separate application of ESA and INA at Agriport A7 provide?

SQ 5. What new insights does the combined application of ESA and INA provide for Agriport A7?

The answers from the first three sub research questions are derived from the literature study. The answers to sub research questions four and five are based on the empirical research conducted at Agriport A7. The answers to the sub research questions are used to answer the main question in chapter 8.

RESEARCH MODEL

Based on the objective and the research questions a research model is presented in figure 1. A research model is a schematic overview of the objective of the research and the steps that need to be taken to reach the objective. *First*, with the use of the literature study the main concepts, EIPs and IONs, are explained, which answers the first research question. Based on the literature of the main concepts, the theoretical framework can be constructed, which answers the second sub question of the research. The second part of the literature study focuses on the methodological background and explains the fundamentals of the two research tools that are used in this research: ESA and INA. This part answers the third research question.

After the literature study the empirical part of the research needs to be executed. In the empirical part, the theoretical framework and the ESA and INA are applied to Agriport A7 in order to test the theoretical- and methodological background to a real life example. This section provides the answer to the fourth sub research question. After the empirical application, the analysis of the results can take place and focus on what new insights can be generated by the combined use of ESA and INA to an eco-industrial park. The analysis answers the fifth sub research question of this research. Finally after the analysis is completed, conclusions can be drawn if the combination of ESA and INA can provide an improved understanding of EIP realization, answering the main research question.

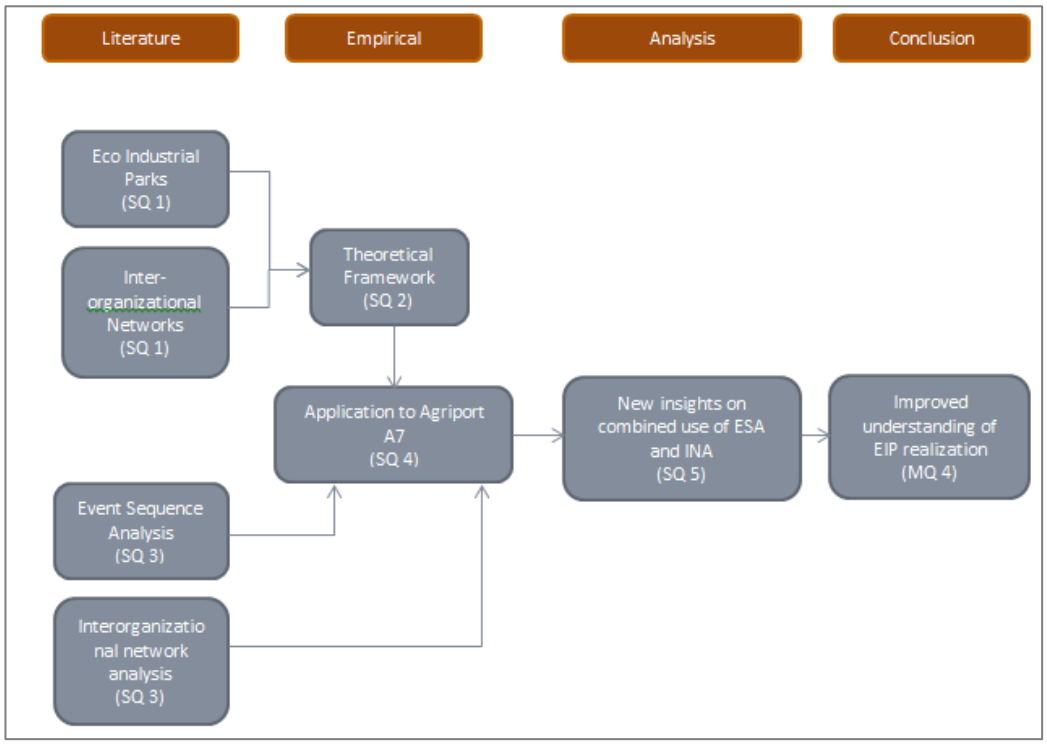


Figure 1. Research model.

1.3 TECHNICAL RESEARCH DESIGN

This section discusses the technical research design and includes the research strategy and the research materials that are used to execute the empirical part of the research. As this research as based on two analysis tools that both require another strategy and materials, each analysis is discussed separately.

RESEARCH STRATEGY

The research strategy is described by Verschuren and Doorewaard (2005) as a set of interrelated decisions on how the research will be carried out. Considering the ESA a desk study is used as the appropriate research strategy. A desk study is a research strategy that is recognized by three main themes: the use of existing material, no direct contact with the object of research and the material is used from another perspective as where for it was produced (Doorewaard and Verschuren, 2005).

The INA requires another strategy, because the interorganizational network analysis makes use of face-to-face interviews in the field. The interorganizational network analysis will use the case study strategy, which is a cross sectional type of research that gains insight into processes and objects restricted in space and time. A case study is able to provide a snapshot of Agriport A7 at a certain moment in time (Vaus, 2001).The case study strategy is characterized among others by a small number of research units , an in-depth approach, a selective sample a qualitative way of collecting data (Doorewaard and Verschuren, 2005). This research, to be more precise, is a clinical case study. The goal of a clinical case is to use existing theories to better understand a case or a problem, which is in this research: Agriport A7 (Vaus, 2001).

RESEARCH MATERIALS

Research materials are understood as the sources where information and knowledge is drawn from for the research (Doorewaard and Verschuren, 2005). The knowledge gathering in this research can be divided into four main parts:

1. A literature study will be conducted to define the main concepts in the theoretical background.
2. A second literature study will be conducted to describe the fundamentals of ESA and INA in the methodological background.
3. In order to conduct an ESA data needs to be collected.
4. In order to conduct an INA separate data needs to be collected.

Next, for each of the parts the research materials will be discussed.

The main source for the theoretical- and methodological background will be scientific literature. Scientific literature provides theoretical insights and in-depth understanding of EIPs. Also, the fundamentals of ESA and INA can be retrieved from the articles. The scientific articles are for the larger part found via the WUR Library by using online databases such as Scopus, Web of Science, Jstor, Sage and more . The articles are for the larger part retrieved from journals such as: Journal of Industrial Ecology, Journal of Cleaner Production, Industry and Innovation and Industrial Market Management.

To conduct the ESA different sources can be used, but the main source will be the media. Media occurs in two ways: printed and electronic. Printed media consists of papers, magazines and brochures. Electronic media entails mainly radio/TV, internet and online documents (Doorewaard and Verschuren, 2005). However, due to a lack of time this research focusses on the printed media, and particularly on newspaper articles. The newspaper articles will be retrieved from LexisNexis. An online database that includes most of the local-, regional- and national

newspaper articles of the Netherlands. In order to construct the ESA, based on the newspaper articles, Microsoft Excel is used.

The main sources of information for the INA will be representatives of the companies present on Agriport A7. The representatives can provide knowledge on the networks that are present at Agriport A7. Furthermore, they can indicate with whom they are collaborating and have immediate ties. The information will be retrieved from the representatives with the use of face-to-face interviews based on a previously prepared questionnaire. The results of the face-to-face interviews will then be analyzed with the program UCINET to provide the interorganizational networks present at Agriport A7.

1.4 READERS' GUIDE

To provide a short overview of what will be discussed in the remainder of the report, a readers' guide is offered. This thesis has the following structure:

Chapter 2: Theoretical background
Chapter 2 delivers the theoretical background for this research. To provide a comprehensive overview of the theory, the theoretical background provides the scientific background of EIPs and IONs and ends with a discussion on the relation between the concepts. This chapter relates to research question number one.

Chapter 3: Theoretical framework
This chapter continues on chapter two by providing the theoretical framework of this research based on the two main concepts. This chapter corresponds with sub research question two.

Chapter 4: Methodological background
The ESA and INA are better understood when the scientific background of these tools is provided. Chapter 4 offers this background and corresponds to research question three.

Chapter 5: Methodology
This chapter starts with a description of the research area: Agriport A7. Furthermore, this part provides the methodology of the research including the research strategy and research materials for both the analysis tools. The chapter ends with statements about the internal- and external validity and reliability of the research.

Chapter 6 & 7: Results and analysis
Chapter 6 provides the results of the ESA and INA applied separately to Agriport A7 and corresponds to research question four. Chapter 7 offers the combination of the two analyses tools and shows how ESA and INA can be combined in order to gain new insights and better understand EIP realization. Chapter 7 focuses on the answer of research question number five.

Chapter 8: Conclusions and discussion
This final chapter covers the conclusions and discussion of the research and provides the answer to the main question of the research. Furthermore, the limitations and recommendations are provided.

THEORETICAL BACKGROUND

ECO-INDUSTRIAL PARKS

&

INTER-ORGANIZATIONAL NETWORK

CHAPTER 2 THEORETICAL BACKGROUND

The theoretical background focuses on the two main concepts of this research: eco-industrial parks (EIP) and interorganizational network (ION). In part, 2.1 EIPs are discussed, and then in section 2.2 the IONs are explained. Continuing in section 2.3 the relationship between the concepts is explained and provides an answer to the first sub research question: *"What is the relationship between eco-industrial parks and interorganizational network based on literature?"*

2.1 ECO-INDUSTRIAL PARKS

This section provides in-depth information on EIPs and starts with an introduction to EIPs, followed by a definition of the concept. Next, the key conditions for EIP realization are discussed and followed by the design of EIPs. This section finishes with a section summary.

INTRODUCTION

Eco-industrial parks originate in industrial ecology, which is an approach for sustainable economic development and states that industrial parks should be designed to resemble the natural ecosystem as close as possible, as in natural ecosystems energy and resources are used optimally and waste is absent (Heeres et al., 2004). Industrial ecology has three main objectives, *first* reduce the use of non-renewable resources and stimulate the use of sustainable energy. *Second*, keep the balance in the use and production of renewable resources and *third* keep renewable and non-renewable resources as long as possible in the material cycles (Heeres et al., 2004). A complete closing of all material flows in production systems is not yet possible, but the waste reduction and reuse of resources can be considerable (Lambert and Boons, 2002). Based on industrial ecology the concept of industrial symbiosis emerged. Industrial symbiosis is a body of exchange structures to progress to a more eco-efficient industrial system. The exchange structures are established by collaborations that create material and energy exchanges among different organizations (Domenech and Davies, 2011).

EIPs are a way of demonstrating industrial ecology and industrial symbiosis that applies ecological principles to manufacturing systems. EIPs form a catalyst for industrial complex developments to bring together the fundamentals of industrial ecology, cleaner production and value-adding waste management. Furthermore EIPs encourage sustainable design, cooperation, innovation, novel technologies and knowledge sharing (Roberts, 2004).

DEFINITION

This section elaborates on the definition for EIPs. Many different definitions are discussed in literature and some definitions are mentioned frequently. Table one offers the most frequently used definitions of an EIP found in literature:

Table 1. Definitions of EIPs.

Author	Definition
Côte and Rosenthal (1998, p. 182)	*An EIP is an industrial community which conserves natural and economic resources; reduces production, material, energy, insurance and treatments costs and liabilities; improves operating efficiency, quality, worker health and public image; and provides opportunities for income generation from use and sale of wasted materials.*
PCSD (1996, part A)	*An EIP is a community of businesses that cooperate with each other and with the local community to efficiently share resources such as information, materials, water, energy, infrastructure, and natural habitat, leading to economic and environmental quality gains, and equitable enhancement of human resources for the business and local community.*

Lowe et al. (2005)	*An EIP is a community of manufacturing and service businesses seeking enhanced environmental and economic performance by collaborating in the management of environmental and reuse issues. By working together the community of businesses seeks a collective benefit that is greater than the sum of the individual benefits each company would realize if it optimized its individual performance only.*

The definition of EIP is still changing, because the domain of industrial ecology is also evolving. New definitions or changed definitions of EIP can arise in the future (Côté and Cohen-Rosenthal, 1998). As this research is written with a business administration background, the definition should be an extension of this focus. The definition of Lowe (2005) is therefor used as the main definition, because it states that collaboration between companies can provide a competitive advantage but also focusses on the environmental aspect of collaborations. The other two are more process oriented, focusing on the flows of energy, water and materials and that is not the focus of this research. Therefor these definitions are less suitable to use. Continuing the next section elaborates on the key activities identified by literature for the realization of EIPs.

KEY CONDITIONS FOR EIP

The realization of an EIP is a difficult process, because a right mix of conditions needs to be fulfilled (Haskins, 2006). From the multitude of conditions mentioned in literature, Yu (2013) has colligated them into five main conditions (Yu et al., 2013):

- Institutional activity,
- Technical facilitation,
- Economic and financial enablers,
- Informational activity and
- Company activity.

First, an appropriate institutional setting is an important condition as policy interventions can motivate the realization of new EIPs or the transformation of existing industrial complexes. The formal institutional regime provides laws and regulation. Together with policies and guidance by governments the appropriate conditions can be created that urges companies to reduce and recycle their waste and by-products (Yu et al., 2013). Elements that urge companies to reduce and recycle are consisting of loans, taxes, fees, fines, levies, subsidies and credits. These elements encourage the development and adoption of environmentally desired technologies and practices. Furthermore the formation of interactions and collaborations between companies is enhanced (Mirata, 2004). Finally planning interventions can take place where, for example, governments can plan EIPs around one vital plant where companies will be clustered, which creates shorter distances for transport and material flows (Gibbs and Deutz, 2007, Lehtoranta et al., 2011).

Second, technical facilitation should focus on the availability of infrastructure for common use and the joint management of resources. The infrastructure is used to arrange the energy and material flows between companies. Furthermore, the technical facilitations can support EIPs by information acquisition and analysis of material flows for potential synergies. Also the technical facilities can be used to monitor the performance of the network (Yu et al., 2013).

Third, the realization of an EIP is dependent on economic- and financial enablers. At first glance companies can hesitate to join an EIP, because of the transaction costs and possible risks that can be involved (Tudor et al., 2007). Subsides, loans and funds can stimulate the collaboration, adoption of technologies and infrastructures by companies. Also, interventions can be made posing standards for emissions or waste, which in turn are incentives

for companies to engage in an EIP (Desrochers, 2001). Despite the fact that subsides and funds can be a stimulation, also marked-driven actions need to be taken to make an EIP financially attractive. This can be achieved by , for example, implementing a tax reduction for the reuse of energy and resources (Yu et al., 2013).

Fourth, in the development of an EIP the main goal of informational support should be the identification of environmentally desirable actions and feasible opportunities for synergies. The main resource flows can be studied in association with the economic activities of the region in order to identify the areas where the major focus on resource consumption and waste reduction needs to be placed. Not only can informational activity aid the development of sustainable resource use, also it is useful to monitor the performance of the network (Mirata, 2004).

Fifth, company activity should focus on the company participation in the exchange of physical by-products and utility sharing. From literature it appears that company participation is a crucial factor for success. Companies need to invest time, money and resources into the EIP project (Yu et al., 2013). In order to exchange products and information between companies, trust, openness, communication, willingness to participate and interaction need to be present to develop and maintain synergies.

REALIZATION PROCESS

Literature provides multiple ways of realizing an EIP and Koenig (2005) provides a four-phase roadmap (Koenig, 2005). Figure 2 shows the four phases where *first,* the initial phase can be identified. The first ideas for an EIP are created and often starts with a piece of property, brownfield or greenfield, that is open for development. Support needs to be mobilized for the EIP and potential stakeholders identified. *Second*, in the preparation phase the scale of the project and potential partners need to be selected. An EIP team needs be established to guide the process and the EIP needs to be communicated to the outside world. *Third*, in the planning phase the vision and goals of the EIP needs be communicated to the outside world. *Fourth*, in the implementation phase the EIP is implemented and an industrial community is build where exchange of materials and waste takes place (Koenig, 2005). The previously mentioned conditions for EIP realization can have effects on the realization process. For example, institutional activity can address a piece of land for the realization of an EIP.

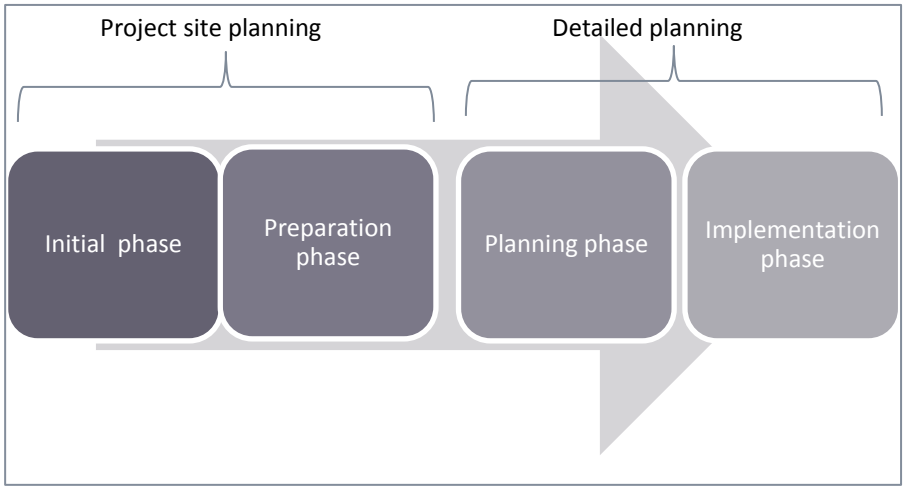


Figure 2. Four phases of EIP realization. Source: Koenig (2005)

Next, in literature there is a distinction between spontaneous developing EIPs where the realization phases are evolving organically and planned EIPs where the realization process is structured in a systematical way.

SPONTANEOUS APPROACH

The spontaneous approach is based on economic market principles and by the virtue of already well-established contacts between organizations (Lambert and Boons, 2002). Kalundborg in Denmark is recognized as a leading example for an EIP that has been established in a self-initiated way. Kalundborg evolved over a number of decades and without any governmental subsidy or academic knowledge (Haskins, 2006). The symbiotic linkages at Kalundborg are perceived crucial for its success, but the challenge for new EIPs is how to encourage the development of collaborations at EIPs. In order to make companies actively participate and collaborate one needs to convince companies of the economic and environmental improvements that can be gained with realizing a planned EIP. It is believed that a well-planned, functioning EIP has the ability to generate both economic and environmentally gains in and near the location of its realization (Heeres et al., 2004).

PLANNED APPROACH

In order to construct an EIP with the planned approach it is necessary that the basic ingredients are in place. The basic ingredients will vary from place to place due to the geographical, social, political, environmental, economic and institutional context. However, it is of vital importance to create an "environment" where an EIP has the opportunity to develop (Tudor et al., 2007). The development of an EIP requires two levels of planning: project site planning and a detailed planning. The project site planning is focused on the macro level where the realization of a park first must be considered at a regional scale before a detailed planning is made. Industries and governments that want to realize an EIP should address assessments of waste materials and energy, economic, environmental and social assessments and more (Roberts, 2004). The project site planning fits into the initial and preparation phase of figure 2.

After the project site planning is done, a detailed planning can be made. It is perceived that many EIPs fail because of weaknesses of detailed planning and analysis. The detailed planning entails organizational arrangements, a catalyst (company) around which others can congregate, a core team that works on the EIP, a detailed development plan, an effective marketing plan, financial and risk management strategies and an economic analysis for the potential product exchange (Roberts, 2004). After a detailed planning is created, implementation can take place and corresponds with the planning and implementation phase of Koenig (2005) in figure 2.

Furthermore, in the planned approach policy can strengthen EIPs by coordination, encouragement and support in terms of logistics and technical and financial assistance. Policy should be focused on arranging an environment where clusters can arise, rather than purely controlling the content of the clustering processes (Chertow, 2008).

SECTION SUMMARY

Section 2.1 elaborated on the concept of eco-industrial parks. EIPs find their origin in the industrial ecology and are an application of industrial symbiosis. Five key conditions are perceived as important for realizing EIPs. *First,* institutional activity creates the institutional background, which provides laws, regulation and policies. *Second, t*he technical facilitation is focused on the availability of infrastructure for common use and the joint management of resources. *Third,* the economic and financial enablers stimulate the realization with among others subsidies, loans and funds. *Fourth,* the informational activity identifies the environmentally desirable actions and feasible opportunities for synergies. *Finally,* the company activity focusses on company participation in the exchange of physical by-products and utility sharing. The five key conditions are incorporated in the four phases, initiation,

development, planning and implementation, of EIP realization and should provide the essential basic ingredients for EIP realization

Next, there is a debate on how to realize EIPs, planned or unplanned. EIPs, like Kalundborg, can be realized in an unplanned fashion but that often takes too long. To realize an EIP in a shorter period, a planned approach seems more desirable, however literature states planned EIPs are often unsuccessful. Therefor more research into the realization process of EIPs is required.

The next section provides a detailed description of the second important concept: interorganizational networks.

2.2 INTERORGANIZATIONAL NETWORKS

This section introduces interorganizational networks (IONs) and provides an introduction of the concept, followed by the definition. Furthermore, the important features of IONs are given and the general process of realizing an interorganizational.

INTRODUCTION

IONs originate in the realm of strategic alliances where networks encompass a firm's horizontal and vertical relationships with other organizations. These strategic networks are composed of interorganizational ties that are of strategic significance and include strategic alliances, joint ventures and a host of similar ties (Gulati et al., 2000). Motives to engage in interorganizational network are divided in broadly two sets.

On the one hand companies try to enhance their revenue by cooperation. Cooperation can result in a reduction of competition by binding competitors as allies and organizations get access to complementary resources or capabilities (Ebers, 1999). On the other hand cooperation in IONs can increase cost reduction, caused by joint research, marketing or production (Ebers, 1999). Moreover, the cooperation between companies is not only delivering economic revenues, IONs can also provide a means for long-term sustainable development (Fichtner et al., 2004). In order to achieve sustainable development, collaborations between companies need to be established that can provide dissemination of environmental knowledge and competencies, but also the exchange of waste materials, energy and by-products to achieve a higher efficiency within companies (Albino et al., 2012).

DEFINITION

The literature on IONs uses multiple definitions of the concept. Table 2 shows definitions that are frequently used and in the remainder of this section, the best fitting definition is given.

Table 2. Definition of ION.

Author	Definition
Gulati et al. (2000, p.1)	*Interorganizational network are described as a firm's set of relationships, both horizontal and vertical, with other organizations—be they suppliers, customers, competitors, or other entities—including relationships across industries and countries. These strategic networks are composed of inter-organizational ties that are enduring, are of strategic significance for the firms entering them, and include strategic alliances, joint ventures, long-term buyer-supplier partnerships, and a host of similar ties*
Chetty and Agndal (2008, p. 178)	*Interorganizational network contain long-term purposeful arrangements among distinct but related for-profit organizations that allow those firms in them to gain or sustain competitive advantage vis-a-vis their competitors outside the network.*
Jones & van de Ven (2013, p.199)	*An inter-organizational network is defined as a set of organizations related through common affiliations or through exchange relations.*

The definitions IONs are focused on collaborations and relationships between companies that favorably result in a competitive advantage (Gulati et al., 2000, Chetty and Agndal, 2008, Jones and van de Ven, 2013). Although, there are some differences, most definitions considering IONs refer to the same common themes, including social interaction, relationships, connectedness, collaboration, collective action, trust, and cooperation (Provan, 2007). As mentioned with the definition for eco-industrial parks (EIPs), the definition for an ION should also be business administration oriented. For this research the definition of Gulati (2000) will be used as a guideline for IONs, because it is frequently used in scientific literature and the broad definition gives space to elaborate on the variety

of relations between companies. The next section will continue with the realization of interorganizational network and will provide a more detailed description of IONs.

REALIZATION OF INTERORGANIZATIONAL NETWORKS

This section continues with the description of interorganizational networks (IONs) and how they are constructed. Figure 3 shows a simplified illustration of the structure of an ION. The realization of an ION starts with individuals that are concerned about a problem or issue and come together to realize an ION. The concerned individuals can then form a group or team. Collaborations and relationships between groups or teams form an organization and cooperation between different organizations constitutes an ION (Ainsworth, 2011).

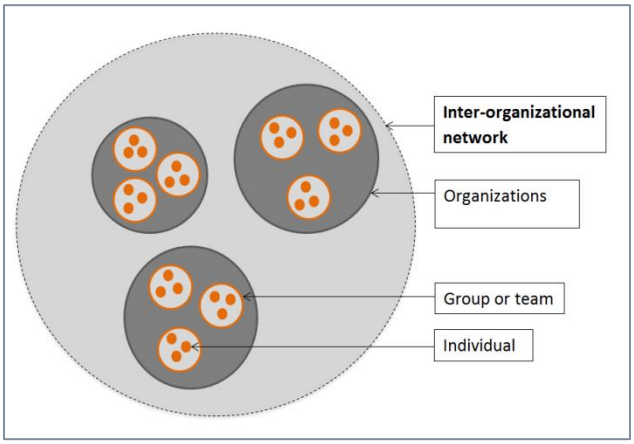
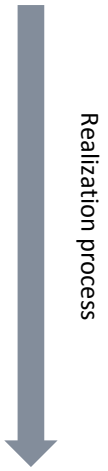


Figure 3. Structure of IONs. Source: Ainsworth (2011)

Often an ION does not develop spontaneously, the realization of an ION does not take place from moment to the other. Several phases are taking place before a functioning ION can be established. In literature five distinct phases are identified in the construction process on an ION (Das and Teng, 1997). The *first* phase is the developing phase, some actors are concerned of some problem or issue and in order to resolve this issue they may agree to create an ION. *Second,* the identifying phase entails the identification of actors that are suitable to join the ION and when identified recruit them. Actors should have complementary resources and skills to create the intended synergy and the actors should have compatible objectives to be both beneficial. *Third,* the formalizing phase includes the establishment of communication tools and a clear governance structure for the ION. Furthermore, the goal of the overall ION should be clear as well as the role of each of the members. *Fourth,* the operating phase includes the implementation and acquiring the resources. *Final*, the ION reaches the *performing phase* where the ION functions and is evaluated and if necessary adjustments can be made (Das and Teng, 1997). Table 3 shows the different phases of ION realization.

Table 3. Five phases of ION realization. Source: Ainsworth (2011)

Phase	Main tasks
Developing	Evaluation of the necessity for an ION. Cost/benefit analysis. Define research problem.
Identifying	Stakeholder identification Recruiting members
Formalizing	Develop communication tools Develop governance structure Create goals clarity Clarify roles of the members
Operating	Acquire resources Develop common language
Performing	Evaluate the EIP Make adjustments



When IONs are functioning with some degree of efficiency, they can achieve observable outcomes such as the creation of collective intelligence leading to innovation. Furthermore, pride and confidence can occur based on the accomplishment of the ION's goals. Next, learning, growth and development can take place and individual companies as well as the ION can grow as whole and learn from each other (Ainsworth, 2011).

KEY FACTORS OF INTERORGANIZATIONAL NETWORKS

The development of IONs takes several phases, but from former research, it results that multiple factors influence the collaborations and partnerships between companies. From the multitude of relevant literature, the book chapter of Cordero-Guzman (2004) and the article of Reniers (2010) provide a comprehensive division of six important key categories including important factors for the realization of IONs (Cordero-Guzman, 2004):

First, factors related to the environment matter for the realization of an ION. Three important factors can be distinguished for successful collaboration. *First*, the history of collaboration in the community can enhance the coalition building. Often the realization of collaborations is dependent on existing linkages in the community (Reniers et al., 2010). The *second* factor considering the environment entails that companies involved in the collaborations are perceived as leaders in the community and are willing to take risks in engaging in IONs. The final factor entails that for ION realization a favorable social and political climate needs to be present (Cordero-Guzman, 2004).

The *second* key category for ION realization is membership. Respect, understanding and trust is of large importance for the success of collaborations (Reniers et al., 2010). Furthermore, the members of the network must see that there is something to gain from the collaboration. To conclude, a member of the network should have the ability to compromise, as not everybody can be satisfied on their specific needs in collaborations (Cordero-Guzman, 2004).

Third, in terms of process and structure there are several important factors mentioned by Cordero-Guzman (2004). *First,* it is stated that members in an ION need to share a stake in the process and the outcome. Next, in the process of ION realization there are multiple layers of decisions making, which should be taken into account. The third factor in this category states that members in a collaboration should be flexible and clear roles and policy

guidelines should be designed (Reniers et al., 2010). Finally, the members in an ION should be willing to adapt during the process of ION realization in order to contribute to successful collaborations (Cordero-Guzman, 2004).

The *fourth* important category in ION realization is communication. It is important to have established formal and informal communication links in order to communicate frequently and open. The communication links offer the opportunity to exchange knowledge or new ideas for innovation (Reniers et al., 2010)

Fifth, the purpose of the ION is the next factor that is important in the realization of IONs. In order to achieve a successful collaboration the ION needs to have concrete and attainable goals and objectives. Furthermore, the group that is involved in the ION needs to have a shared vision in order to achieve the unique purpose of the ION. The purpose of an ION could be related to complementarity, the degree in which activities of collaborating companies are similar or overlapping, is the cooperation adding value to the company or are they working approximately the same (Reniers et al., 2010).

The *final* key category for ION realization are the resources. Resources are needed to start a collaboration. For example the availability of funds and subsidies can enhance the realization process. Furthermore it is perceived that a skilled convener is present to guide the process towards a successful collaboration (Cordero-Guzman, 2004).

SECTION SUMMARY

To summarize section 2.2, IONs originate in strategic alliances where companies are focused on increasing their revenue, reducing their costs and improve sustainable development. In order to achieve their goals, companies in an ION should take care that the actors are complementary and aligned. Greater efficiency and observable outcomes can then result in achievements like growth and innovations. The realization of an ION is however dependent on different key factors. Six categories can be distinguished: factors related to the environment, membership, process and structure, communication, the purpose and resources. Each of these categories possess key factors that are important for the realization of an ION.

Section 2.3 elaborates on the possible relationship between eco-industrial parks and interorganizational network. Furthermore, the first research question will be answered at the end of section 2.3

2.3 RELATIONSHIP ECO-INDUSTRIAL PARKS & INTERORGANIZATIONAL NETWORKS

As can be understood from section 2.1 eco-industrial parks (EIP) can be perceived as a community of manufacturing and service businesses. The community seeks enhanced environmental and economic performances by collaborating in the management of environmental- and reuse issues in order to create sustainable industrial complexes.
Section 2.2 states that interorganizational networks (IONs) are perceived as a set of organizations related through common affiliations or through exchange relations. To find fitting partners is essential for the successful realization of EIPs in the long-term. Collaborative arrangements can lead to more sustainable products, sustainable management practices and sustainable organizations (Reniers et al., 2010).

COMPARISON BETWEEN EIP AND ION REALIZATON

The first sub research question addresses the question what the relationship is between EIPs and IONs. To show this relationship a closer look to the realization processes of both key concepts is necessary. Figure 4 shows the different phases of EIP realization and figure 5 visualizes the different phases of the ION realization. A comparison between the two realization processes provides the opportunity to make statements about the coherency of the processes and how they relate to each other.

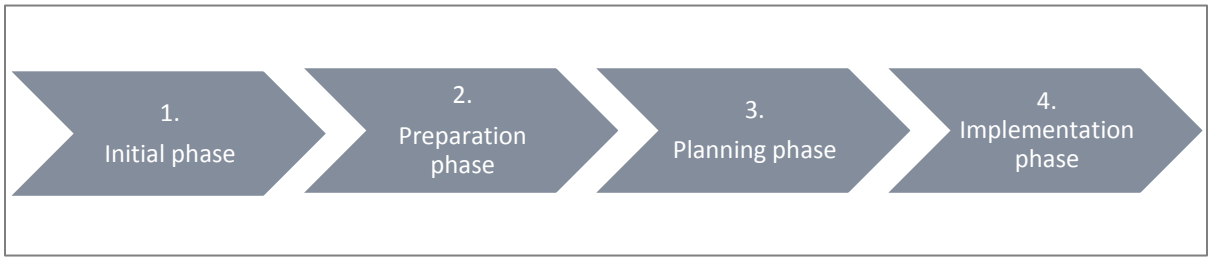


Figure 4. Different phases of EIP realization.

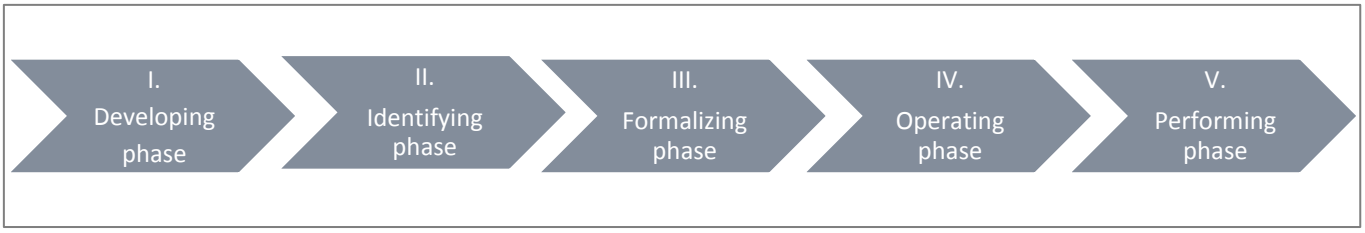


Figure 5. Phases of ION realization.

The comparison starts with the realization phases of an EIP. The realization of an EIP starts with the initial phase where the first ideas for an EIP are posed by an initiator, this is followed by the preparation phase where the scale of the project and the potential partners are selected. Next, in the planning phase the vision and goals of the EIP are decided upon and finally in the implementation phase the EIP is implemented and an industrial community is build where exchange of materials and waste takes place (Koenig, 2005).
The realization process of an ION starts with the developing phase where one or some actors are concerned of some problem and want to resolve this issue followed by the identification of actors that could join the ION. After the identifying phase communication tools are formalized and the ION is implemented in the operating phase. Finally in the performing phase the IONs can be assessed and evaluated. It should be mentioned that at an EIP multiple IONs can be present. A couple of companies may collaborate with each other to have access to one another's resources or knowledge, but not necessarily needs this from all companies present at an EIP.

Figure 6 shows the four phases of an EIP realization visualized against the five phases of ION realization. The first phase of ION realization states that some actors are concerned about a problem, like climate change. The actors want to challenge this issue by realizing an EIP. This corresponds to the first phase of the EIP realization process: the first idea for an EIP. Next, potential actor(s) that could join an ION are identified, actors need, for example meet some requirements to join an ION. This phase is similar to the preparation phase of EIP realization, where the scale of the project and potential partners are selected. After the former step, visions and goals can be created and the scale of the project can be decided upon. This corresponds with the third phase of the EIP (planning phase) and ION (formalizing) realization process. If the vision and goals are established the EIP can be implemented, although IONs uses the operating phase both phases entail the same step: the implementation of an EIP. However after the EIP is implemented, the IONs should be evaluated in the fifth phase: the evaluation.

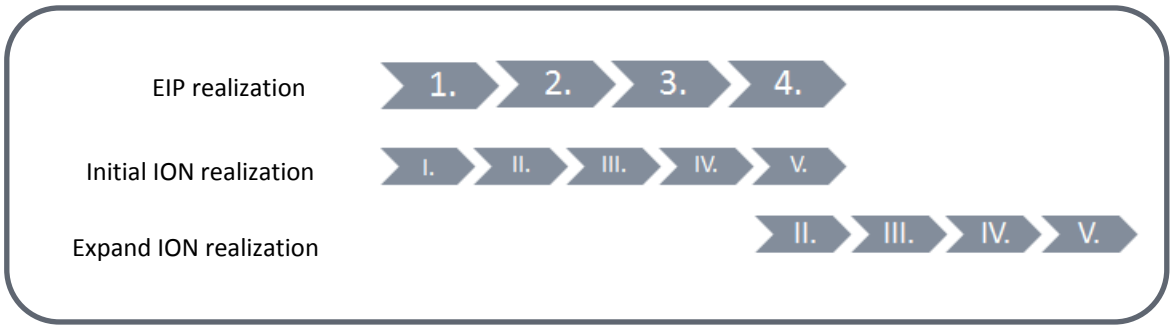


Figure 6. Relationship EIP and ION.

An EIP can be considered as a whole network, which is the collective of all dyadic inter-organizational relationships (Saris et al., 2012). An interesting approach is that a whole network is composed of multiple smaller IONs. The initial ION is mainly realized to get the EIP started, bringing pioneer companies together that want to start the EIP process. If an EIP is eventually in operation new companies can enter the EIP and expand the community building where collaborations between companies occur and exchange of knowledge, information, materials and waste is increased. New interorganizational network can be created and the process can start over again for several times (see figure 6).

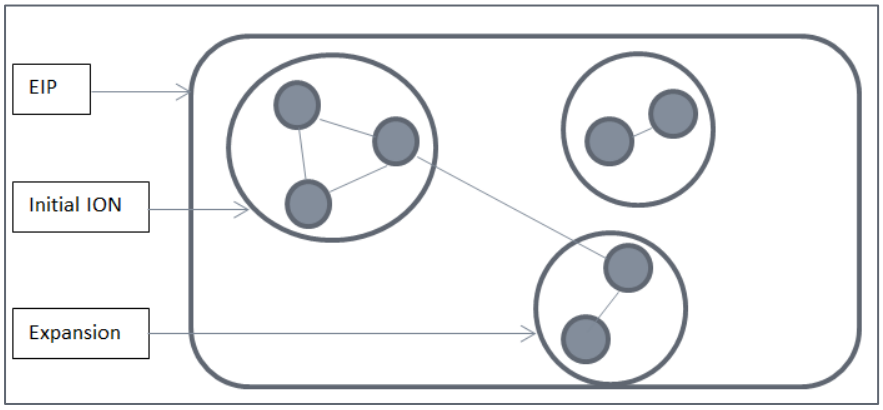


Figure 7. Multiple IONs at an EIP.

The realization process of an EIP and the realization process of the initial ION are developing more or less simultaneously, because an EIP exists by the virtue of IONs. The relationship between an EIP and associated IONs are necessary, because without IONs, EIPs would not exist. An eco-industrial park is actually composed of multiple interorganizational network (see figure 7).

SECTION SUMMARY

There is an evident relationship between EIP and ION. If no IONs are present, then the realization of an EIP is not possible. Exchange relations between companies are not established without collaborations. To explain the relationship between and EIP and the associated IONs it is interesting to compare the realization processes of both concepts. It appears that the realization of an EIP depends on the realization of IONs between companies. However, during the realization of an EIP, new IONs can continuously be created and the different phases of ION realization can occur frequently. New collaborations can arise and new companies can join the EIP.

2.4 CHAPTER SUMMARY

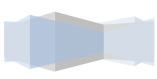
Chapters 2.1, 2.2 and 2.3 discussed the theoretical background where a description of the two main concepts is provided. This chapter summary answers to the first sub research question: *"What is the relationship between eco-industrial parks and interorganizational network based on literature?"*

In order to answer this research question the characteristics of both concepts will be summarized. Section 2.1 investigated the EIPs and provided a clear overview of the concept. EIPs focus on the exchange and flows of knowledge, energy, materials and waste among companies in order to create companies that are more efficient and create industrial parks with an enhanced sustainable development. A multitude of conditions that are necessary for the realization of an EIP are mentioned in literature. However, in this research institutional activity, technical facilitation, economic and financial enabler, informational activity and company activity provide the overarching conditions. If the conditions are tried to be fulfilled, the realization process can take place. Four phases can be identified in the realization process: the initial phase, the preparation phase, the planning phase and the implementation phase. Finally, the realization of an EIP can take a spontaneous or a planned approach.

Section 2.2 focused on the IONs, which originate in the realm of strategic alliances where networks encompass a firm's horizontal and vertical relationships with other organizations. The realization of IONs depend on multiple key factors: environmental factors, memberships, resources, process and structure, communication and the purpose of the ION. The realization process of an ION represents five distinct phases: the developing phase, the identifying phase, the formalizing phase, the operating phase and ends with the performing phase.

Section 2.3 investigates the relationship between EIPs and IONs. A closer look shows that the realization process of both concepts is roughly the same. The different phases are comparable and this seems logical as IONs are of vital importance for the realization of EIPs. IONs entail an organization's common affiliations and exchange relations with other companies. IONs are necessary to achieve the main goal of EIPs: exchange and flows of knowledge, energy, materials. The relationship between an EIP and the associated IONs is clear: if there are no IONs, there is no EIP. The EIP exists due to the networks that are present, an EIP is actually a collection of IONs at a spatially bounded place.

In the next chapter the theoretical framework based on the two main concepts is provided.



THEORETICAL FRAMEWORK

CHAPTER 3 THEORETICAL FRAMEWORK

This section aims to provide a theoretical framework based on the previous literature study on concepts of eco-industrial parks (EIP) and interorganizational networks (ION). The remainder of this section focusses on the relevant variables of the two concepts in order to explain the theoretical basis of this research. At the end of the chapter the theoretical framework belonging to this research is provided and an answer to the second research question is provided: *What are the key variables of eco-industrial parks and interorganizational networks that, based on the literature study, realize the theoretical framework?*

3.1 ECO-INDUSTRIAL PARKS

This part provides a description how the concept of EIPs is related to the empirical part of the research. The realization of EIPs is way of constructing an industrial park in such a way that sustainable development of the area is enhanced. EIPs demonstrate industrial symbioses, where ecological principles are applied to manufacturing systems and results in exchange relations between companies. The exchange relations encourages sustainable development, cooperation, innovations, knowledge sharing and more (section 2.1). Literature shows that the realization of an eco-industrial park depends on a couple of conditions:

- Institutional activity – The involvement of governments that provides laws and regulation, but also loans and subsidies.
- Technical facilitation – the availability of infrastructure for common use and the joint management of resources.
- Economic and financial enablers - Subsides and funds can stimulate the collaboration, adoption of technologies and infrastructures by companies.
- Informational activity – the identification of environmentally desirable actions and feasible opportunities for synergies
- Company activity – focused on the company participation in the exchange of physical by-products and utility sharing.

An important factor, however, in EIP realization is the presence of interorganizational networks. The IONs provide the basis for the exchange relations. Therefor section 2.3 claims that EIPs are actually one big interorganizational network. So, in order to get an improved understanding of EIP realization it is important to investigate the IONs of an industrial park. The empirical research focuses on the description of IONs at EIPs by applying the two analysis tools: event sequence analysis (ESA) and interorganizational network analysis (INA).

3.2 INTERORGANIZATIONAL NETWORKS

EIPs exist by the presence of IONs and therefor form one of the main aspects considering the successful implementation of an EIP. IONs originate in the realm of strategic alliances and encompass a firm's horizontal and vertical relationships with other organizations. The relationship offers the opportunity to exchange materials, goods and knowledge in order to enhance the sustainable development of an EIP. The literature study, part 2.2, presented six categories with key variables that are essential for successful collaboration between companies and realization of a network: factors related to the environment, membership, process and structure, communication, the purpose and resources.

First, factors related to the environment of the company have an effect on the realization of an ION. Literature defines three key factors regarding the company's environments. *First,* the history of collaboration in the community, coalition building is dependent on existing linkages in the community. Experiences in the past with partnerships and collaborations can define if a company wants to join an ION again. It is perceived that negative experiences in the past have a negative effect on new collaborations (Reniers et al., 2010). The *second* factor considering the environment entails that companies involved in the collaborations are perceived as leaders in the community. Companies that take the lead and dare to join an ION at an EIP. The *final* factor includes that for ION realization a favorable social and political climate needs to be present (Cordero-Guzman, 2004). The variables are showed in figure 8.

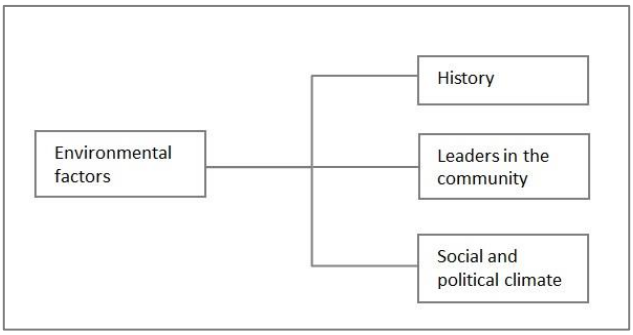


Figure 8. Operational variables of environmental factors.

Second, membership is a key variable for ION realization (figure 9). Respect, understanding and trust is important for the success of collaborations. Reniers et al (2010) and Popp et al (2013) state that trust functions as the lubricant that makes cooperation between companies possible and it is believed that a higher level of trust creates a higher effectiveness. Furthermore, the members of the network must see that there is something to gain from the collaboration. To conclude, members in a network should be open to compromise, it is not possible to satisfy all the companies' self-interest in a large network (Cordero-Guzman, 2004).

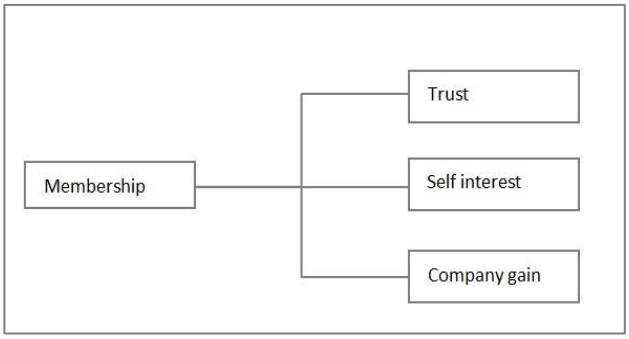


Figure 9. Operational variables of membership.

Third, in terms of process and structure several important factors are mentioned. First it is stated that members in an ION need to share a stake in the process and the outcome. Next, in the process of ION realization there are multiple layers of decisions making, which should be taken into account. Clear guidelines can provide a framework for the different levels of decision making (Cordero-Guzman, 2004). The third factor in this category states that members in a collaboration should be flexible as not every need of a company can be satisfied in a collaboration (Reniers et al., 2010). Finally, the members in an ION should be willing to adapt during the process of ION

realization in order to contribute to successful collaborations (Cordero-Guzman, 2004). All key factors in this category are showed in figure 10.

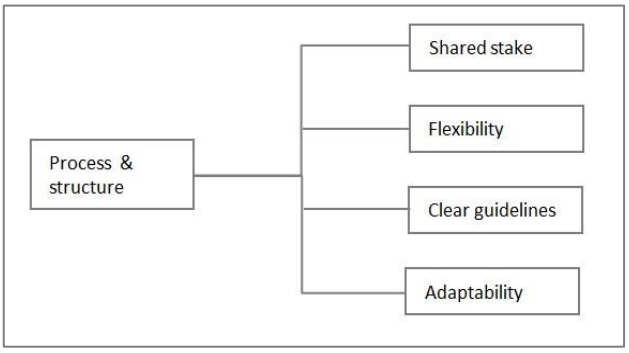


Figure 10. Operational variables of process and structure.

Fourth, communication is the next important category in ION realization. There is a need to establish formal and informal communication links. Formal and informal linkages can provide more openness, that again can create transparency between companies in terms of communication of costs, benefits and risks (Reniers et al., 2010). Furthermore, open and frequent communication offers the opportunity to exchange ideas and knowledge regularly (figure 11). Communication increases the flows of knowledge between companies and enable companies to engage in organizational learning, which entails the exchange of knowledge and integration of new knowledge (Cordero-Guzman, 2004).

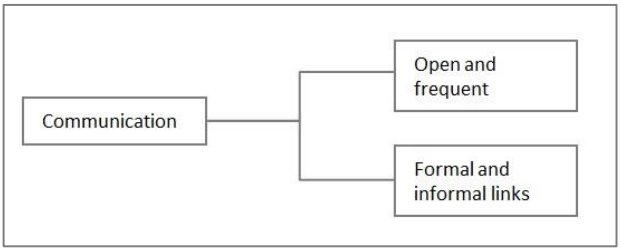


Figure 11. Operational variables of communication.

Fifth, the purpose of the ION is the next factor (figure 12). In order to achieve the purpose of an ION it is necessary to set clear and attainable goals. Including the set goals, a shared vision among the members is needed to achieve the unique purpose of the ION (Cordero-Guzman, 2004). The purpose of an ION could be related to complementarity, the degree in which activities of collaborating companies are similar or overlapping (Reniers et al., 2010).

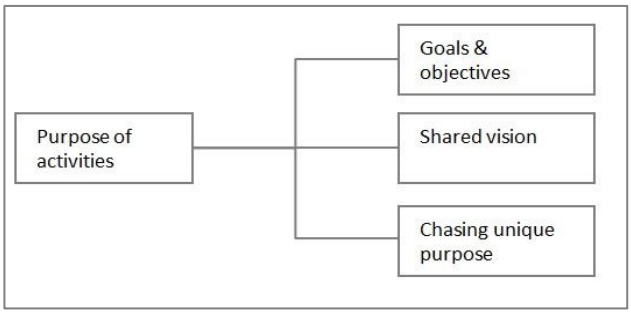


Figure 12. Operational variables of purpose of activities.

The *final* key category for ION realization entails the resources (figure 13). Often resources are needed to start collaboration, for example the availability of funds and subsidies. Furthermore, it is perceived that a skilled convener is able to guide the process towards a successful collaboration (Cordero-Guzman, 2004). The variables belonging to the resources are showed in figure 13.

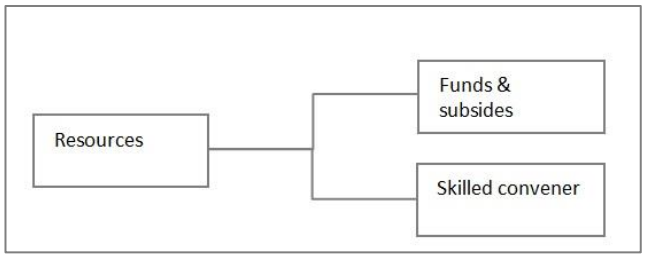


Figure 13. Operational variables of resources.

3.3 THEORETICAL FRAMEWORK

The aim of this research is to get an improved understanding of eco-industrial park realization and this section specifically answers the second research questions: *"What are the key variables of eco-industrial parks and interorganizational networks, based on the literature study, that realize the theoretical framework?"*

Based on the literature study of chapter 2 it is perceived that IONs play an important role in the realization of EIPs. Section 3.2 provided six variables that drive the successful realization of IONS at an EIP. Figure 14 shows a visual representation of the theoretical framework. The left column shows the conditions that should facilitate the realization of EIPs. The second column shows the operational variables derived from section 3.2, which have an effect on the realization of the exogenous variable in the third column: ION realization. In the fourth column the endogenous variable (EIP realization) is showed, which is affected by the exogenous variable.

Considering EIP realization the theoretical framework should be interpreted as follows. In the conditions for EIP realization certain events can take place, these events have an effect on the operational variables. A change in the operational variables has consequences for the exogenous variable: the realization of IONs. Consequently the endogenous variable (improved EIP realization) is then affected by the exogenous variable. This explanation is perhaps a bit theoretical so an example is given based on figure 14:
Let us assume that in the institutional activity an event takes place where a government provides a subsidy when companies exchange energy. This effects the operational variable "funds & subsidies" and subsequently "resources". Due to the subsidy the resources for an ION increase, companies at an EIP may engage in new IONs as this delivers them a return. The change in ION realization based on the occurrence of events can improve our understanding of an EIP realization.

In order to examine these events and changes in networks, this research uses two analysis tools: event sequence analysis and interorganizational network analysis. The next chapter will discuss the methodological background of ESA and INA.

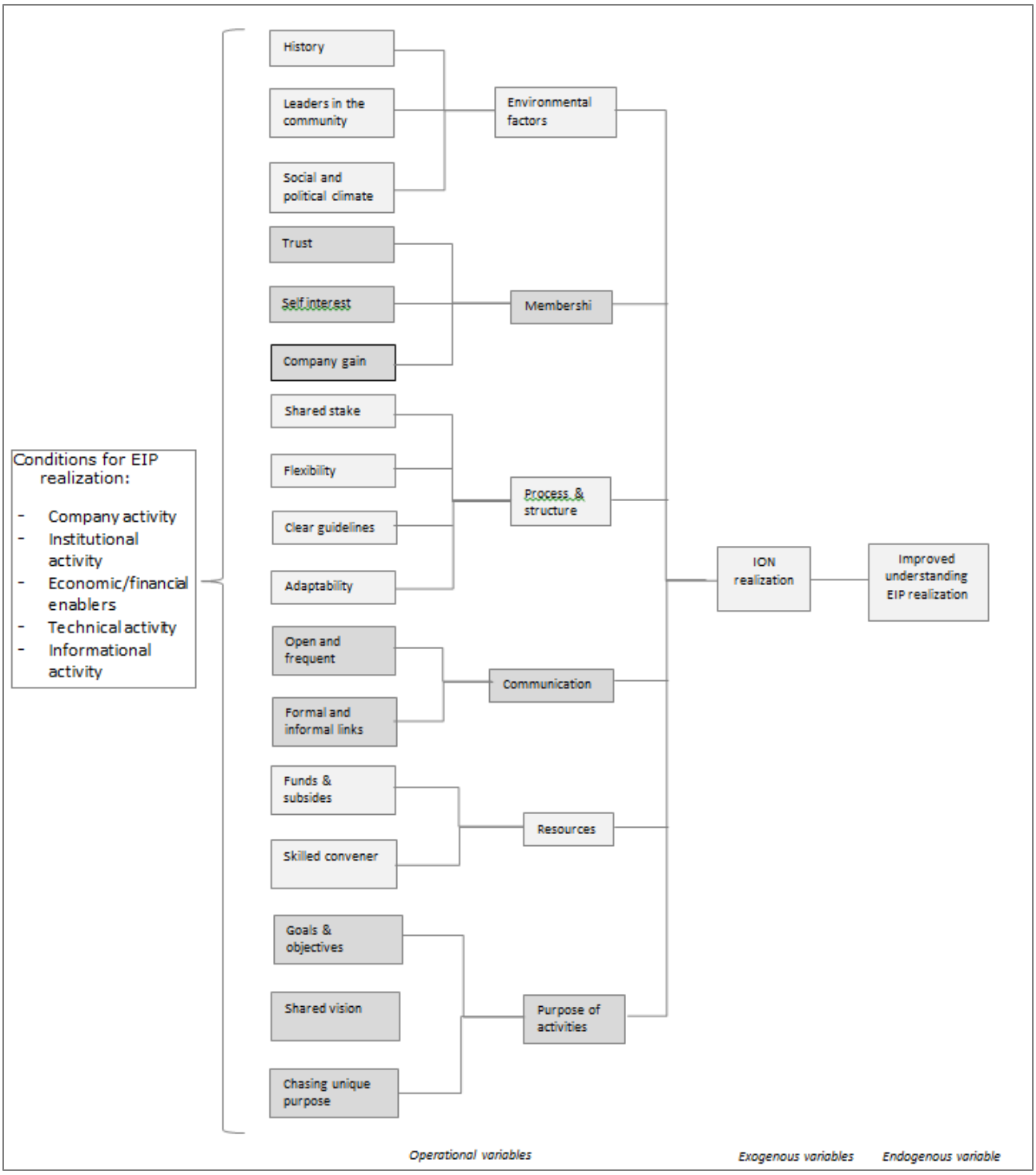


Figure 14. Theoretical framework

METHODOLOGICAL BACKGROUND

EVENT SEQUENCE ANALYSIS

&

INTERORGANIZATIONAL NETWORK ANALYSIS

CHAPTER 4 METHODOLOGICAL BACKGROUND

In chapter 2 and 3 the theoretical background of the main concepts is discussed including the theoretical framework. In order to investigate eco-industrial parks (EIP) this research uses events sequence analysis (ESA) and interorganizational network analysis (INA). This chapter continues with the theoretical background of ESA and INA by explaining their fundamentals. In section 4.1 the ESA is elaborated and the fundamentals of the INA are provided in section 4.2. In the chapter summary the answer is provided to the third sub research question: *"What are the fundamentals of event sequence analysis and interorganizational network analysis?*

4.1 EVENT SEQUENCE ANALYSIS

The analysis of EIPs by ESA is a relatively new approach and finds itself in the exploring phase. In literature on ESA, industrial networks can be seen as webs of interdependent business relationships, where exchange is dependent on activity links, resource ties and actor bonds between different companies (Halinen et al., 2013). The networks between companies are described as interactive and dynamic, but the understanding of the processes behind the networks remains limited (Halinen et al., 2013). To analyze the process of network development the chronological sequence of events constitutes the key building blocks to analyze a network (Halinen et al., 2013). Recently social sciences starts to use ESA to reconstruct the process of ION development in order to constitute a clear image how events emerge, develop and possibly dissolve over time. It offers the opportunity to create and image which crucial decisions and events contributed to the realization of IONs at an EIP (Spekkink, 2013b).

DEFINITION

As stated in section 3.1 the use of ESA for investigating EIPs is still in the primary phase. Research focused on ESA is up to three years old, which has the consequence that few definitions of the concept in this realm are present. However, the Erasmus University Rotterdam is currently performing research on this topic and they have formulated a definition for ESA:

Table 4. Definition of ESA.

Author	Definition
Spekkink (2013a, p.343)	*"ESA is a research approach that offers a set of methods and techniques for the systematic longitudinal investigation of process phenomena."*

The definition from table 4 is very broad and needs explanation. In ESA a process is defined as (Spekkink, 2013a): "*a sequence of events that describes how entities emerge, develop and possibly dissolve over time."* To define something as a process a central subject needs be chosen, this can be a person, group, company or industrial park. When a central subject is decided upon, events can be used to describe the development of the central subject. Events can be described as (Buttriss and Wilkinson, 2007): "*interconnected actions over time and place and can involve individual actions or a system of actions taking place at a given time or over a defined period."*
Because of the limited amount of research on ESA in social sciences the definition is still broad, however with this extended explanation, this definition will be used. The next section will elaborates on how an ESA can be constructed.

CONSTRUCTION OF AN EVENT SEQUENCE ANALYSIS

The goal of an ESA is to analyze the processes behind a central subject, a central subject can be a person, a firm or a network. The focus in ESA should be on the interaction of events that take place over time where actors act and interact. There is a need to move from snapshots in time towards moving pictures where time and order of events is the main interest (Buttris and Wilkinson, 2004).

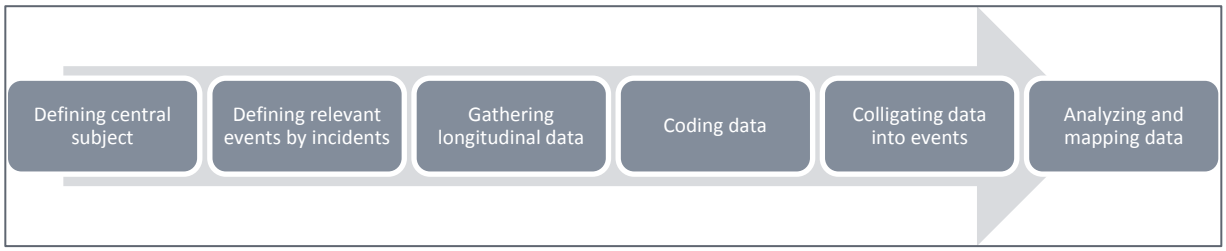


Figure 15. Phases in ESA. Source: Spekkink (2013)

Based on literature on event sequence analysis, six distinct phases can be identified and are visualized in figure 15. *First,* the central subject that needs to be decided upon. A central subject can be any kind of entity, a person, a company or an industrial complex (Makkonen et al., 2012). The central subject does not need to be a fixed entity, because it is subject to change as a result of the events that it endures (Spekkink, 2013a).

Second, the relevant events on the central subject need to be defined. Events can be understood as theoretically significant occurrences that the central subject endures or makes happen (Spekkink, 2013a). Relevant events should be based on the theoretical and conceptual framework of the researcher, moreover events can occur at three levels: macro-, meso- and micro level. An event is not observed directly, but it is a construct that explains a pattern of incidents. Events emerge form single and interconnected incidents occurring at a given time or period (Halinen et al., 2013).

Third, after the relevant types of events are defined, data gathering can take place. The gathered data is recorded as incidents and are retrieved from sources with already existing materials, for example longitudinal data from internet, newspapers and written documents. Figure 16 shows how multiple incidents (I) create events and how subsequently the events form the central subject (Poole et al., 2000). The gathered information is recorded in an event sequence dataset.

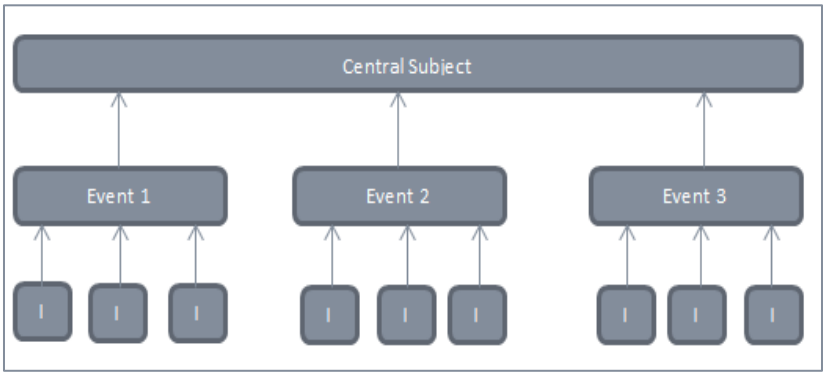


Figure 16. Incidents, events and central subject.

Fourth, after the data is gathered and recorded in a dataset the data needs coding. Coding is necessary to make a clear overview of which incidents belong to which event. *Fifth*, after coding the incidents can be colligated into

events and following the s*ixth* step, the events can be analyzed in several ways. For example by a narrative analysis (Makkonen et al., 2012, Buttriss and Wilkinson, 2007), event time series design (Poole et al., 2000) or by visual/event mapping (Spekkink, 2013a, Halinen et al., 2013). This research will use visual mapping where events are positioned on a timeline. This offers the opportunity to show sequences of events that help to identify processes that influence the central subject. Figure 17 shows a schematic representation of a visual map for ESA. Different incidents occurring in time represent one event.

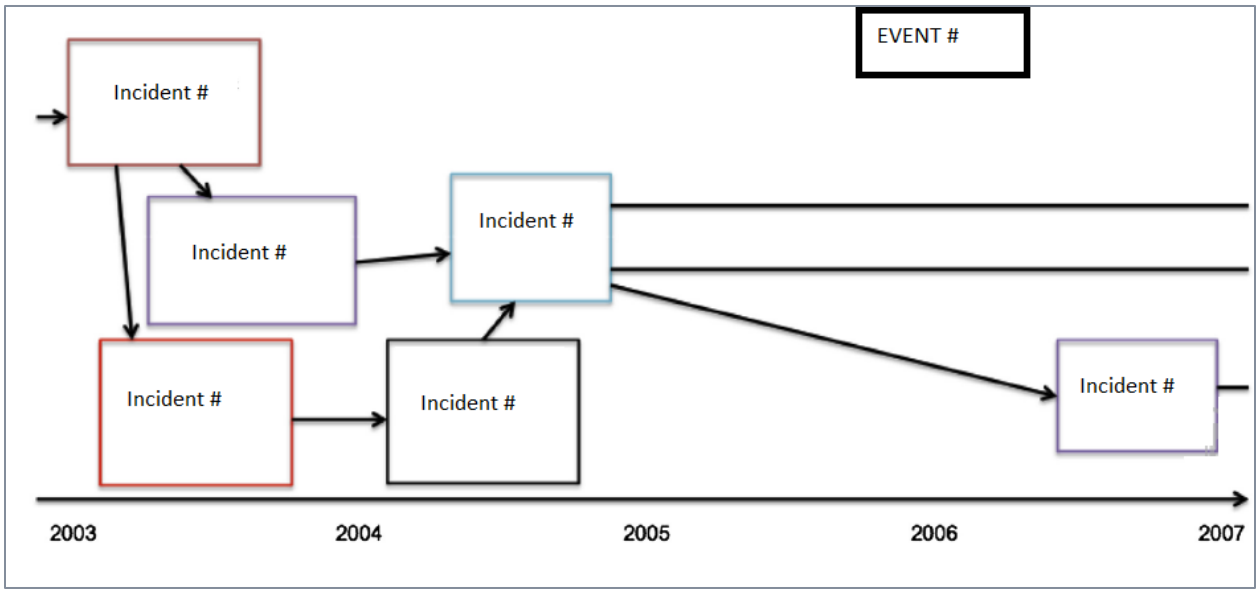


Figure 17. Visual representation of ESA. Source: Spekkink (2013)

To summarize, the theory behind the construction of an ESA is limited, however in the past three years the use of ESA is increased in the social sciences. ESA offers the opportunity to investigate processes behind a central subject by the identification of incidents and events. To construct an ESA six phases can be identified: defining a central subject, defining relevant events, data gathering, coding, colligating and analyzing. Finally, by applying an ESA a more profound understanding of processes realizing a central subject can be achieved.

4.2 INTERORGANIZATIONAL NETWORK ANALYSIS

Section 4.1 elaborated on the first analysis tool, event sequence analysis (ESA), this section continues with the explanation of the second analysis tool: the interorganizational network analysis (INA). An introduction into INA is presented together with the definition to explain the interorganizational network (IONs). Next, section 4.2.4 discusses how INA is based on social network analysis (SNA) in order to IONs.

INTRODUCTION

In order to understand INA it is important to understand the social network concept. Literature states that a network consists of a collection of nodes with a set of ties that link them. The nodes in a network are individuals or collectives of individuals (Halgin, 2012). The analysis of these networks is often executed with the use of SNA. The central idea of SNA is constituted by the graph theory showed in figure 18. A network can possess multiple actors (A, B, C and D), which are linked with each other by lines (or ties). The representation of nodes and lines is the starting point of network analysis. The research goal in social sciences is to explain the formation of network ties and to predict a host of network properties (Borgatti et al., 2009).

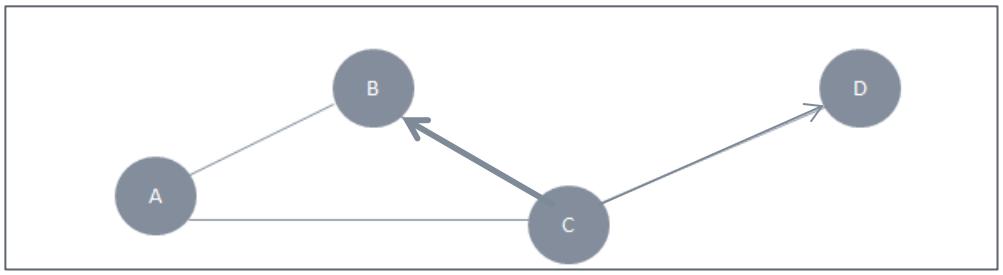


Figure 18. Nodes and ties.

The lines in the socio-gram can be assigned a direction and a value. The line represents the flow of information or resources in a social network, for example the arrow on the line C-D indicates that C provides a flow of information or resources to D. Furthermore, the thickness of line indicates how 'strong' a relation is. For example, the relation between C and B is stronger than the relation between C and D (Scott, 2011).

DEFINITION

There is a main body of literature available on SNA that relates respectively to Wasserman (1994) and Scott (1992, 2000). Definitions in literature are often based on the definition provided by these two scientific writers. Together with the definitions of Wasserman (1994) and Scott (1992), table 5 shows several other definitions for SNA:

Table 5. Definition of an SNA.

Author	Definition
Wasserman and Faust (1994, p.20)	SNA investigates a finite set or sets of actors and the relation or relations (between them)(Wasserman and Faust, 1994).
Scott (2000, p.38)	SNA has emerged as a set of methods for the analysis of social structures, methods which are specifically geared towards an investigation of the relational aspects of these structures (Scott, 2000).
Marin and Wellman (2009, p.2)	SNA is the investigation of a set of socially-relevant nodes connected by one or more relations (Marin and Wellman, 2009).

Hopp and Reinelt (2010, p.600)	SNA is an evaluation approach that uses mathematics and visualization to represent the structure of relationships between people, organizations, goals, interests, and other entities within a larger system (Hoppe and Reinelt, 2010).
Carpenter et al. (2012, 1329)	SNA is the investigation of social phenomena composed of entities connected by specific ties reflecting interaction and interdependence, such as friendship, kinship, knowledge exchange (Carpenter et al., 2012).
Pryke (2012, p.78)	SNA involves the representation of organizational relationships as a system of nodes or actors linked by precisely classified connections, along with the mathematics that defines the structural characteristics of the relationship between the nodes (Pryke, 2012)

The main purpose of a SNA is to identify the relationships between different actors or nodes in a network. When the relationships are identified one can make assumptions about the access to resources, trust, power and control within the network. This research holds on to the most common used definition of SNA, which is the formulation of Wasserman and Faust. Furthermore, it offers the opportunity to see organizations as the actors in the network and offers the opportunity to investigate the relationships between them (Wasserman and Faust, 1994):

"A social network analysis investigates is a finite set or sets of actors and the relation or relations (between them)."

In the next section, the difference between SNA and INA is explained.

FROM SNA TO INA

In the previous section the SNA is discussed, however the focus in SNA is on individual actors (people) whereas this research is focused on the analysis of IONs. The application of SNA in order to analyze IONs has increased in the last years (Zaheer et al., 2013). The study on relationships between companies is referred to as interorganizational network analysis (INA). It differs from other types of social network analysis, because the focus is on the relationships between organizations rather than between persons (Corteville and Min, 2009).

The analysis of the interorganizational level is focused on the ties between organization or firms, for example strategic alliances and buyer-supplier relationships. Zaheer (2013) states that tie strength and content have a bearing on firm behavior and performance and that firms have access to resources and capabilities through their networks. The application of the SNA to IONs helps to explain how central an organization is within the network and if it has a certain power. Furthermore, the INA is able to explain how the interorganizational relations influence the organization's strategy and political behavior (Kraus et al., 2004).

Literature on IONs identifies four mechanisms or properties that are frequently present at networks, separately or as a mix of mechanisms. The four mechanisms are mutually exclusive and offers the opportunity to make a clear distinction on the operations of networks. Networks can function as (Zaheer et al., 2013):

1. resource access,
2. a source of trust,
3. tools of power and control, and as
4. signaling mechanisms.

First, networks are often studied as an important source of resources and capabilities in order to increase the social capital. Social capital refers the instrumental utility and beneficial consequences of a social network, which

can be composed of enhanced performance, increased innovation, greater access to resources and reduced transaction cost (Carpenter et al., 2012).

Second, INA tries to identify networks as a source of trust. It is suggested that higher closure in a network lead to a higher overall trust, moreover a higher trust in networks is connected to lower transaction costs and an increase in the efficiency of the inter-organizational relationships (Zaheer et al., 2013)

Third, in the analysis of networks, centrality is an important feature. Three forms of centrality are seen as important in the analysis of networks: degree-, closeness- and betweenness centrality. Furthermore, INA offers the opportunity to divide companies in a network in "core"-companies and companies belonging to the periphery. They are discussed in the next part shortly, because in the analysis chapter they will be explained further (Hanneman and Riddle, 2005):

> **Degree centrality** is a very simple and effective measure of an actor's centrality and power. It measures their degree of ties, actors with more ties are perceived to be in an advantaged position in the network. These actors have alternative ways to satisfy their needs and are less dependent on other actors.
>
> **Closeness centrality,** where degree centrality only focusses on in- and outgoing ties, closeness centrality puts the emphasis more on the distance of an actor to all other actors in the network. Information or products can reach another actor faster with high closeness, which can be an advantage again.
>
> **Betweenness centrality** focusses on the presence on an intermediary in the network. Suppose actor A want to send information to actor C, but in order to do that it has to via actor B (the intermediary. If you have only one option to send the information, which is B makes actor A heavily dependent on actor B. It is perceived that having more option than actor B to get the information to actor C makes an actor more powerful.
>
> **Core and periphery** actors or nodes with fewer connections are perceived the periphery of a network, actors with more connections are situated in the core of the network.

Fourth, networks can function as signal for the marketplace, which entails that an actor can be judged by its relationships where there is no effective other way to measure the quality of that actor. The quality and status of newcomers can be inferred if they have a relationship with a high-status organization (Zaheer et al., 2013)

This section focuses on the realization of an INA. Past and contemporary literature state that several steps need to be taken in the realization of an INA (Scott, 2000, Pryke, 2012, Carpenter, 2012, Carpenter et al., 2012, Marin and Wellman, 2009): boundary specification, data collection and data analysis.
This section will shortly introduce these steps, in chapter 5 the methodology of this research will examine these steps deeper.
The first step is the boundary specification, the geographical and social boundaries of an INA should be defined. Two basic issues of boundary specification need to be identified: the actor set of potential nodes in the network under study and defining what kind relationships between these nodes will be investigated (Carpenter et al., 2012).

First, the actors inside the specified boundary should be defined, this can be achieved in two ways (Pryke, 2012): In the realist approach the actors in the network define the boundary of the network themselves. They will identify other actors with whom they need to interact to achieve their goals. In the nominalist approach, the researcher specifies the boundary.

Second, after the actors are defined the possible relationships between the actors should be examined. Relationships between different actors can take many shapes and can include among others (Pryke, 2012): transfer of material resources, association or affiliation, physical connection and more. The relationships could be based on social ties, but nowadays the definition is expanded and also includes contractual and financial relationships between actors (Pryke, 2012).

After a clear boundary specification, the second step is data collection. Data can be gathered in multiple ways by observation, from archives and historical materials, scientific literature, interviews and more (Marin and Wellman, 2009). To collect the data the researcher has several network sampling methods to his disposal. The choice depends on the type of network that is going to be investigated: the whole network, a dyadic network or an egocentric network. If a well-defined actor set exists, which focus on modeling the whole network and connecting all actors in the actor set, socio-centric sampling methods are available (Carpenter et al., 2012). This sampling method results in a whole network design which shows the structure of the entire network of interest (Scott, 2000).
Networks that are focused on modeling the properties of single actors and dyadic ties can be captured independently from the boundaries of networks under study. Following, scholars can directly take their sample from the complete actor set without specifying the whole network to which these belong, simple random sampling is the most straightforward method in this case (Carpenter et al., 2012).
Egocentric networks focus on studies that demand for well-defined network boundaries, but have no predetermined actor sets. Egocentric networks often use the snowball sampling method. In snowball sampling an initial set of selected actors report on with whom they have relations and in turn the nominated actors are asked on their relationships with other and so on (Carpenter et al., 2012).

The final phase of the INA entails the analysis of the data. The goal of the analysis is to visualize and calculate measures of the network's properties such as degree-, closeness- and betweenness centrality. It indicates properties of a network and can include the number of relations, the strength of ties, the number of shared relationships, the density of a network, the centrality of nodes and the composition of a network (Marin and Wellman, 2009). In order to make these calculations social network analysts have developed a number of software packages to analysis social network data such as UCINET. Besides the calculations that can be made, visualization of the networks can be provided by the software packages.

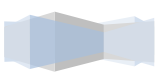
4.3 CHAPTER SUMMARY

Chapter 4 described the two analysis tools that are used in this research: event sequence analysis and interorganizational network analysis. This section provides the information to answer the second sub research question: *"What are the fundamentals of event sequence analysis and interorganizational network analysis?"*

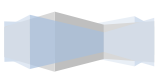
Section 4.1 elaborated on how ESA can be a useful tool to analyze networks. In order to analyze the network processes, the chronological sequence of events can provide new useful information. A sequence of events offers the opportunity to describe, which events have influenced the realization and structure of central subject. In this research the application of ESA is focused on the IONs and the realization of EIPs. The construction of an ESA entails six phases: *first,* a central subject needs to be defined. *Second,* the relevant events on the central subject need to defined. *Third,* incidents to construct the ESA need to be gathered. *Fourth,* the gathered data needs to be coded. *Fifth, a*fter coding the incidents are colligated into events and *finally,* the ESA can be analyzed, for example by visual mapping.

Section 4.2 discussed the fundamentals of INA. INA is based on SNA, which focuses on the graph theory. The graph theory entails that individuals and groups are represented by nodes and are connected by ties. Next, the INA focuses on, instead of individual relationships, on the ties between organizations or firms. The application of SNA to IONs helps to identify how how networks have developed in time and what the reasons are for the shape of the network. The realization of an INA roughly involves three stages: boundary specification, data collection and data analysis. Finally, INA uses software packages to analyze the networks with a visual- and statistical approaches.

This chapter provided the methodological background, the next chapter focusses on the methodology that is used to investigate the IONs at Agriport A7 with ESA and INA.



METHODOLOGY



CHAPTER 5 METHODOLOGY

This chapter starts with a description of the study area of this research: Agriport A7. Following, the methodology for the application of event sequence analysis (ESA) and interorganizational network analysis (INA) to Agriport A7 is described. Separately for ESA and INA the research strategy and research materials that are used are discussed. The chapter ends with a discussion on the validity and reliability of the research.

5.1 STUDY AREA: AGRIPORT A7

Agriport A7 is a modern project location located in the municipality Hollands Kroon, North Holland. The project location is designed for large scale greenhouse growing and open field crops. Hollands Kroon is composed of four municipalities: de Wieringermeer, Anna Paulowna, Niedorp en Wieringen which merged into Hollands Kroon in 2012. The land of the Wieringermeer is reclaimed from sea by creating a classic Dutch ' polder' and created in the 1930s for new farmland. Before the land was reclaimed, the Wieringermeer was part of the Zuiderzee. Prior to the start of Agriport A7 the area was entirely in use for agricultural purposes (Bergstra and Veldhuizen, 2006).
In October 2004 the North Holland 'Development Scenario" was determined by the Province as the new regional plan for North Holland north. The regional plan described that they foresaw a growing demand for glass area due to the growth of the sector and the nationwide restructuring of the horticultural sector. Furthermore, there was a need for more space for the bundling of greenhouses that were scattered throughout the north of Holland. The approval of the regional plan was the starting point for Agriport and from October 2004 onwards Agriport A7 started to develop (BugelHajema, 2010). The goal of Agriport A7 is to cluster companies that are active in the agricultural and logistical business. The combination of different sectors has the aim to close material cycles, reduce traffic, share knowledge, enhance innovation, achieve economies of scale, efficiency improvements and many more (Saris et al., 2012).

The project started with approximately 410 hectare (ha),a ha is 100m x 100m, for greenhouses, 80 ha for agribusiness and logistics and 15 ha for knowledge-intensive business and leisure (Saris et al., 2012). The ha of Agriport were not just available for Agriport, but farmers were bought out. The father of project developer Anton Hiemstra, Simon Hiemstra, is a well-known person in the Agriport-area. He negotiated with farmers on selling their land to Agriport A7, receiving compensation and new land in another area to start a new farm. The first 450 obtained ha was called Agriport 1 (green area in figure 19), where the 410 ha for greenhouses was called the Agropark and the remainder ha for business has the name Business park. At the end of 2006 the Agropark was sold out, Royal Pride Holland, Nursery "de Wieringermeer", Agro Care, Barendse DC, Kesgro, Nursery Helderman had bought land for the large-scale cultivation of peppers and tomatoes with the first harvest in 2007. Furthermore during 2005 en 2006 companies as GAM Bakker, Hiemstra B.V., ZON and Peter Appel Transport, started to settle at the business park.

Agriport 1 was successful and Agriport B.V., the project developer, asked permission to expand with almost 500 ha for new greenhouses. At the end of 2007 the municipality de Wieringermeer (after 2012 Hollands Kroon) agreed with the change in the regional plan and Agriport 2 was born (blue area in figure 19) (BugelHajema, 2010). Red Harvest, Sweetpoint and Combivliet were the first growers to settle at Agriport 2 to start with large-scale growing of peppers and tomatoes.

Figure 19. Map of Agriport A7.

The main goal of Agriport A7 was to cluster agribusiness and logistical companies in order to achieve economies of scale, but also to increase the sustainable development of the sector. Besides agribusiness and logistical companies, Agriport A7 is an agropark that nowadays offers new opportunities for companies to enter the park. The opportunity rose that a datacenter could be realized at Agriport A7. Agriport A7 was perceived as a convenient location for a datacenter as it was close to Amsterdam, a reliable safety profile and it has a fiberglass network. Furthermore, the combination of Agriport A7 and a datacenter offered new opportunities for sustainability as energy or other waste residuals can be reused by greenhouses and contribute to a decrease of the climate problem. At 2010 the regional plan was revised for the third time, now allowing for a datacenter and providing opportunities to expand the datacenter when needed (Dekker, 2010). A related major achievement of Agriport A7 is the datacenter settlement announced in 2013. From 2014 on Microsoft will invest 2 billion euros for a datacenter on Agriport A7 including related infrastructures.

Besides the growth of the Agropark, both in square meters as well as in companies, also the business park kept growing. Between 2006 and 2014, Accon AVM, Bakker Personnel, van der Bel, Crown of Holland, Dakoplast, Dakvenster de Dijken, Graham and Brown, Hesp and sons, Kieft en Elsenga, Microsoft, Palletcentrale, Poultry v/d Laan, Ruigewaard B.V., Schrooder Transport, unmanned gasstation of Shell, restaurant de Tafel van Agriport, Truckwash and Schrooder Transport started to work at the business park of Agriport A7.

The next section present the steps in the application of ESA to Agriport A7, followed by the steps in the application of the INA.

5.2 RESEARCH STRATEGY EVENT SEQUENCE ANALYSIS

The research strategy is described by Verschuren and Doorewaard (2005) as a set of interrelated decisions on how the research will be carried out. Research can be performed by several quantitative methodological strategies. For the event sequence analysis (ESA) a desk study will guide this part of the empirical research. Section 4.1 already briefly described how an ESA should be conducted. The remainder of this section describes an in-depth approach of the ESA applied to Agriport A7. It provides the way of data collection, the selection of relevant incidents and the creation of events and themes.

DESK STUDY

A desk study is a research strategy that is recognized by three main themes: the use of existing material, no direct contact with the object of research and the material is used from another perspective as where for it was produced (Doorewaard and Verschuren, 2005). The construction of ESA is a data-intensive way of research and can be composed of several sources, for example, newspapers, websites and documents. In this research the ESA is composed only from newspapers. This decision is made on the one hand, due to a lack of time. An ESA is very data-intensive and the collection of data takes a long time. On the other hand, newspapers often provide a structured and chronological way of presenting news, which is useful in the construction of an ESA.

DATA COLLECTION

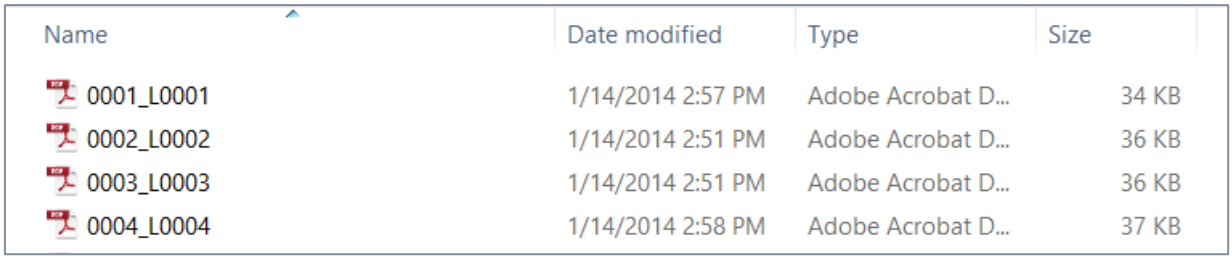
To collect the necessary newspaper articles for the construction of the ESA the program LexisNexis is used. The LexisNexis Group is a corporation that provides computer-assisted legal research services, which entails the electronic accessibility to legal and journalistic documents. From 2006 onwards LexisNexis has the largest electronic database of public-records and legal related information. For the Netherlands it has quick and easy access to articles from the leading newspapers in the Netherlands, but also regional and local newspapers are represented (LexisNexis, 2014).

On 14 December 2013 the collection of data started and finished at 14 February 2014. For the ESA of Agriport A7 the search item “Agriport” was used. It is specifically chosen to use “Agriport” instead of “Agriport A7”, because the addition of A7 is often omitted in newspaper articles. The search term provided exactly 1000 hits, or articles, however the ESA will be conducted for the period 2004-2013. This resulted in the use of 990 articles at the start of this longitudinal research. These articles were put in a database and in the next section the construction of the database will be elaborated.

DATA PROCESSING

In order to organize the newspaper articles in a chronological way, a database was created. The database is a useful tool to store the articles in a systematic way. The next steps were taken to create the database:

First, the hits from LexisNexis were saved manually, one by one, as a PDF-file on a hard disk with a case number e.g. 0968_L0968. Figure 20 presents that the first part of the case number entails four numbers that shows the total amount of units in the whole dataset up to that hit, so 968. The *second* part of the case number

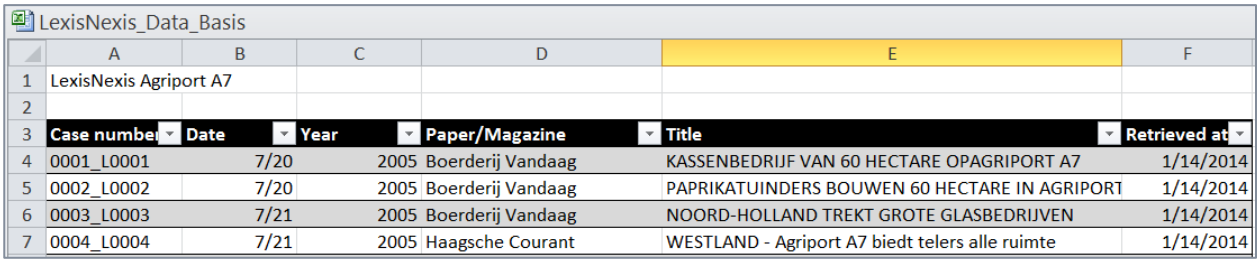


Name	Date modified	Type	Size
0001_L0001	1/14/2014 2:57 PM	Adobe Acrobat D...	34 KB
0002_L0002	1/14/2014 2:51 PM	Adobe Acrobat D...	36 KB
0003_L0003	1/14/2014 2:51 PM	Adobe Acrobat D...	36 KB
0004_L0004	1/14/2014 2:58 PM	Adobe Acrobat D...	37 KB

Figure 20. Database PDF-files.

starts with the letter L, which stands for LexisNexis. The four numbers followed by the L entail the number of units of that particular source. Therefore, this is the 968th LexisNexis-file in this database, up to that point. This coding scheme allows the opportunity to expand the database with other sources. Let us assume that the database is expanded with websites. Every website that is added will get the letter W. For example 1153_W0067, this is interpreted that the total database entails 1153 units up to that point, this particular file is a website and it is the 67th website in the total database.

Second, after the newspapers were saved, key information of that article was filed in an Excel map, such as case number, date , year, paper/magazine, title and date of retrieving.
Figure 21 shows the saved key information in Excel and allows the researcher to order the data in different ways. By using the top down menus the articles can be ordered by date, by newspaper and so on.



LexisNexis_Data_Basis

	A	B	C	D	E	F
1	LexisNexis Agriport A7					
2						
3	Case numbe	Date	Year	Paper/Magazine	Title	Retrieved at
4	0001_L0001	7/20	2005	Boerderij Vandaag	KASSENBEDRIJF VAN 60 HECTARE OPAGRIPORT A7	1/14/2014
5	0002_L0002	7/20	2005	Boerderij Vandaag	PAPRIKATUINDERS BOUWEN 60 HECTARE IN AGRIPORT	1/14/2014
6	0003_L0003	7/21	2005	Boerderij Vandaag	NOORD-HOLLAND TREKT GROTE GLASBEDRIJVEN	1/14/2014
7	0004_L0004	7/21	2005	Haagsche Courant	WESTLAND - Agriport A7 biedt telers alle ruimte	1/14/2014

Figure 21. Database in Excel.

Third, the database based on the LexisNexis articles contained 990 files. In this database some necessary corrections needed to be made. The articles had to be checked for redundancy, as some articles are identical printed in multiple newspapers throughout the Netherlands, as they all copy one source. After the removal of the redundant copies, the total dataset consisted of 860 articles.

Fourth, after the redundant copies were removed the dataset needed to be checked on relevance. Not all 860 articles are useful to create the ESA. This is achieved by reading and scanning the articles on relevance. Relevance is based on the fact that Agriport A7 needs to be the central subject of an article, and not play just a minor role in the article. After the scanning of the articles the total database for the ESA consisted of 208 articles.

Each time a new selection process starts, a copy of the previous made database needs to be saved. If the next step is to check for redundancy a copy of the original dataset is used, named “Clean database”, to delete the files that are redundant. To check on “relevance” a copy of the map “Clean database” is made and named “Relevance” where the articles are deleted that are not relevant. The same should be done for the Excel file. After the creation of the database, three databases with articles were created: the original database (990 units), the cleaned

database, after a check for redundancy (860), and finally the database sorted on relevancy (208). The same counts for the Excel map. In the next part, the creation of the actual ESA is exemplified and is based on the “Relevance” – database.

DATA CODING

After all the incidents were collected and stored in a database and the needed corrections were made, the final incidents from the “relevance” - database needed to be ordered in a structured and chronological way. This is achieved by creating a timeline, it shows how the incidents follow each other in time. Annex 1 shows the timeline with the key features, such as a short description of the incident, date and year of occurrence, original magazine and a hyperlink to the PDF-file where the incident is mentioned, this gives a clear overview when the incidents has taken place and where it can be found.

Furthermore, Annex 1 presents the coding scheme, which can identified by the colored squares. Former research, among others by Spekkink (2013) created a coding scheme in such a way that with statistics the reliability of the coding scheme could be measured. However, due to a lack of time this is not possible and a more simple, tough effective coding scheme is created. Each incident receives a code composed of a color and text. Each code represents an event. All incidents will be assigned a code and translated into an event. This Excel sheet serves as the basis for the ESA analysis part.

5.3 RESEARCH STRATEGY INTERORGANIZATIONAL NETWORK ANALYSIS

This section describes the research strategy for the interorganizational network analysis (INA). In empirical research there are many strategies possible, in this research the case study has been chosen as an appropriate research strategy. Section 4.2 already briefly described how an INA should be created, however in the remainder of this section the case study design will be elaborated further. Next, the case study strategy is explained, the interview design and interview protocol are discussed and a section summary is provided.

CASE STUDY STRATEGY

The case study is a cross sectional type of research that gains insight into processes and objects restricted in space and time. It can provide a snapshot of an organization or event at a certain moment in time, where the goal is to understand the case of analysis as a whole (Vaus, 2001).The case study strategy is characterized among others by (Doorewaard and Verschuren, 2005):

- by a small number of research units,
- an in-depth approach,
- a selective sample, and
- a qualitative way of collecting data.

On the one hand, case studies can be focused on creating and extending a certain theory, called theory-centered case studies. On the other hand, theory can be used to better understand a case, this is called a case-centered study. This research is a case-centered research and to be more specific, a clinical case study. The goal of a clinical case is to use existing theories to better understand a case or a problem (Vaus, 2001). In this research, the goal is to get a better understanding of eco-industrial park realization (EIO) and the role that IONs play in this realization. The existing theories on eco-industrial park realization, Interorganizational networks, ESA and INA applied to Agriport A7 should create a better understanding.

INTERVIEW DESIGN

In order to conduct the case study, questionnaires are conducted at Agriport A7 (Annex 2). The questionnaires can be perceived as a semi-structured interview with standardized open and closed questions (Doorewaard and Verschuren, 2005). Respondents could answer in multiple ways, for example by a 5- or 7-point Likert scale, by ticking boxes or by giving answer to an open question.

To conduct the questionnaires, face-to-face interviews are an appropriate tool to use for this research. The use of the face-to-face variant offers a couple of advantages for the researcher (Doorewaard and Verschuren, 2005):

- There is possibility of interaction between the researcher and the respondent,
- The respondent/researcher can ask for an explanation – the respondent might not understand a question or the researcher might not understand an answer,
- Advantage of expressions – voice, intonation, body language, facial expression. These can be crucial for the correct interpretation of an answer, and
- There is a possibility to ask follow up questions etc.

Though, the face-to-face interviews has also disadvantages (Opdenakker, 2006, Doorewaard and Verschuren, 2005) :

- Performing the interviews can be very time consuming,
- Also the transcription of the interviews can take up a lot of time afterwards,
- Due to a possible large distance to the respondents, transportation costs can arise,
- The position of the respondent is important for the outcomes of the interview, and
- The interviewer is able to guide the interview in a certain directions with his behavior.

The main reason to choose for the face-to-face interview was the crucial factor to get in touch with all the respondents available at Agriport A7. It was important to include as much interviews as possible in order to get a complete overview of the social relations and collaborations present at Agriport A7. It was perceived that the response-rate by doing interviews would be higher than by sending them questionnaires by email. Conducting the questionnaires by phone was not an option as the questionnaire is complex to do by phone.

The time factor appeared as a crucial factor after the first three interviews. The set up was that the interviewer would complete the questionnaire on a laptop together with the respondent. However, after the first three interviews it became clear that the respondents did not like this way of working, it was perceived is boring and very time consuming. This was caused by the fact that they had to read all the questions and answers, which took too long.
After this was noticed, it was decided that the interview set up needed to be adapted. For the remainder of the interviews a more interview-style was created. The interviewer asked the exact same questions of the questionnaire, but now in a real conversation and not by completing a questionnaire on a laptop (see Annex 3). This resulted in better answers; respondents were more eager to give answers and provided more information than when just a questionnaire was completed. Based on the interviews, the interviewer completed the questionnaires afterwards for the respondents. By using this method, interviews were pleasant for the respondents and also the questionnaires could be completed.

INTERVIEW PROTOCOL

In order to profit from the advantages that a face-to-face interview offers and to avoid the disadvantages the face-to-face interview possesses an interview protocol is created. An interview protocol provides the interviewer with a plan for the interview. At one extreme, an interview protocol may provide very minimal directions, leading to a less structured interview. On the other extreme the interview protocol can contain elaborate specifications to ensure that the researcher's topics of interest are covered (Tavakoli, 2012). Moreover the main function of the interview protocol is to help the interviewer by (Tavakoli, 2012):

- ensuring the domain is properly covered an nothing important is forgotten,
- suggesting appropriate choice of words,
- offering a list of useful questions to be used,
- offering a template for the opening- and closing statement, and
- list some remarks to keep in mind.

In this research the questionnaire functioned as the interview protocol, it contained an opening, and closing statement, the questions covered the interested areas and the choice of words were deliberately chosen. However, during the research, as mentioned earlier, the way of working changed from completing the questionnaires on a laptop with the respondent into a real interview. The questions from the questionnaire were still used however in a different form (Annex 3), these had to be asked now instead of reading them from the screen.

In order to obtain good interviews the disadvantages of face-to-face interviews needed to be reduced as much as possible. Therefor the interviews, with the help of the interview protocol, were conducted in the following way. *First*, as interviews can be very time consuming and data-intensive not everything that was said could be noted at that moment. In order to get a complete overview of what was said in the interview, they were recorded on tape (with permission of the respondent) and a transcription of each recording was provided (see Annex 4). However, it is stated that transcribing the interviews afterwards can be very time consuming it is a method that guarantees that everything that is said in the interview can be used in the analysis.

Second, in order to conduct the interviews, the researcher had to travel to Agriport A7. The distance was overcome with the use of a car owned by the interviewer. The decision was made to make as many appointments for interviews on one day, so the number of rides and costs could be reduced. Nevertheless, some costs were made on gas and a gift as appreciation (bottle of wine) for the respondent, but these were reimbursed by the university of Wageningen.

Third, the position of the respondent should be in line with the goal of the research. In this research the aim is to expose the inter-organizational relationships and networks at Agriport A7. Therefor it is necessary that the respondents are people that represent the company and are aware of the relationships with other companies. The decision is made that this should be the director of the company, or when there are multiple directors, the director who has the most knowledge on this matter. Furthermore not only the companies present at Agriport A7 should be interviewed, but also the project developer and the director of Agriport's own energy company. This should result in a clear overview of the inter-organizational relationships.

The challenge in this research was to get at least all the agricultural and logistical businesses included in the interviews, as well as the project developer and the director of the energy company. The contact information was far from complete, so email addresses were retrieved from the Internet. For the larger part, it was possible to make appointments by email, but some respondents needed to be called to make an appointment. Appointments were made with the companies that were in full activity at Agriport in 2013. This resulted in the fact that 70% of the organizations were interviewed, which corresponds to 19 interviews. On forehand, the aim was to, at least, interview all greenhouse growers, logistical companies, the project developer and the director of the energy company. In the 70% all agricultural- and logistical companies were included, as well as the project developer and the energy director. During the appointments always a high representative (e.g. a financial-, operational- or executive director) was interviewed.

Fourth, in order not to guide the respondent in a certain direction it was important to stick close to the questions from the questionnaire. Furthermore, the respondents were asked permission to use the results of the interview, although anonymous, in the research. This was recorded in a confidentiality agreement, however in practice the larger part of the respondents did not see the need to sign this agreement and were fine with publishing the outcomes.

At the start of the interview, the purpose of the interview was explained and a short description of the kind of questions the respondent could expect was given. The duration of the interviewed varied from 35 to 90 minutes as the crops in the greenhouses were replaced during this period and most agricultural organizations were very busy at that moment. During the interviews, the questions from the questionnaire were asked focusing on themes ranging from the establishment of the organization on Agriport to the inter-organizational relationships among the companies. Question 1 to 12 relate to the business information: name, function of the respondent etc. From question 13 onwards the questions were focused on the establishment of companies at Agriport A7 and topics related to their mutual relationships. Table 6 shows which subject belonged to which question and what type of question this was.

Table 6. Subject of the questionnaire- and interview questions.

Subject	Question number	Type of question
Business/personal information	1-12	Open question/tick boxes.
Performance at Agriport	13	7-Likert scale
Satisfaction of collaborations	14	7-Likert scale
Influence of external stakeholders	15	7-Likert scale
Other stakeholders	16	Open question
Collaborations: history	A	Open question/tick boxes
Collaborations: interest	B	5-Likert scale
Collaborations: frequency formal	C	7-Likert scale
Collaborations: frequency informal	D	7-Likert scale
Collaborations: dependency	E	7-Likert scale
Collaborations: trust	F	7-Likert scale
Collaborations: impact and affection	G	7-Likert scale
Collaborations: governance	H	Tick boxes
Other organisations on Agriport A7		Open question
Additional information		Open question

Despite the big variety of data that was provided, this research will mainly focus on the mutual collaborations at Agriport A7, which is Question number A. Due to a lack of time it is not possible to include more questions in the analysis. However, the remainder of the data from the interview can be used in further research on this topic. With the use of UCINET the relationships will be visualized. Deeper elaboration on the collaborations will be provided in the analysis chapter.

5.4 VALIDITY AND RELIABILITY

The internal and external validity of a research design is fundamental. Internal validity is achieved when a research design can sustain the causal conclusions that are claimed for it. External validity refers to the extent to which the results of a research can be generalized (Vaus, 2001).
Not only the validity is crucial in a research design, also the reliability is of great importance. Reliability entails that one gets the same reading of a measure when it is used on a repeated occasion. From this point of view it seems that reliability and validity are the same, however this is not the case. A research can be reliable without being valid. Measures in social science will never be completely valid or reliable, but the aim needs to be to maximize these two aspects and minimize the ambiguities as far as possible (Vaus, 2001).

INTERNAL VALIDITY

The internal validity considers whether or not a researcher is sufficiently able to underpin claims about the research with empirical data (Doorewaard and Verschuren, 2005). In both event sequence analysis (ESA) and interorganizational analysis (INA) it is attempted to enlarge the interval validity as far as possible. In the next part for each of the analysis method the internal validity will be described.

The event sequence analysis (ESA) is a relatively new method of describing social events. A comparable research is done at Biopark Terneuzen. The research is published in the meanwhile and shows that his way of working with an ESA is of academic level (Spekkink, 2013a). To enhance the internal validity of this ESA, Wouter Spekkink was consulted on how to conduct an ESA. The way he conducted an ESA was explained and repeated for Agriport A7. However, due to a lack of time it was not possible to conduct the ESA exactly the same, as also is mentioned in the methodology of the ESA previously. To be certain that the method used in this research was comparable with the method used by Wouter Spekkink another meeting was arranged to discuss the results. The conclusion was that the way the ESA was conducted in this research is adequate for scientific research. Furthermore, in order to enhance the internal validity other sources are consulted, such as scientific literature to make explicitly clear what is meant with the different theories and terms used in ESA.

To conduct the INA already a questionnaire was created and used in other research projects. The use of the questionnaire at other agro-parks proved that the questions was solid for scientific research and usable for publications. This enhances the internal validity for the INA at Agriport A7, furthermore literature is consulted to strengthen the theories and understanding of terms.

EXTERNAL VALIDITY

The external validity entails in which extent the research can be generalized beyond the particular study (Vaus, 2001). For both the ESA and INA it is difficult to enhance the external validity for the desk study as well as the case study. Agriport A7 is a unique agro park, which provides personal opinions and interpretations. Also, the realization process described by the ESA is unique to Agriport A7 and cannot be copied exactly to other agro parks. To generalize the particular outcomes, considering the realization of Agriport A7 and the role of interorganizational network, to other agro parks is difficult.

However, there are possibilities to generalize the findings of this research. It can be stated that the single case has not the highest interest, but the higher goal is the main interest. In this research, Agriport A7 is just the practical example for the main research (*Mayring*, 2007). The main research consists of the application of ESA and INA to EIPs. Therefor the methods and techniques described in section 5.2 and 5.3 can be generalized to the investigation of other EIPs and provides the external validity beyond this particular study.

RELIABILITY

Reliability in a research concerns the fact that a certain measure gives the same reading when it is repeated. Poor questioning, different interviewers, questioning respondents with insufficient information or ask a question that requires a too precise answer can lead to unreliable data (Vaus, 2001). *First*, the reliability of this research is enhanced due to the fact that all interviews are done by the same person. *Second*, the methods and materials (the use of LexisNexes and an already structured questionnaire) that are used in the ESA and INA have been proved scientifically sound. The questionnaire for the INA was provided by a PhD-candidate and was already tested on other agro parks, which have resulted in scientific publications. The method used for ESA is used by another PhD-candidate, Wouter Spekkink, and proved to be scientifically usable as also a publication has been provided (Spekkink, 2013a). *Third,* the respondents were high ranked representatives of their companies and possessed the required information to give precise answers to the questions. Furthermore, all interviews are recorded and transcribed and questionnaires have been filled in and saved on a external hard disk.

5.5 CHAPTER SUMMARY

Section 5.1 provided an overview of the study area: Agriport A7. This section was followed by part 5.2, which demonstrated the research strategy and materials used for the ESA. To conduct an ESA a desk study is used and data needs to be collected from LexisNexis and processed in a database. Next, the database is updated to the point that only relevant newspaper articles are included. These newspaper articles, or incidents, are then coded and colligated into events. The coded Excel sheet serves as the basis for the analysis part of the event sequence analysis.

Section 5.3 elaborated on the research design of the INA, a case study of Agriport A7. To realize a good analysis of the case study, performed by face-to-face interviews, it is important to create a well-fitting interview protocol. The protocol provides the researcher with a guideline for the interviews and can help to minimize the disadvantages and maximize the advantages of the face-to-face interview. The interview protocol has yielded 19 interviews, which is a 70% coverage of respondents at Agriport A7.

Finally in section 5.4, the internal- and external validity of this research is covered. The internal validity is based on former research on the topics. This research by amongst others Spekkink (2013) and Nuhoff-Isakhanyan (2010) show that used methods for INA and ESA are sufficient to perform this research. The external validity of this research is sometimes difficult to enhance. However, one should keep in mind that external validity of this research lies in the higher aim of the research. This particular case may not have the high external validity, but the methods and techniques used in the research strategies can be generalized for further research to EIPs.

RESULTS & ANALYSIS

CHAPTER 6 RESULTS AND ANALYSIS

This chapter shows how event sequence analysis (ESA) and interorganizational network analysis (INA) are applied to Agriport A7. First, a start is made with the creation of a complete timeline of Agriport A7 with the application of ESA. Followed, by a visual- and statistical approach of Agriport A7 by using the INA. Chapter 6 discusses what additional information the use of ESA and INA, applied to Agriport A7, can generate and whether or not this is an added value to the domain of EIP. This will answer the fourth research question: *"What additional information does the application of ESA and INA at Agriport A7 provide"*

6.1 AGRIPORT A7: EVENT SEQUENCE ANALYSIS

As stated in section 4.1 the ESA is a longitudinal investigation of a project, in this research: Agriport A7. This part shows the result of the application of an ESA to Agriport A7 based on the research strategy formulated in the methodology chapter. This part is an expansion of part 4.1 on the construction of an ESA and shows a more in-depth approach of the method.

INCIDENTS

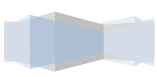
To construct the ESA the most important incidents that have occurred at Agriport A7 are displayed in a timeline (see Annex 1). Each incident (or newspaper article) is given a short description and a code. We will discuss this code in the next section. Furthermore, for each incident the date, the year of publishing and the original magazine or newspaper is shown. Finally, each incident has a hyperlink that directs to the accompanying newspaper article in the database.

The result of this timeline is a visual overview of the realization trajectory of Agriport A7; Annex 1 provides the full timeline of Agriport A7. It offers the opportunity to get familiar with the study area in a relatively short time. These incidents entail some crucial events that are of importance for the realization of interorganizational networks (IONs) and the realization of Agriport A7. Next, these incidents need to be colligated into events in order to recognize a pattern how these incidents follow upon each other and influence processes at Agriport A7. This is discussed in the next section.

EVENTS AND THEMES

After the 208 relevant incidents for Agriport A7 were identified and placed in the timeline, the incidents belonging to the same event are colligated and a name for that event is assigned. Each event shows a crucial process or range of decisions that might be important for ION realization. Each single event can be assigned to a theme and each theme can possess multiple events. To illustrate, at Agriport A7 multiple events are performed in the informational activity area, for example the realization of wind turbines and geothermal heat. In this context, the (possible) realization of wind turbines is a single event and the realization of geothermal heat is a single event. However, they belong to the same theme called informational activity. This colligating in events and themes is of vital importance to understand the different processes and decisions taken at Agriport A7. Annex 1 shows that each incident can be provided with a code. This code represents one particular incident that belongs to one single event. For example, table 7 shows that *geothermal heat* in the event *informational activity* has de code "IA_01". IA is the abbreviation of informational activity and 01 means that geothermal heat is the first event in this theme. Incidents related to that particular theme receives this code.

However, this research aims to investigate the combination of ESA and INA. For this purpose, it is not necessary to code all incidents, create each single event and assign it to a theme. To show the combination, chapter 7 discusses five examples of an event and shows how these can be combined with INA.



MAPPING

The output of the ESA on Agriport A7 is comprised of two parts. *First*, a complete timeline is provided in Annex 1, providing important incidents occurred at Agriport. *Second*, visualizations of important events at Agriport A7 are presented, based on the layout discussed in section 4.1. Figure 22 illustrates the mapping of one single event, again using the example of geothermal heat. In the visualization the theme, event and code are provided in the left upper corner. Next, the incidents retrieved from the timeline which are coded are placed on the new timeline. This shows how a certain event is created, evolved, and possibly dissolved over time. When we analyse the geothermal heat event, it can be stated that the geothermal heat event has started already in 2007, but really started to develop since 2012.

The advantage of mapping events is *first*, it gives a more clear and structured overview of one particular event. *Second*, it offers the opportunity to see if an event evolves or maybe dissolves over time. *Third*, the visualization can help to analyse the INA, as will be treated in the section on a combined use of ESA and INA.

EVENTS AT AGRIPORT A7

Based on Annex 1 five events have been identified that will be investigated in this research. Each event is situated in a theme and the themes are based on the five conditions that are key to EIP realization mentioned in section 3.1. Off course, more events have happened at Agriport A7, however due to a lack of time this analysis restricts to one event per key condition. Table 7 shows the events, the accompanying themes and codes. In the remainder of this section the each event and accompanying theme will be discussed. Each event and theme will be described shortly and in chapter 7 these events will be used for the combined use of ESA and INA.

The *first* event is situated in the theme *company activity* and is called *settlement*. Company activity focuses on the company participation in the exchange of physical by-products and utility sharing (Yu et al., 2013). The importance of the theme is that it presents when companies have entered Agriport A7.

The *second* event represents the theme *institutional activity* and is called *structural- and development plans.* Yu et. al (2013) states that an appropriate institutional setting is an important condition as policy interventions can motivate the realization of new EIPs. Structural- and development plans are important tools for the realization of EIPs, as they indicate what the function of a piece of land is and if, for example, greenhouse are allowed to build on Agriport A7.

Third, this event concerns *economic and financial enablers* and is called *financial crisis.* As stated in section 3.1 the realization of EIPs depends on economic and financial enablers such as subsidies, funds and loans. Without economic and financial support, the realization of an EIP can become difficult.

The *fourth* event is part of the theme *technical facilitation* and is called *ECW*. Technical facilitation focuses on the availability of infrastructure of common use. For example, to arrange energy and material flows (Yu et al., 2013). The ECW is the energy facilitator at Agriport A7 and it is interesting to investigate how the company has been established and which networks are involved.

Finally, the *fifth* event that is discussed is positioned in the theme *informational activity* and focusses on *geothermal heat*. The main goal of informational activity at an EIP is the identification of environmentally desirable actions and feasible opportunities for synergies. Event 5 is focused on *geothermal heat* and can be perceived as a environmentally desired action as less natural resources have to be used due to the heat that can be used.

Table 7. Events at Agriport A7

Theme	Event	Code
Company activity	Settlement	CA_01
Institutional activity	Structural/development plans	InA_01
Economic and financial enablers	Financial crisis	EE_01
Technical facilitation	Energie Centrale Wieringermeer	TA_01
Informational activity	Geothermal heat	IA_01

In chapter 7, focusing on the combination of ESA and INA, the five events from table 7 will be presented in an visual image. Following, the events will be discussed and compared with the INA of that particular event. First, the separate application of INA to Agriport A7 will be elaborated in the next section.

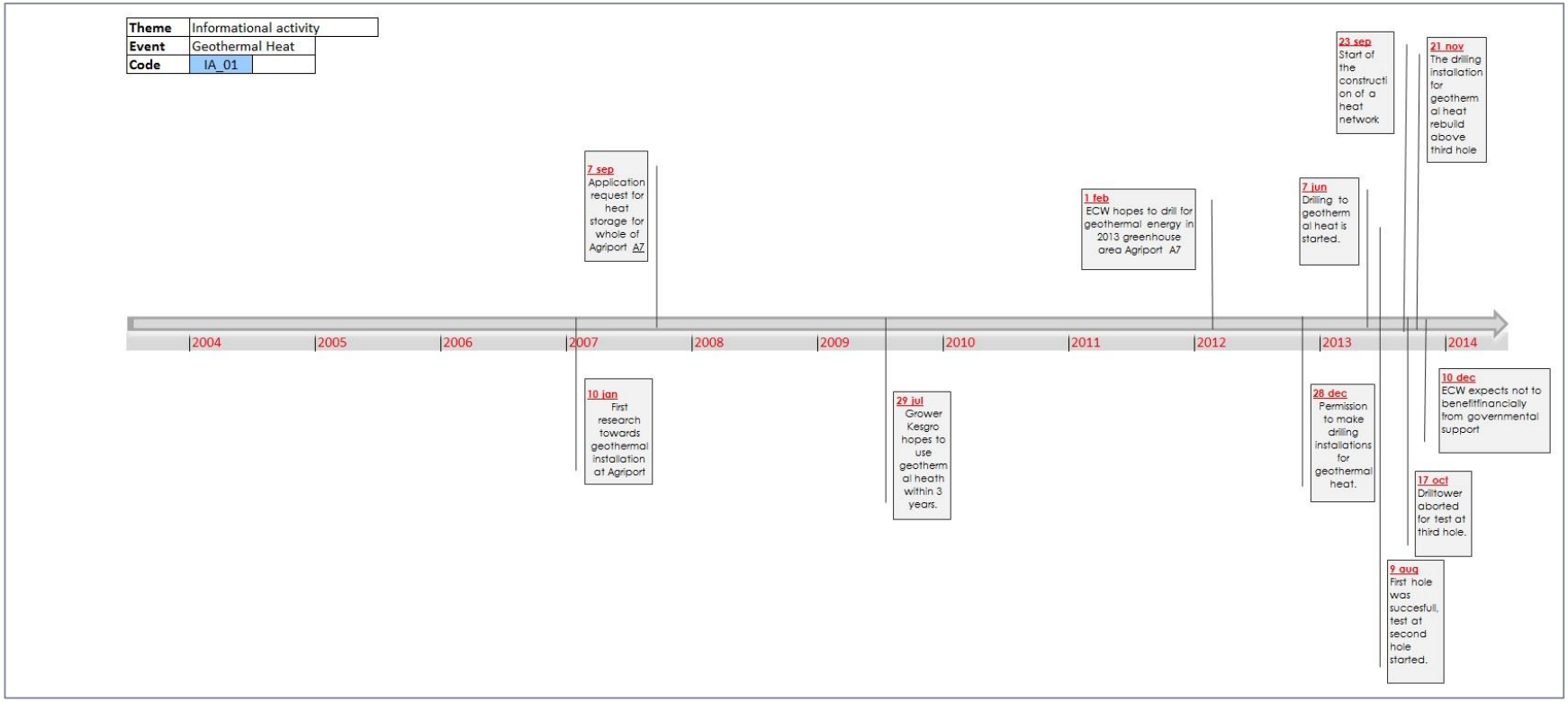


Figure 22. Example event geothermal heat

6.2 AGRIPORT A7: INTERORGANIZATIONAL NETWORK ANALYSIS

In this research, one of the main interests is how interorganizational network (IONs) could contribute to eco-industrial park (EIP) realization. In order to retrieve the IONs, an interorganizational network analysis (INA) was conducted at Agriport A7 to make clear which organizations collaborated with other organizations. This part shows the result of the INA at Agriport A7, where the program UCINET is used to analyse the interviews taken at Agriport A7. This sections starts with a short explanation of the software program UCINET, followed by comments on centrality at Agriport A7

UCINET

UCINET is a program that, amongst others, can analyse social relationships by offering two approaches: the visual approach and the statistical approach. The visual approach of UCINET offers the opportunity to visualize a network and the accompanying relationships. Furthermore, UCINET can provide a statistical approach in order to calculate the centrality of a network; the fundamentals of centrality are described in section 3.3.3. The visual- and statistical approach help to better understand and interpret a network..

This research focusses on the basic ties between companies, basic ties includes whether or not companies collaborate. As a result, the measures are also on a basic scale. However, it still provides a good first insight on the collaborations at Agriport A7.

VISUAL APPROACH

The visual approach is based on the data obtained from the interviews conducted at Agriport A7. The interviewees were asked with whom they collaborated. The result is figure 23, which shows the companies present at Agriport A7 and the relationships between the companies. In addition, the year in which the company signed the purchase agreement at Agriport A7 is indicated on the right side. However, a remark needs to be made about figure 23 as

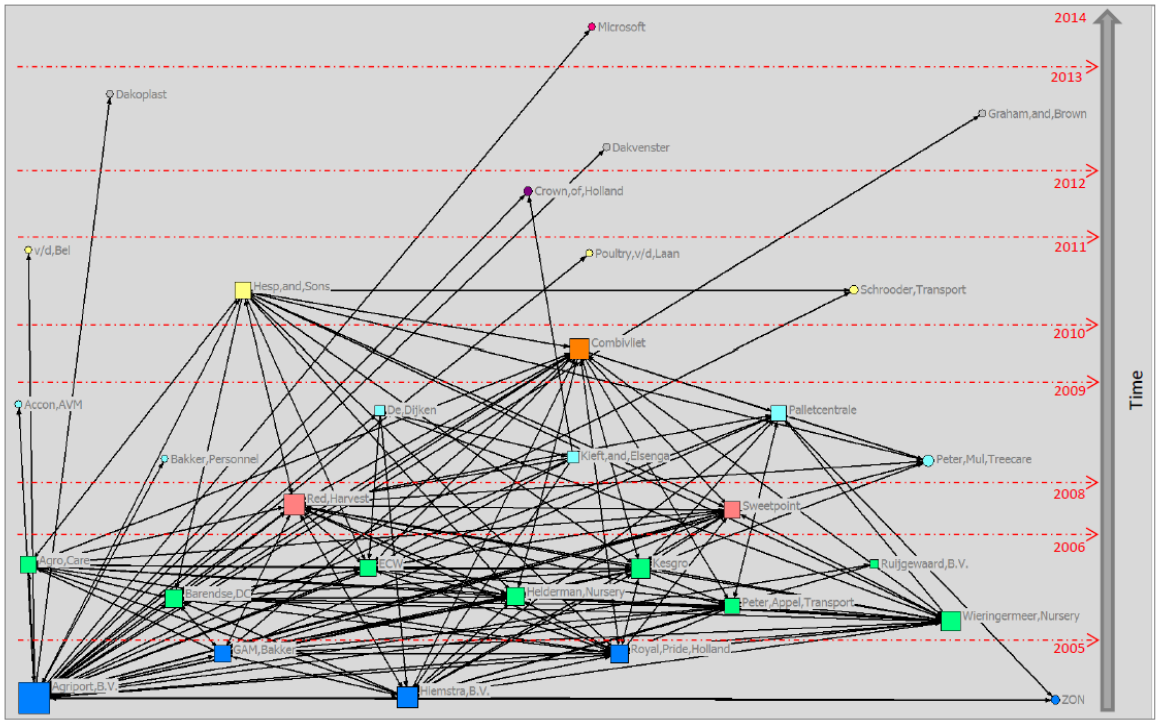


Figure 23. Network Agriport A7

not all actors are interviewed. On the one hand, because they were unattainable or did not want to participate in the research. On the other hand, companies that originate in 2013 en 2014 were not operational at Agriport at the moment of interviewing (see table 8)

Nevertheless, the unattainable and not-interested companies are included in figure 23 to give an upmost updated current situation of Agriport A7. Furthermore, the key actors like growers, logistical companies and early business park companies are almost all included in the interviews, which provides a sufficient amount of respondents. The companies with a square node indicate interviewed actors and the companies with a round node indicate the ones that are not interviewed. The black lines indicate the in- and outgoing ties from the actors:, the outgoing ties reflect with whom an organization from Agriport collaborates; the ingoing ties reflect how many other companies from Agriport state that they are collaborating with that single company. The size of the square and round nodes in figure 23 indicates the relative size of a company. So, the more in- and outgoing ties a companies has, the bigger the actor is.

Table 8. Interviewed companies at Agriport A7.

Company	Interview – not interviewed	Shape in figure 23
Agriport B.V., *Agro Care*, Barendse DC, *Combivliet*, De Dijken, *ECW*, GAM Bakker, *Helderman Nursery*, Hesp and Sons, *Hiemstra B.V.*, Kesgro, *Kieft and Elsenga*, Palletcentrale, *Peter Appel Transport*, Red Harvest, *Royal Pride Holland*, Ruigewaard B.V., *Sweetpoint*, Wieringermeer Nursery.	Yes	Square
Accon AVM , *Bakker Personeelsdiensten*, Peter Mul Treecare, *Poultry v/d Laan*, Schrooder Transport, *v/d Bel*, ZON.	No, unattainable or not interested.	Round
Crown of Holland, *Dakoplast*, Dakvenster, *Graham and Brown*, Microsoft	No, not operational yet. Presumably in 2014.	Round

From figure 23 one can learn, that Agriport A7 started in 2005 with five companies. Gradually more companies joined the agro park. Figure 23 shows that collaborations between companies that settled between 2005 and 2010 are present in a high degree. However, figure 23 shows that the density of ties between companies decreases after 2010. This has some specific reasons, which will be discussed in chapter 7 on a combined use of ESA and INA.

STATISTICAL APPROACH

The statistical approach of UCINET offers calculations on centrality of the network of Agriport A7. It offers an in-depth investigation providing information of the degree of the network, the closeness and the betweenness of the actors of Agriport A7.

DEGREE CENTRALITY

The degree centrality informs the researcher on the number of ties that an actor has. Actors with more ties may be in an advantaged position. However it is possible that a network has multiple central actors (Hanneman and Riddle, 2005). Figure 24 shows the degree centrality of Agriport A7, the Outdegree focusses on the outgoing ties of a company and Indegree focuses on the ingoing ties of a company. The figure shows that the companies in the blue box have more ties than the companies outside the blue box, which is reflected by the high numbers in column 1 and 2.

Two remarks need to be made, *first* it should be noted that a company in the blue box is a greenhouse grower, the project developer or the energy company. The data shows that the companies from the blue box do not refer a lot to the other companies, which indicates that the upper companies probably have more inter-organizational ties than the lower part. *Second,* a distinction should be made between the growers, logistical companies, ECW and Agriport B.V., visible in the blue box, and the other companies that are interviewed. The companies positioned between outside the blue box differ in their core business compared to the companies in the blue box. Apparently, the companies in the blue box have systematically more inter-organizational ties between each other than others.

Compared with the results from figure 23, each company in the blue box is in the lower part of figure 23 where the density of ties is high. The high scores on degree centrality explain the high density of ties in figure 23. The lower scores of the companies between outside the blue box are represented by the higher upper part of figure 23, where the ties are less and explain the lower values in figure 24.

		1 OutDegree	2 InDegree	3 NrmOutDeg	4 NrmInDeg
2	Agriport B.V.	30.000	16.000	100.000	53.333
24	Red Harvest	16.000	15.000	53.333	50.000
30	Wieringermeer Nursery	14.000	14.000	46.667	46.667
17	Kesgro	14.000	14.000	46.667	46.667
6	Combivliet	14.000	11.000	46.667	36.667
14	Helderman Nursery	13.000	13.000	43.333	43.333
12	GAM Bakker	13.000	10.000	43.333	33.333
15	Hesp and Sons	13.000	2.000	43.333	6.667
16	Hiemstra B.V.	13.000	10.000	43.333	33.333
5	Barendse DC	12.000	14.000	40.000	46.667
25	Royal Pride Holland	11.000	13.000	36.667	43.333
3	Agro Care	10.000	12.000	33.333	40.000
11	ECW	10.000	13.000	33.333	43.333
28	Sweetpoint	8.000	13.000	26.667	43.333
18	Kieft and Elsenga	6.000	2.000	20.000	6.667
20	Palletcentrale	6.000	7.000	20.000	23.333
10	De Dijken	5.000	3.000	16.667	10.000
21	Peter Appel Transport	5.000	10.000	16.667	33.333
26	Ruijgewaard B.V.	1.000	1.000	3.333	3.333
8	Dakoplast	0.000	1.000	0.000	3.333
7	Crown of Holland	0.000	2.000	0.000	6.667
22	Peter Mul Treecare	0.000	6.000	0.000	20.000
1	Accon AVM	0.000	1.000	0.000	3.333
9	Dakvenster	0.000	1.000	0.000	3.333
4	Bakker Personnel	0.000	1.000	0.000	3.333
19	Microsoft	0.000	1.000	0.000	3.333
27	Schrooder Transport	0.000	2.000	0.000	6.667
13	Graham and Brown	0.000	1.000	0.000	3.333
29	v/d Bel	0.000	1.000	0.000	3.333
23	Poultry v/d Laan	0.000	1.000	0.000	3.333
31	ZON	0.000	3.000	0.000	10.000

Figure 24. Degree centrality at Agriport A7.

CLOSENESS CENTRALITY

In centrality measures, the concept of farness indicates how “far” an actor is from another actor. For closeness, centrality the reciprocal of farness is computed and refers to how close an actor is to other actors in the network. The computed reciprocal distance measures how short the path lengths between nodes are. The greater the value of the reciprocal distance, the greater is the ‘connectedness’ of the actor (Abhishek and Aseem, 2010).

Closeness centrality is used as degree centrality is sometimes criticized, because it only takes immediate ties in account that an actor has, rather than indirect ties to all others. It is possible that an actor will be tied to a lot of others, but those others might be rather disconnected from the whole network. This results in the fact that an actor can be rather central, but only in the local neighbourhood. Closeness centrality tries to fill this gap by emphasizing the distance of an actor to all others by focusing on the distance from each actor to all others (Hanneman and Riddle, 2005).

Closeness Centrality Measures

		1	2	3	4
		inCloseness	outCloseness	NinCloseness	NoutClosenes
2	Agriport B.V.	17.000	30.000	56.667	100.000
24	Red Harvest	16.500	23.000	55.000	76.667
30	Wieringermeer Nursery	16.000	22.000	53.333	73.333
5	Barendse DC	16.000	21.000	53.333	70.000
17	Kesgro	16.000	22.000	53.333	73.333
14	Helderman Nursery	15.500	21.500	51.667	71.667
25	Royal Pride Holland	15.500	20.500	51.667	68.333
28	Sweetpoint	15.500	19.000	51.667	63.333
11	ECW	15.333	20.000	51.111	66.667
3	Agro Care	15.000	20.000	50.000	66.667
6	Combivliet	14.500	22.000	48.333	73.333
16	Hiemstra B.V.	14.000	21.500	46.667	71.667
12	GAM Bakker	14.000	21.500	46.667	71.667
21	Peter Appel Transport	14.000	15.333	46.667	51.111
22	Peter Mul Treecare	12.333	0.000	41.111	0.000
20	Palletcentrale	12.333	18.000	41.111	60.000
31	ZON	11.000	0.000	36.667	0.000
7	Crown of Holland	10.167	0.000	33.889	0.000
10	De Dijken	10.167	17.500	33.889	58.333
27	Schrooder Transport	10.167	0.000	33.889	0.000
15	Hesp and Sons	9.833	21.500	32.778	71.667
19	Microsoft	9.667	0.000	32.222	0.000
8	Dakoplast	9.667	0.000	32.222	0.000
4	Bakker Personnel	9.667	0.000	32.222	0.000
18	Klett and Elsenga	9.667	18.000	32.222	60.000
29	v/d Bel	9.667	0.000	32.222	0.000
9	Dakvenster	9.667	0.000	32.222	0.000
13	Graham and Brown	9.667	0.000	32.222	0.000
23	Poultry v/d Laan	9.667	0.000	32.222	0.000
1	Accon AVM	9.667	0.000	32.222	0.000
26	Ruijgewaard B.V.	9.333	12.833	31.111	42.778

Figure 25. Closeness centrality at Agriport A7.

Figure 25 shows the closeness of Agriport A7, column 1 & 2 present that the closeness between the companies do relatively not differ much. In column 1 that maximum inCloseness is 17.000 and the minimum 9.667. In column 2 the maximum outCloseness is 30.00 and the minimum is 12.833. This indicates that there is some distance between companies considering their collaborations. This can be referred back to their core business activities. Companies can be close to each other, but if the core business differs too much, no collaborations will start. As the maximum and minimum of the column 1 and 2 are relatively close to each other, the network can be perceived as close. Entailing that companies can easily and fast contact each other and distances to other companies are short.

BETWEENNESS CENTRALITY

The data obtained by the interviews is directed, binary data. Directed data means that ties point towards a certain direction, from or towards a node. Binary data indicates that relations are simply distinguishable, a relation can be absent or a relation can be present (Hanneman and Riddle, 2005). With binary data betweenness centrality views a company in a favored position, when the company is situated on the geodesic paths between other pairs of companies in the network. The more other companies depend on this intermediary, the more power that company has (Hanneman and Riddle, 2005). The data shows a lot of variation in the betweenness of the different companies. Figure 26 shows the spread ranging from zero to 253.235 and there is also some variation as the standard deviation is 44.756 relative to a mean of 12.419.

Despite the fact that the network shows a large variation, the overall centralization of this network is relatively low, which is shown by the relative low numbers after the first four actors in figure 26. This makes sense in this case, as each company at Agriport has easy "access" to other companies without using an intermediary. This is the cause that there is not much betweenness at Agriport A7, also there is not one company that has a lot of power over others at Agriport A7.

		1 Betweenness	2 nBetweenness
2	Agriport B.V.	253.235	29.108
16	Hiemstra B.V.	40.845	4.695
24	Red Harvest	23.969	2.755
30	Wieringermeer Nursery	13.656	1.570
17	Kesgro	9.870	1.135
20	Palletcentrale	7.379	0.848
5	Barendse DC	6.579	0.756
12	GAM Bakker	6.137	0.705
25	Royal Pride Holland	5.347	0.615
6	Combivliet	4.717	0.542
11	ECW	4.393	0.505
14	Helderman Nursery	3.208	0.369
21	Peter Appel Transport	1.571	0.181
28	Sweetpoint	1.501	0.173
10	De Dijken	0.825	0.095
18	Kieft and Elsenga	0.700	0.080
15	Hesp and Sons	0.667	0.077
3	Agro Care	0.400	0.046
8	Dakopiast	0.000	0.000
19	Microsoft	0.000	0.000
7	Crown of Holland	0.000	0.000
22	Peter Mul Treecare	0.000	0.000
1	Accon AVM	0.000	0.000
9	Dakvenster	0.000	0.000
4	Bakker Personnel	0.000	0.000
26	Ruijgewaard B.V.	0.000	0.000
27	Schrooder Transport	0.000	0.000
13	Graham and Brown	0.000	0.000
29	v/d Bel	0.000	0.000
23	Poultry v/d Laan	0.000	0.000
31	ZON	0.000	0.000

DESCRIPTIVE STATISTICS FOR EACH MEASURE

		1 Betweenness	2 nBetweenness
1	Mean	12.419	1.428
2	Std Dev	44.756	5.144
3	Sum	385.000	44.253
4	Variance	2003.089	26.464
5	SSQ	66877.195	883.567
6	MCSSQ	62095.746	820.396
7	Euc Norm	258.606	29.725
8	Minimum	0.000	0.000
9	Maximum	253.235	29.108
10	N of Obs	31.000	31.000

Network Centralization Index = 28.60%

Figure 26. Betweenness Centrality Agriport A7

Nevertheless, there is a structural basis for a couple of actors to be perceived as "different" from the other in the population. For example Agriport B.V. and Hiemstra B.V. have a relatively high score on betweenness. The interviewees could see these actors as the companies that make things happen (Hanneman and Riddle, 2005). In the case of Agriport A7 the project developer, Anton Hiemstra, is highly involved in both companies. Agriport B.V. facilitates actions like: innovations, park management, expansions and more. Interviewees may perceive Agriport B.V. as an intermediary in this sense, however Agriport B.V. has not a lot of power over the business operations of single companies.

CORE AND PERIPHERY

Besides the measures on degree-, closeness-, and betweenness centrality, UCINET provides a measure that indicates which actors belong to the core or the periphery of the network. Figure 27 shows the set of actors that have a high density of ties and form the core of the network. The second set shows the set of actors that have a lower density of ties and therefor they form the periphery (Hanneman and Riddle, 2005). However, to the periphery group also the not-interviewed actors are attached.

```
Core/Periphery Class Memberships:

    1:  Agriport B.V.  Agro Care Barendse DC Combivliet ECW
GAM Bakker Helderman Nursery  Hesp and Sons Hiemstra B.V.
Kesgro Peter Appel Transport Red Harvest Royal Pride Holland
Sweetpoint Wieringermeer Nursery
    2:  Accon AVM Bakker Personnel Crown of Holland Dakoplast
Dakvenster De Dijken Graham and Brown Kieft and Elsenga
Microsoft Palletcentrale Peter Mul Treecare Poultry v/d Laan
Ruijgewaard B.V. Schrooder Transport v/d Bel ZON
```

Figure 27. Core and Periphery

The actors that are belonging to the core of the Agriport A7 – network are involved in the most ties, this is also visible in figure 23. The ties have highest density between the core-actors that entered Agriport A7 between 2005 and 2010. Furthermore, the companies that belong to the periphery are situated more in the upper area, 2010-2014, or outside the large amount of ties in the area 2005-2010.

6.3 CHAPTER SUMMARY

The chapter summary allows the fourth sub research questions to be answered: *"What additional information does the separate application of ESA and INA at Agriport A7 provide?"*

Section 6.1 described that the application of ESA to Agriport A7 resulted in a number of findings. *First,* a timeline is presented that provides a chronological overview of how Agriport A7 is realized. The timeline is based on newspaper articles and includes amongst other the date, the year of publishing and the original magazine the incident. Based on these incidents, events can be created that have played a crucial role in the realization and development of Agriport A7.

Section 6.2 discussed the INA of Agriport A7. Based on the face-to-face interviews conducted at Agriport A7. UCINET could be used to provide two approaches of network analysis: a visual and a statistical approach. The visual approach showed the companies and their relationships in a map. Besides the visualizations that the INA could provide by using UCINET, also a statistical approach can used to determine the centralities. Centrality measures offer the opportunity to calculate which companies are central in a network or how close the companies are to each other. Furthermore, the calculations provide an overview of companies belonging to the core of the network or the periphery.

This research shows that the use of ESA and INA both provide another way of describing the realization of Agriport A7. The ESA offers the longitudinal scope of Agriport A7, including a historical perspective. Furthermore, the ESA provides the opportunity to identify events inside the five main conditions that influence the structure of a network and the realization of an EIP. Additionally, the events that are indicated in the ESA can explain changes in the operational variables of the theoretical framework (figure 14).

INA offers the cross-sectional scope that is focused on the current state of Agriport A7. UCINET is used to analyse the findings from the face-to-face interviews and provides additional information to the ESA in two ways. *First,* UCINET offers the opportunity to visualize the changes in the structure of a network due to the events identified in the ESA. *Second,* the program provides a statistical perspective, where measures on centrality can be executed. Statistics on centrality offer the opportunity to make statements about the overall properties of the network.

As a conclusion, it can be stated that the separate application of ESA and INA provides the bigger picture of Agriport A7. Additional information of Agriport A7 is provided by the timeline with the accompanying events. Furthermore, the INA offers new information as relationships are visualized and the centrality of Agriport's network is calculated. However, the separate application of ESA and INA does not provide information how events have influenced the realization of IONs at Agriport and subsequently how this can improve the understanding of EIP realization. Chapter 7 focuses on these more detailed information and provides new insights how events can influence IONs.

COMBINATION OF ESA & INA

CHAPTER 7 AGRIPORT A7: COMBINATION OF ANALYSIS TOOLS

Chapter 6 described the application of event sequence analysis (ESA) and interorganizational network analysis (INA) separately and showed that both tools provide additional information in the analysis of Agriport A7' network. However, the scope of this research is to identify if the combination of ESA and INA offers new insights for eco-industrial park (EIP) realization by investigation the interorganizational networks (IONs). The aim of this section is to focus on particular events at Agriport A7, derived from the ESA-timeline in Annex 1 (section 6.1). Next, the combination of ESA and INA provides a more detailed investigation of Agriport's networks. This chapter answers the final sub research question: *What new insights does the combined application of ESA and INA provide for Agriport A7?*

7.1 EVENTS AND NETWORKS

Chapter 7 focuses on the combination of ESA and INA, and if the combination provides new insights in ION realization of Agriport A7. Chapter 6 offered the timeline of Agriport A7 (see Annex 1), from the timeline several crucial events could be retrieved that contributed to the realization of Agriport A7. Section 7.1 describes how in the next parts the combination of ESA and INA is tested. To conduct the combination, the five events described in section 6.1 are used in combination with figures derived from the INA that help to analyse the shape of the network and how the shape is affected by the events.

In the five following sections, 7.1.1 – 7.1.5, each time a theme with the accompanying event is discussed. Based on part 6.1, in short the events were:

1. Company activity – Settlement
2. Institutional activity – Structural- and development plans
3. Economic and financial enablers – Financial crisis
4. Technical activity – ECW
5. Informational activity – Geothermal Heat

In order to discuss the combination of ESA and INA, the next section shows five events that have occurred at Agriport. A short explanation of the event is provided, followed by a figure derived from UCINET. The figure shows what the consequences or implications of the event have on the network of Agriport A7. Each section ends with the describing how the combination of ESA and INA in a particular event provides new insights on the realization of the network of Agriport A7.

LEGENDA

In the figures derived from UCINET, figure 29, 31, 33, 35 and 37, the actors are indicated with nodes. These nodes can be squared or circled. A squared node means that this company is interviewed during the fieldwork, a circled node indicates that this actor was not able to be interviewed or the company was not yet operational (see table 8). The size of the nodes is based on the amount of network ties, so a big node indicates a high amount of ties and a small node indicates fewer ties.
Furthermore, the colours of the node indicate the year of settlement, so all blue nodes are from 2005, all green nodes are from 2006 and so on. One exception needs to be made and that is figure 33, the explanation of the colours is give at the figure itself.

COMPANY ACTIVITY – SETTLEMENT

Section 6.1, stated that *company activity* refers to participation of companies in the exchange of physical by-products and utility sharing. In order to investigate the participation in the network it is necessary to know when each company entered Agriport A7 and what the current relationships are between those companies.

Figure 28 shows the event sequence analysis of the event *settlement*. It shows in a chronological order that in the period 2005-2014 constantly companies entered Agriport A7. The ESA indicates that Agriport A7 is growing every year since it has started. However, it is not possible to identify how the network has evolved. A weakness of ESA is that the method is not able to visualize the construction of the network and the accompanying ties between the different actors.

Next, in figure 29 the INA of the event settlement is presented. During the interviews, the companies were asked about their collaborations with other companies at Agriport A7. The results from the interviews offer the opportunity to construct an overview of how the network has evolved during the period 2005-2014. Each block in figure 29, shows how each year new companies entered Agriport A7, including the ties that are currently present between those companies. The figure on the right of the last row shows the current state of the Agriport A7 considering companies and their accompanying ties.

It is interesting to analyse what new insights can be derived from the combination of ESA and INA in this event. The ESA shows that during the period 2005-2014 every year new companies enter Agriport A7, it is expected that this should also increase the amount of interorganizational ties. More companies at Agriport A7 could foster more collaborations for the exchange of materials, goods and knowledge.
However, figure 29 shows the INA of the event and presents the amount of ties generated between the companies of Agriport A7. What is striking is that between companies that settled in the period 2005-2010, 189 ties are created. Proceeding on this finding, in the period 2011-2014 only 25 more ties have been created between settled and new entered companies. A new insight that is derived is that at Agriport A7, an increase of companies not necessarily involves an increase of interorganizational collaborations.

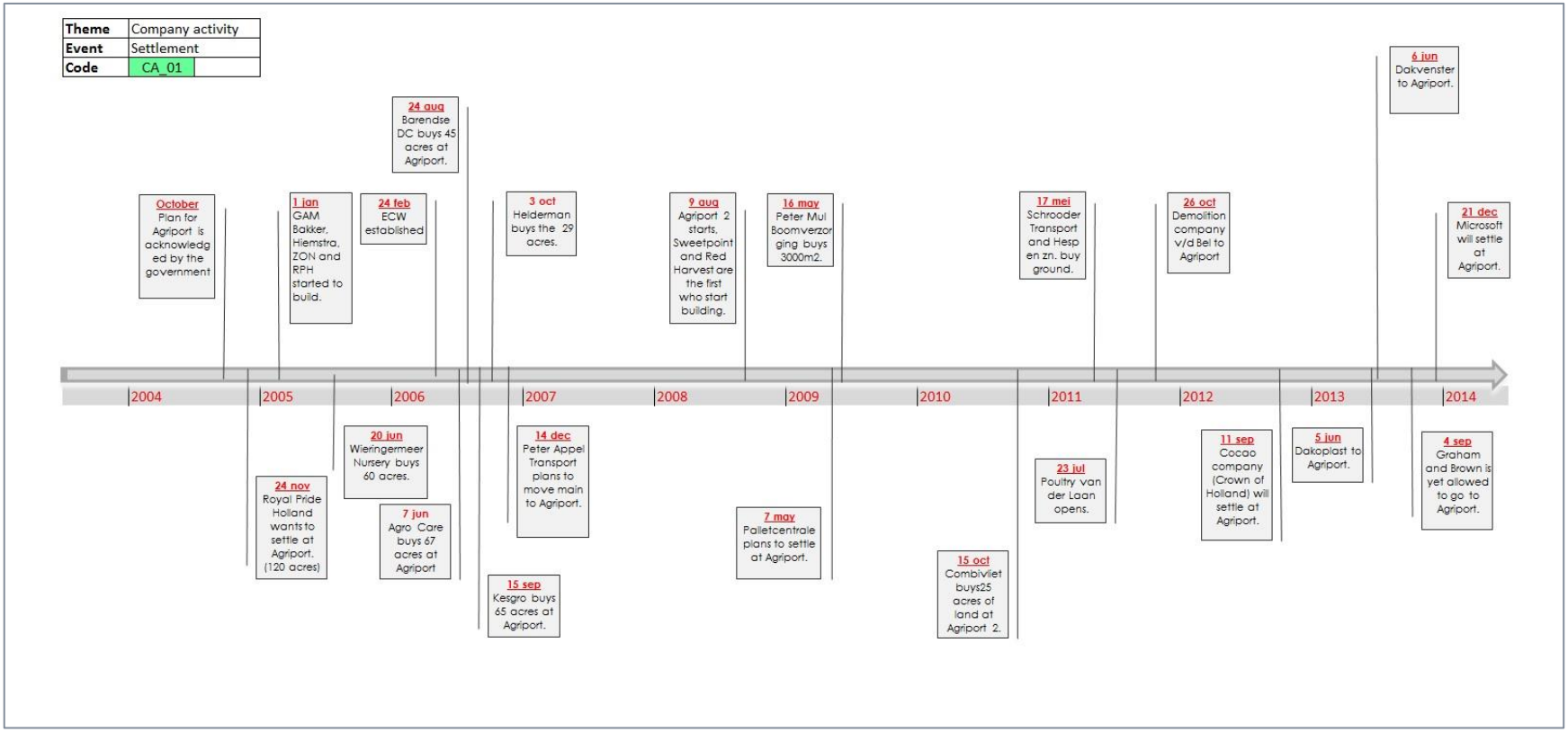


Figure 28. ESA of the event Settlement.

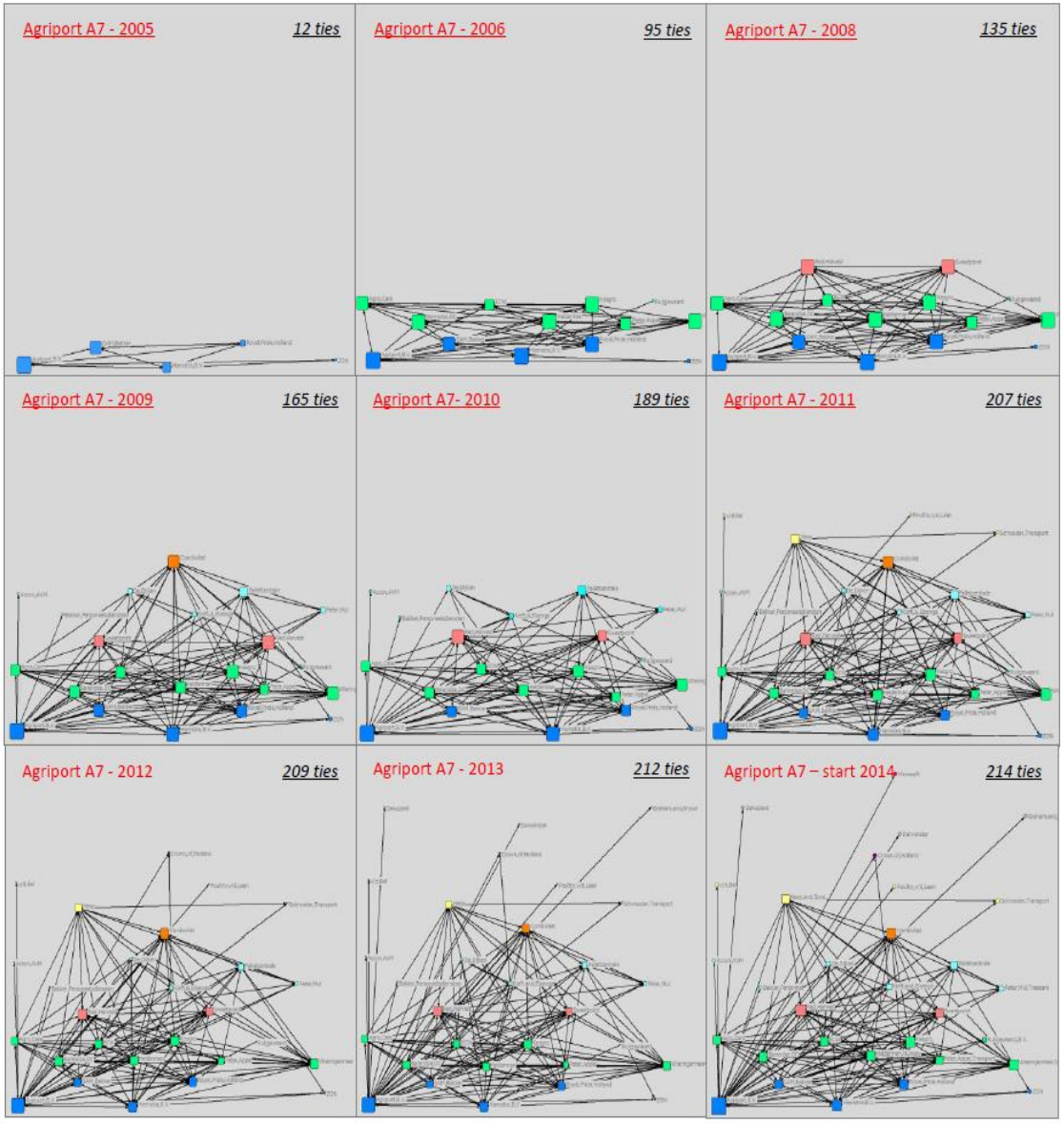


Figure 29. INA: Settlement at Agriport A7.

INSTITUTIONAL ACTIVITY – STRUCTURAL- AND DEVELOPMENT PLANS

An appropriate institutional setting is an important condition as policy interventions can motivate the realization of new EIPs. This section elaborates on the event *structural- and development plans* in the theme *institutional activity.* Structural- and development plans of a municipality entail which function a part of land has, for example housing, industry or glasshouses.

Figure 30 shows that for Agriport different structural plans are approved. In 2004 the first structural plan was acknowledged and the first companies entered Agriport A7. However, soon there was a call for an expansion of the glasshouse area and the structural plans needed to be changed for Agriport 2. These structural plans were revised and approved in 2007 and new glasshouse companies entered Agriport A7.
Next, Agriport A7 is an agro park that is located at a favourable position. It is close to Amsterdam, is has a reliable safety profile and the area has a connection to the national energy grid. These factors offer the opportunity to develop a datacenter at Agriport. However, the ground was not addressed for a datacenter, so the development plan again had to be revised and was acknowledged in 2010.

Figure 31 represents an enlarged version of the right-bottom figure of figure 29, this represents the current state of the companies at Agriport A7 and their collaboration ties presented in time. The INA shows the growth of the network, which is partly caused by the institutional activity. The blue lines indicate the approval of (revised) development plans in 2004, 2007 and 2010. The companies at Agriport 1 entered Agriport A7 in 2005 and 2006 after the approval of the development plan in 2004. After the approval of the revised plans, Agriport 2 could be realized and new companies could enter Agriport A7 from 2008 onwards. Furthermore, in 2014 a datacenter will be established at Agriport A7 as a consequence of an new revised plan in 2010.

The question is, what new insights could be derived from this particular event at Agriport A7? The development plans that were approved in 2004 and 2007 were particularly focussed on the settlement of companies with the same core business. The settlement of growers at Agriport A7 could be seen as a homogeneous group, where collaborations between companies can be executed easily due to matching core business. That makes the exchange of goods, knowledge and materials easier. However, in 2010 the development plans were changed as such that companies with a different core business could settle at Agriport, for example a datacenter or skilight reseller. So, where the ESA is giving the impression that Agriport keeps growing and the new collaborations between companies can be created, the INA shows that due to a mismatch of the core business of companies the ties after 2010 are decreasing.

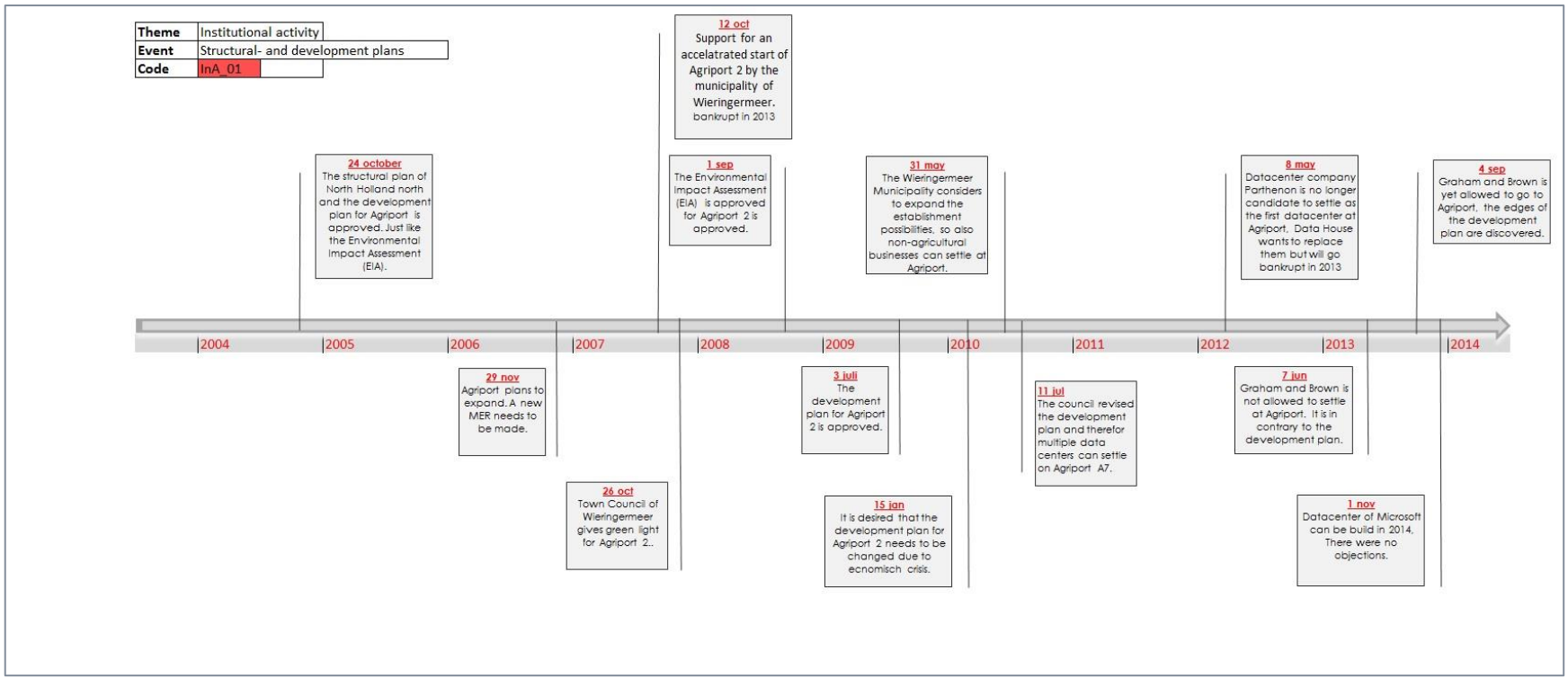


Figure 30. ESA of the event structural- and development plans.

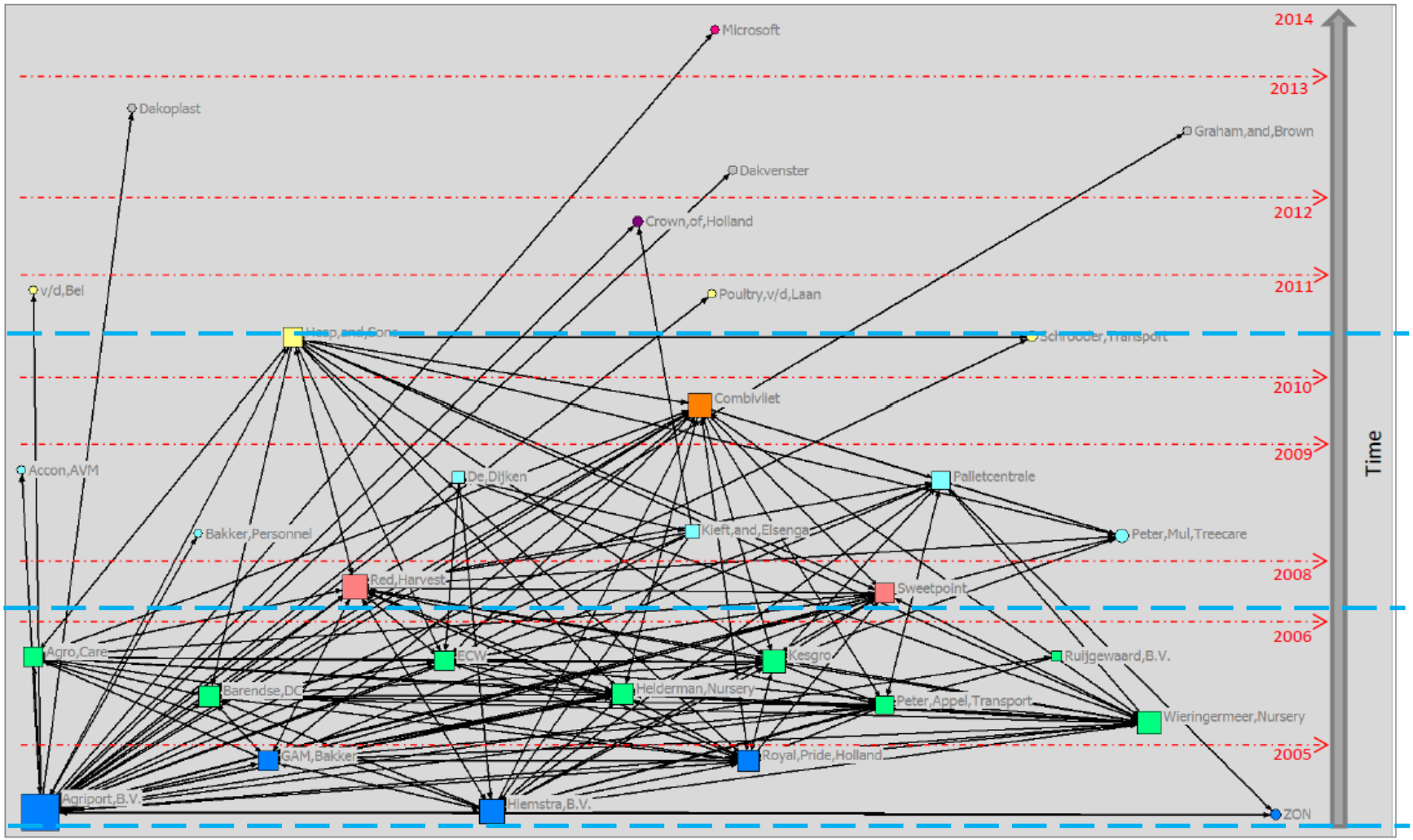


Figure 31. INA: Public policies affecting the network.

ECONOMIC AND FINANCIAL ENABLERS – FINANCIAL CRISIS

The realization of EIPs depends partly on economic and financial enablers such as subsidies, funds and loans. Without economic and financial support, the realization of an EIP can become difficult. From 2008 onwards the financial crisis also stroke at Agriport A7, which has its implications for the shape of the network. The event *financial crisis* occurs in the theme *economic and financial enablers*.

The ESA in figure 32 shows that when the financial crisis stroke the Netherlands, banks became more cautious with providing loans to growers. Loans are indispensable for growers in order to start a new business at a new spot, like Agriport A7. Another important feature at Agriport at the moment of the financial crisis, is that just before the crisis Agriport 2 opened. New land came available for greenhouse growers, however after the crisis only in 2010 a new grower entered Agriport A7. Furthermore, the ESA offers more interesting features about the consequences of the financial crisis at Agriport A7. *First,* during the crisis none of the companies at Agriport has gone bankrupt. This implies that Agriport A7 is, despite the crisis, a convenient location to have a business. *Second,* growers at Agriport are still expanding the total surface of their companies.

In figure 33 the INA is presented, where the blue line represents the financial crisis at Agriport. Furthermore, a distinction between glasshouse growers (green nodes) and other companies (red nodes) is made to show what type of companies entered Agriport during the financial crisis. It is clear that after 2010 the companies with a focus on greenhouse growing are not entering Agriport A7 anymore. The remainder of the new companies during the economic crisis have a different focus then agribusiness such as wallpaper, skylights and data.

The combination of ESA and INA for this event offers new insights in the structure of Agriport's network caused by the financial crisis. The decrease in loans provided by the banks resulted in a decrease of new greenhouse growers at Agriport A7, however the open space at Agriport 2 needs to be filled. If the available land is not filled with companies, the project developer (Agriport A7) loses a lot of money. The combination of less loans and the urge to fill the land shows that the boundaries of the development- and structural plans are discovered in order to contract new companies. As a result, companies are contracted with another focus then agribusiness and collaborations between companies are more difficult to realize, which is visible in figure 33. Above the blue line, the collaborations between companies have decreased for the larger part.
A new insight is, that this event shows that the crisis has a negative impact on the EIP. Less collaborations are taking place, presumably caused by a mismatch of core businesses and the urge to fill the available land.

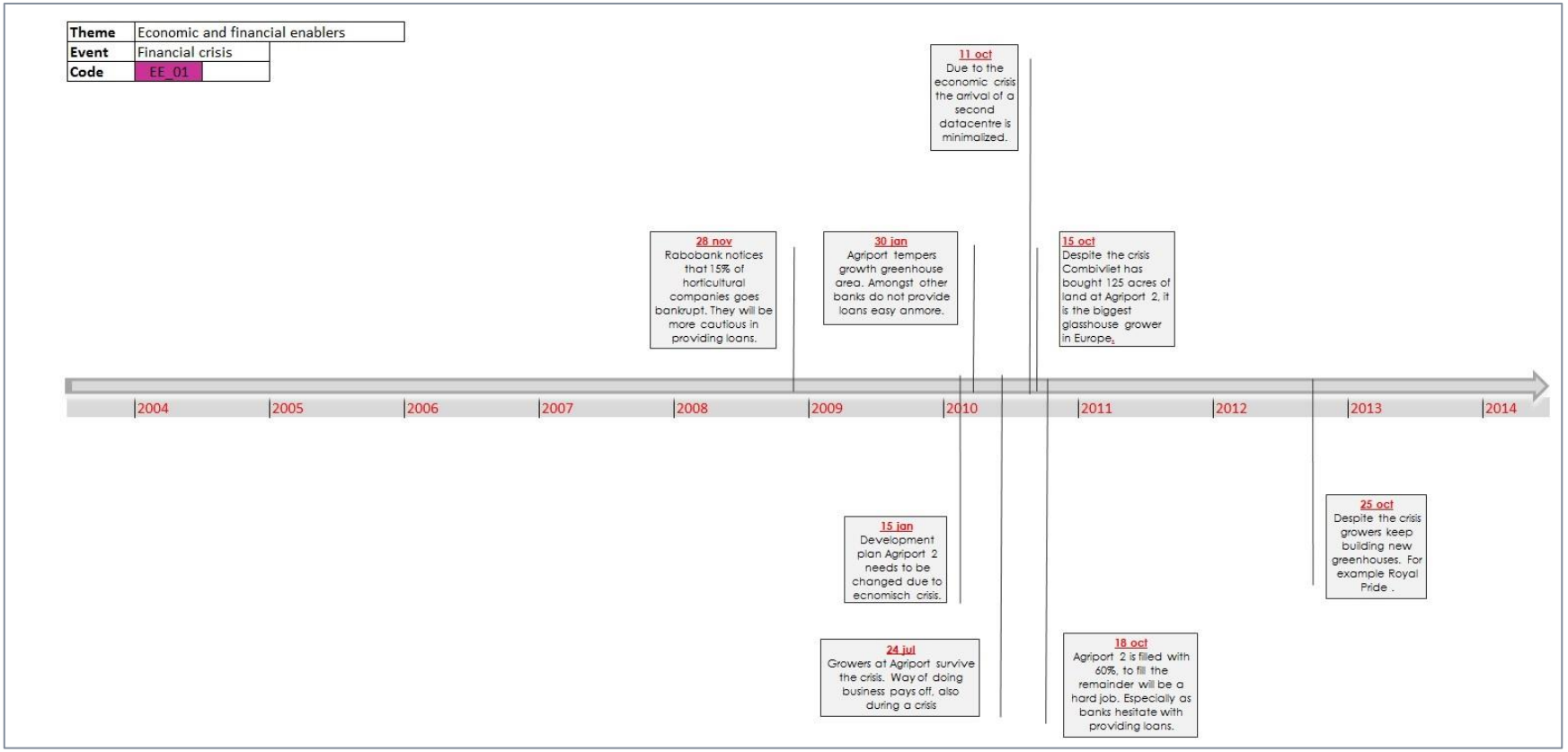


Figure 32. ESA of the event Financial Crisis.

As stated in section 7.1, the legenda for this figure is slightly different. The green nodes show the greenhouse growers at Agriport and the red nodes companies with other core activities.

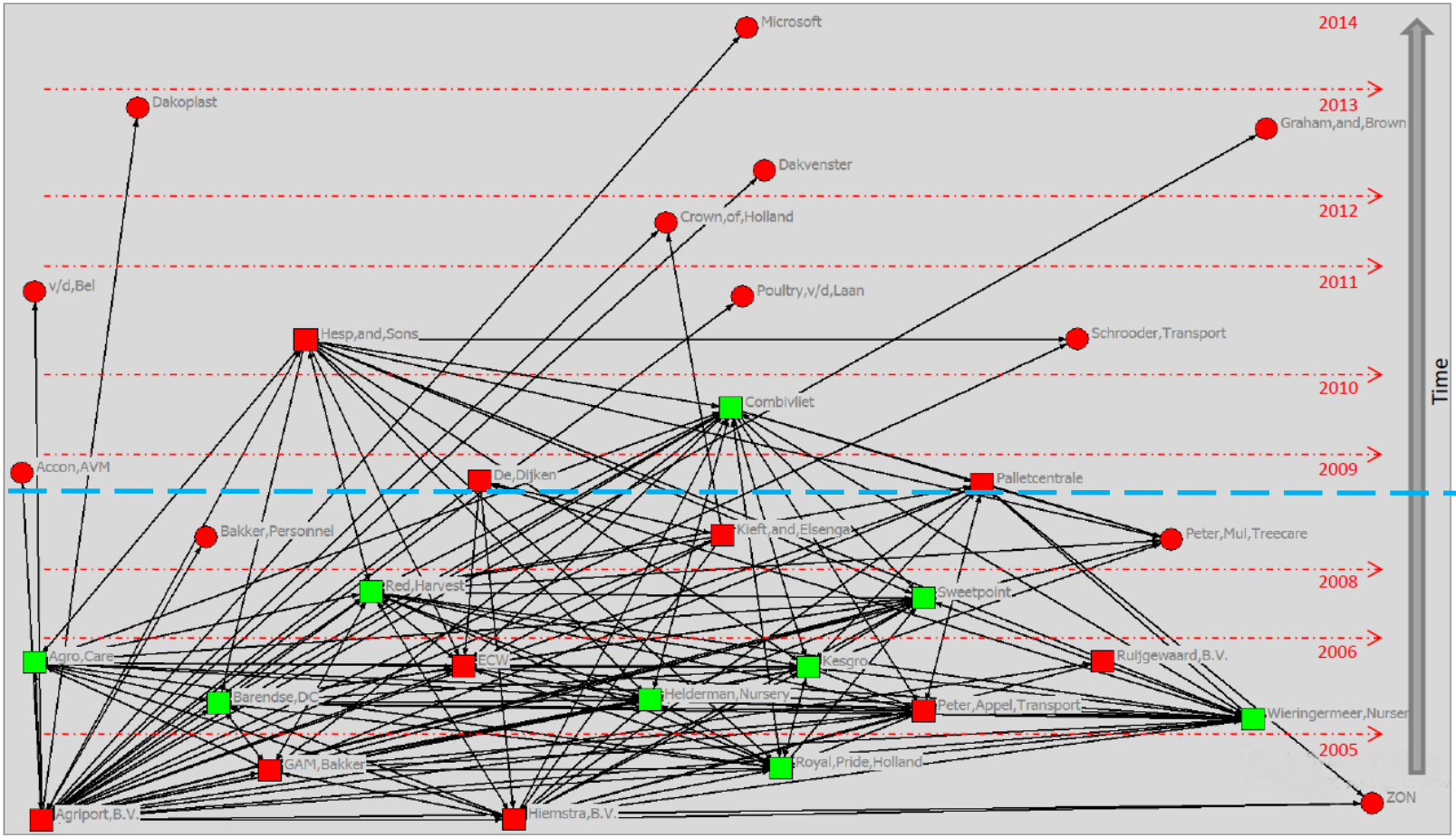


Figure 33. INA: Financial crisis.

TECHNICAL ACTIVITY – FINANCIAL CRISIS

Technical activity focuses on the availability and facilitation of infrastructure of common use. For example, to arrange energy and material flows (Yu et al., 2013). Growing vegetables in greenhouses in Holland is typically an energy-intensive business. The demand for energy at Agriport A7 consists of electricity, heat and CO2. Furthermore, growers that make use of illuminated glasshouses need electricity in the winter months. In order to meet this energy demands combined heat and clutch systems (CHC) have been placed at glasshouses. A CHC is a gas engine that produces heat, electricity and CO2. The majority of the electricity that is produced is delivered to businesses and consumers by the national grid. The glasshouses themselves use the heat and CO2 and a portion of the electricity for illumination. For the transmission of electricity to the national grid, the ECW (Energy Combination Wieringermeer) is established. ECW is the private operator for gas, electricity and heat production and transport at Agriport A7. Furthermore, the ECW sells connection capacity and provides connectivity and transport services to its customers. A greenhouse grower is obliged to join the ECW if it the company wants to settle at Agriport. The growers and ECW together form a small power plant that can generate electricity for about 200.000 households (ECW, 2014).
Next, the EWEB is established with the goal to market energy flows first inside the ECW, only when this is not possible the energy will be traded on the national grid. For example, electricity deals are closed between growers that do make use of illuminations and growers that do not. As a result the CHC's are less used, the growers can save and earn money and it is a more sustainable way of working (ECW, 2014).

The ESA in figure 34 shows how the energy network of ECW is constructed in time. Agriport B.V. started with the creation of an own energy network in 2006/2007, which became an independent company: the ECW. Furthermore, the EWEB was constructed to market the energy flows. Agriport B.V. and the ECW are the founders and managers of the electricity grid at Agriport A7. The growers are obliged to join the ECW if they want to settle at Agriport, but in return, they have a vote on which activities to perform within the ECW. In the last two to three years ECW is involved in the realization of geothermal heat.

Figure 35 represents the INA of the ECW, all growers are involved in generating and marketing energy. The founders, Agriport A7 and ECW are represented with a red circle due to their leadership role in the energy market. Due to the intensive cooperation between the growers, Agriport A7 and ECW the ties are very dense between these actors. Other companies are not involved in the ECW, as their electricity use is too low to join the ECW. The costs to join would be too high in comparison with the returns. This also explains why the density in figure 33 is high in 2005-2010, as in that period almost each of the growers have settled at Agriport and start to collaborate in the ECW.

The analysis of this event provides new insights in the structure of the network of Agriport A7. As mentioned earlier the ECW is started to market energy between growers in order to achieve energy efficiency. Businesses are not able to join the ECW, as their surface is too small and there for would not receive a beneficial return. The exchange of goods, in this case energy, shows that the growers are important, active and form a homogenous set of actors in the network. The exchange of (knowledge on) energy to enhance sustainable development is key to EIP A new insight for Agriport A7, based on the ECW, is that presumably large project ofr sustainable development only work with a homogenous set of actors. Furhtemore, these actors have companies with asurface that makes the initiative worth investing in.

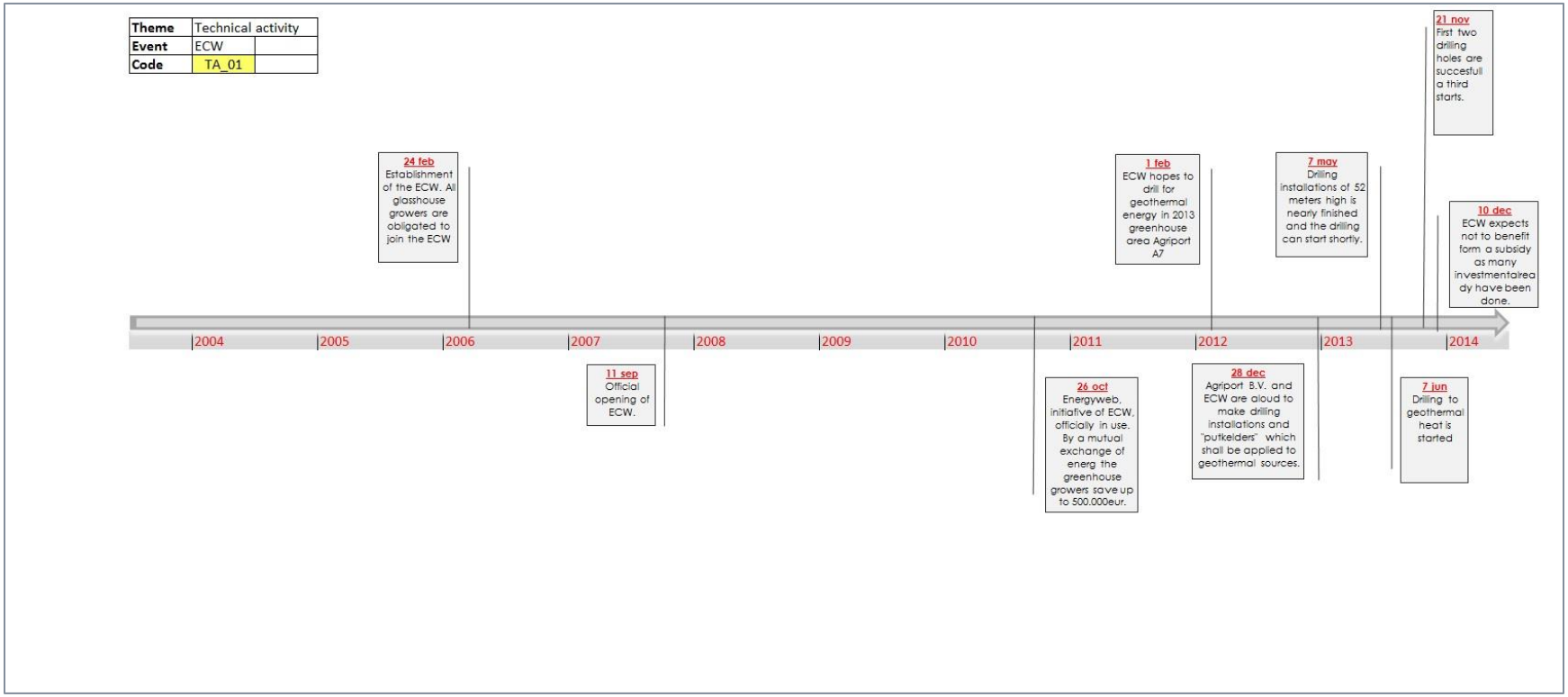


Figure 34. ESA of the event ECW.

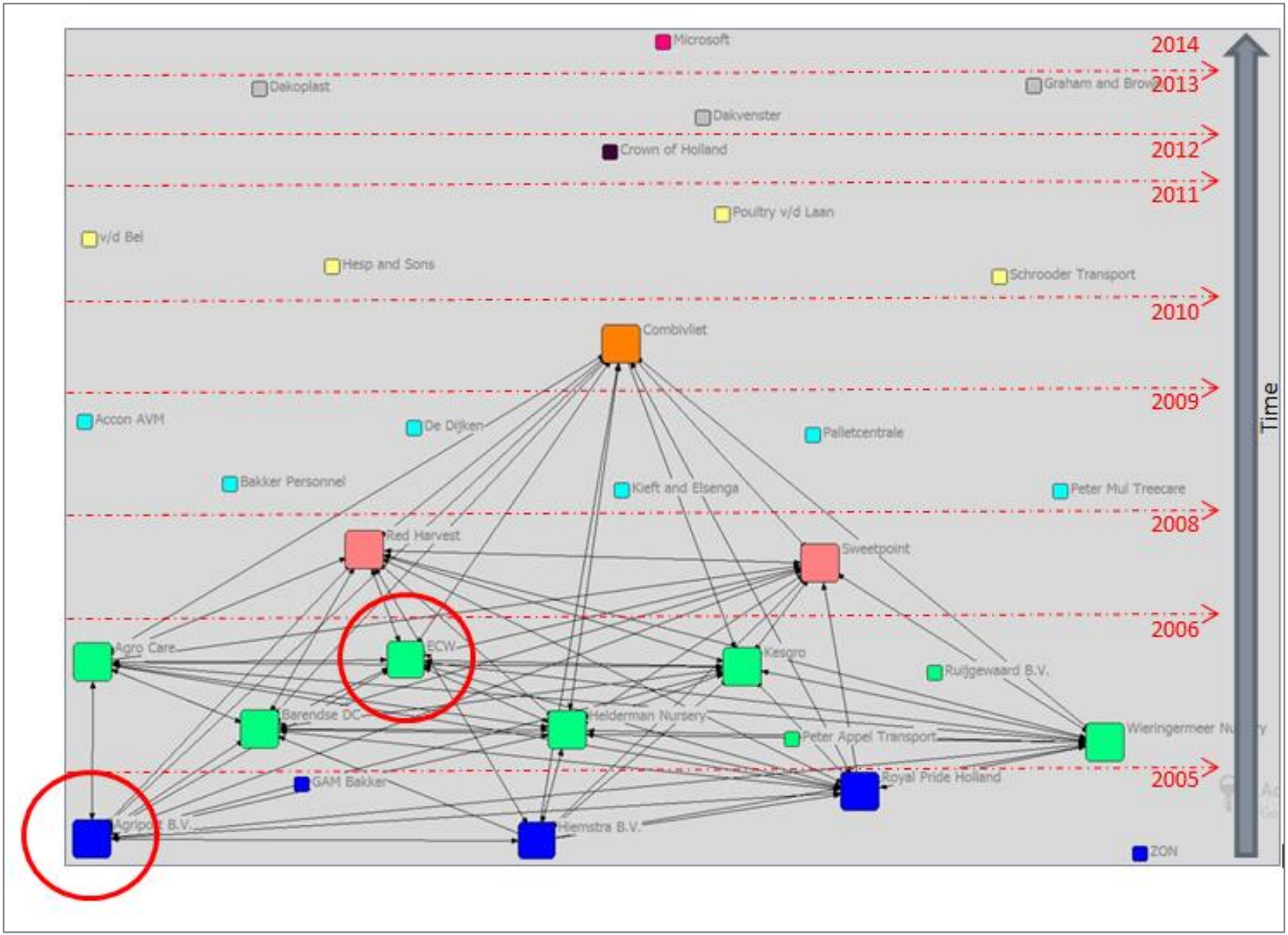


Figure 35. INA of the ECW.

INFORMATIONAL ACTIVITY – GEOTHERMAL HEAT

The main goal of informational activity at an EIP is the identification of environmentally desirable actions and feasible opportunities for synergies. Agro parks are amongst others characterized by their innovative nature. This section shows the event *geothermal heat* which is assigned to the theme *informational activity*. The use of geothermal heat is one of the main innovations that is executed at Agriport A7.

Figure 36 shows that the event geothermal heat already started in 2007, developed through the years and at the end of 2013 two successful holes were drilled and the ECW starts with the third hole in 2014. The aim is that the growers use this natural source for heating in 2014. As a result, the use of CPH's can be reduced and sustainable development can be enhanced. Although the geothermal heat at first is a big investment for the growers, during the years this investment will be earned back as less gas needs to be paid to run the CHC's.

Figure 37 shows the participating companies in geothermal heat, as one can see again it consists of the growers together with the ECW and Agriport B.V. The reason that only growers participate in geothermal heat is that it is only beneficial for companies with a large surface, so business park companies are too small. They would not get a return on their. In figure 37 three red circles are visible and indicate the main leaders in the geothermal heat process. Agriport B.V. and ECW take care that the network for the geothermal heat is constructed. However, different from the previous event on ECW, Wieringermeer Nursery is also one of the initiators of geothermal heat. The geothermal heat installation is built on the parcel of the Wieringermeer Nursery, this is where the drillings take place.

The analysis of the ESA and INA of this particular event can provide new insights for EIP realization. At Agriport A7 it is visible that companies want to take the lead in creating new synergies leading to sustainable development. In this case Wieringermeer Nursery takes the lead, with the support of Agriport B.V. and the ECW, to drill for geothermal heat. Companies that have ideas for new sustainable practices and also want to execute them are needed for the realization of an EIP. However, a remark should be made: figure 37 again shows that only a select group of companies is joining these sustainability initiatives. Since 2010 no new companies have entered these collaborations and raises the question if Agriport A7 is still growing as an EIP or that it becomes more or less a normal industrial site.

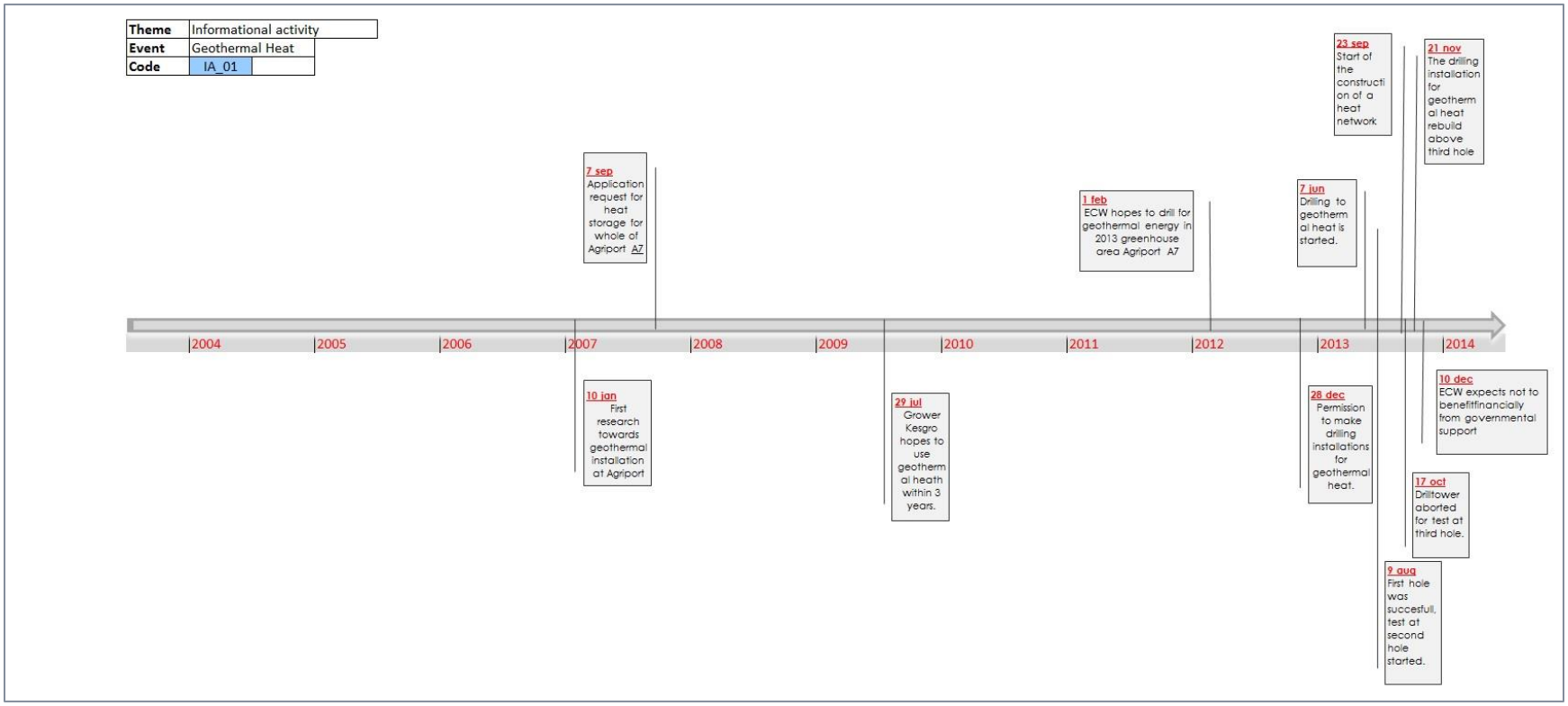


Figure 36. ESA of the event Geothermal Heat

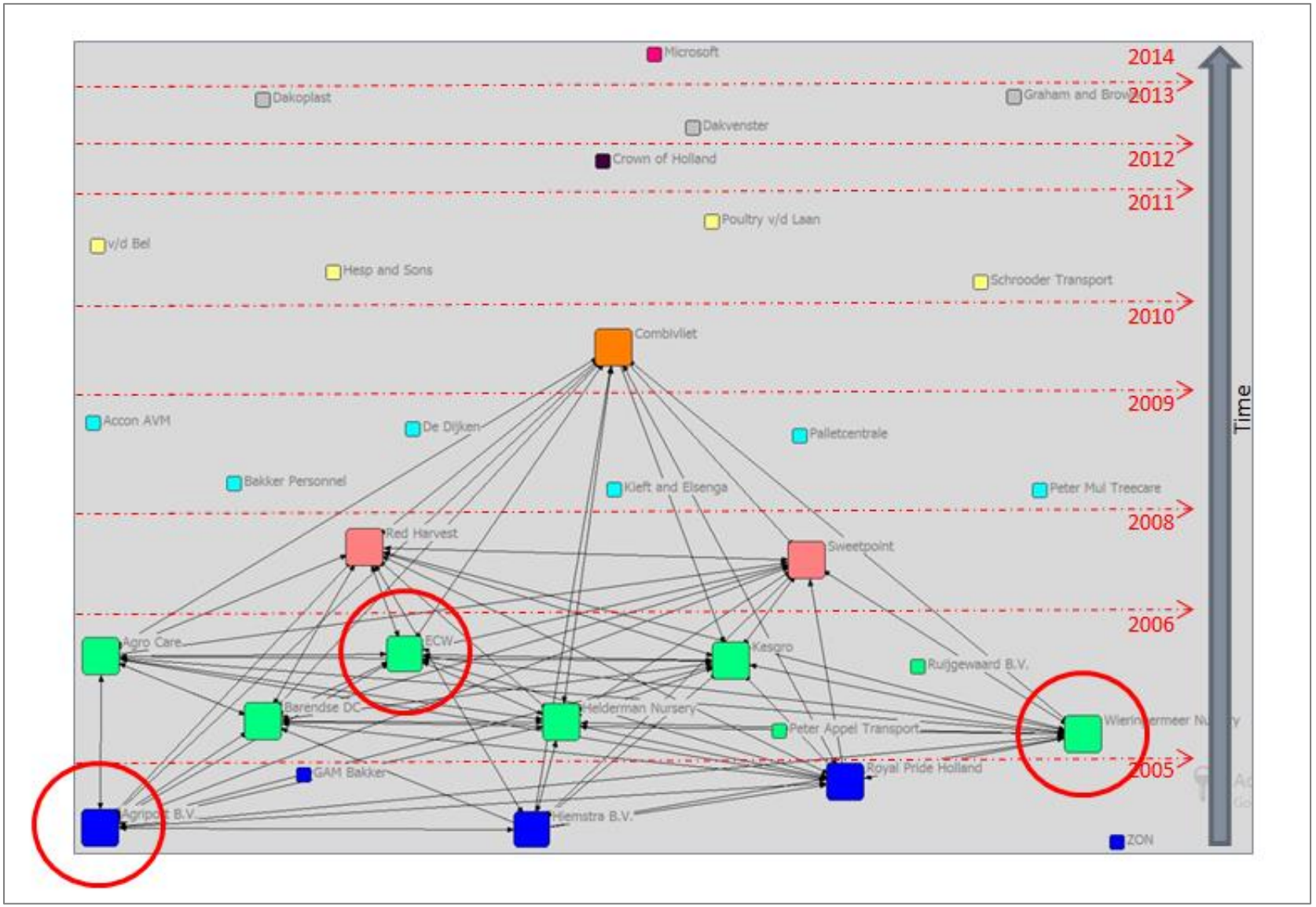


Figure 37. INA of the geothermal heat project.

7.2 CHAPTER SUMMARY

This chapter focused on the fact whether or not the combination of ESA and INA can provide new insights for EIP realization. This section answers the final sub research question: *"What new insights does the combined application of ESA and INA provide for Agriport A7?"*

This sub research question will be answered with the findings from the analysis executed on Agriport A7. In the answering of the main research question the insights will be showed in a more general fashion. The investigation of five particular events presented new insights in the EIP realization of Agriport A7. The insight of each event will be described shortly.

First, the increase of companies at Agriport A7, presentedin the ESA, would suggest that an increase of companies would also yield a sufficient amount of extra ties. However, it showed that this is not necessarily the case, as between companies settled between 2005-2010 189 ties are constructed and only 25 more ties have been constructed with the arrival of companies between 2011-2014. Despite of the arrival of nine new companies.

Second, the approval of different development- and structural plans indicates that multiple new companies could enter Agriport and start collaborating. However, during the years the aim of the development plans at Agriport shifted from agribusiness, to companies with another core business. A shift in core businesses makes collaborations more difficult.

Third, the financial crisis had its implication for the realization of Agriport A7. The crisis forced Agriport to quickly contract companies for the available land. This, in combination with a decrease in loans provided by the bank, resulted in a slower realization of Agriport A7. Land is difficult to fill and collaborations are more difficult to create.

Fourth, the ECW at Agriport contributes to the sustainable development of Agriport A7. The ECW markets energy between companies in order to make companies more energy efficient. However, it appears that large scale initiatives for sustainable development at Agriport are only feasible for a homogenous set of actors, with companies that have to opportunity to gain form such large investments.

Fifth, the input of "sustainable leaders" has been of large importance at Agriport A7. In the case of geothermal heat Wieringermeer Nursery took, together with Agriport B.V. and ECW, the lead in the geothermal heat project. Companies that take the lead in sustainable development are important, as new practices are examined and executed. Leaders take care that, in this case Agriport A7, keeps on developing itself in the domain of sustainable development.

An overall conclusion, based on these five events, indicates that the realization of Agriport A7 is enhanced if the EIP consists of a homogenous set of actors. An homogenous set of actors offers the opportunity to collaborate on sustainable initiatives that are in the focus of the company. For example, the realization of the ECW and geothermal heat is mainly realized by the growers, ECW and Agriport, because these initiatives are beneficial for them. Furthermore, it is presented that external factors, such as the financial crisis or development plans, can have an effect on the realization of IONs and subsequently on the realization and development of Agriport A7.

CONCLUSION & DISCUSSION

CHAPTER 8 CONCLUSIONS AND DISCUSSION

This chapter entails the general conclusions of the research, including the discussion section, the limitations and recommendations of the research. The first section presents the answers to the research questions, closing off with answering the main research question. The second section provides the discussion, which focusses on the main findings, the connection to former research and the scientific- and societal relevance. The chapter finishes with presenting the limitations and recommendations resulting from the research, in section three.

8.1 CONCLUSIONS

The aim of this research is to investigate if the combination of event sequence analysis (ESA) and interorganizational network analysis (INA) could improve the understanding of eco-industrial park (EIP) realization. In order to validate the usefulness of the combination of the two analytical tools, both tools were applied to a practical example: Agriport A7, near Amsterdam, the Netherlands. This section contains the answers to the sub research questions and ends with the answer to the main research question.

Chapter 2 discussed the theoretical background and explained the two main concepts. This section offers the opportunity to answer to the first sub research question: *"What is the relationship between eco-industrial parks and interorganizational network based on literature?"*

EIPs are industrial sites where companies focus on the exchange of materials, goods and knowledge. The aim of the exchange relation between companies at an EIP is to achieve a more efficient use of resources. Exchanges between companies can benefit multiple domains. *First,* companies can achieve cost reductions as resources are reused or exchanged against lower costs. *Second,* the environment benefits from the reuse of goods and materials, because fewer resources have to be extracted from the environment. *Third,* society can gain from EIPs as they can be a powerful economic development tool for communities.
Section 2.2 focuses on the interorganizational networks (IONs), which encompass a firm's horizontal and vertical relationships with other organizations. Due to the relationships with other companies, exchange of resources is possible. This also shows the relationship between an EIP and IONs. Without the presence of IONs the exchange of resources is impossible, so in order to realize an EIP interorganizational networks are necessary. EIPs exist by the virtue of interorganizational networks.

Chapter 3 described which variables of the two main concepts, EIPs and IONs are processed into the theoretical framework. This part provided the information to answer the second sub research question: "*What are the key variables of eco-industrial parks and interorganizational networks, based on the literature study, that realize the theoretical framework?"*

The literature study discussed that EIPs exist by the presence of IONs and therefor form one of the main aspects considering the successful realization of an EIP. To achieve an improved understanding of EIP realization, it is necessary to investigate the IONs. Figure 14 presented the theoretical framework, which visualizes how the ION can be investigated. The framework shows that an improved understanding of EIP realization can be achieved by investigating the ION realization at an EIP. Next, the realization of IONs depends on several categories of operational variables. Proceeding, the operational variables are influenced by events that are endured by the five conditions that are set for the realization of an EIP. Concluding, if a researcher wants to get an improved understanding of EIP realization, events that are endured in the five conditions should be made clear. These events influence the realization of IONs, in a positive or a negative way. Finally, based on this analysis of IONs, improved understanding of EIPs can be derived.

In order to analyze the events that identify how IONs develop and are structured chapter 4 describes two analysis tools that are used in this research: event sequence analysis (ESA) and interorganizational network analysis (INA). This section provides the information to answer the second sub research question: *"What are the fundamentals of event sequence analysis and interorganizational network analysis?"*

In order to identify which events had an impact on the realization of IONs, the ESA can provide the needed information. ESA offers the opportunity to describe an EIP with the use of written documents such as newspaper articles, documents and websites. By constructing a chronological overview of an EIP with documents, different events are identified that can influence the construction of an ION. The ESA offers the opportunity to show how events in a network emerge, develop and possibly dissolve over time.

Section 4.2 discussed the fundamentals of INA. Whereas ESA is focused on existing, written documents, the INA is based on the social network analysis. By conducting interviews at an EIP the social network of organizations can be identified: called the INA. The INA offers the opportunity to present the consequences and implications of events to the structure of an ION. Different computer programs based on social network analysis offer the opportunity to show the effects of an event to a network by two approaches: the visual- and the statistical approach.

Chapter 6 focuses on the results of the application of ESA and INA separately to Agriport A7. This chapter answered the fourth sub research question: *"What additional information does the separate application of ESA and INA at Agriport A7 provide?"*

The application of ESA to Agriport A7 delivers a multitude of new information. *First,* due to the ESA a complete chronological timeline on the realization of Agriport A7 is provided. The timeline entails the events that influence the realization process of IONs. By coding the different events it is possible to distinguish multiple important events that contribute, or not, to the realization on IONs at Agriport A7.

The application of INA to Agriport offered the opportunity to analyse the IONs of Agriport A7 in two ways. *First,* the IONs are visualized in a graph, providing an overview of the interorganizational collaborations at Agriport A7. *Second,* with the use of the statistical approach calculations are made about the network of Agriport A7. The degree-, closeness- and betweenness centrality are calculated and provide additional information on the IONs of Agriport A7. The separate application of ESA and INA presents a way of describing the bigger picture of an EIP and provides additional information of the overall network.

Chapter 7 investigates if a combination of ESA and INA can provide new insights for EIP realization. This section answers the final sub research question: *"What new insights does the combined application of ESA and INA provide for Agriport A7?"*

This section is based on the findings of the combination of ESA and INA at Agriport A7. From the five events that have been discussed the new insights will shortly be mentioned. *First,* the increase of companies at Agriport A7 did not show that the interorganizational relationships between companies also increased proportionally. *Second,* the revision of development- and structural plans at Agriport A7 shows that more companies entered Agriport with different core businesses resulting in a decrease of relationships after 2010. *Third,* external factors such as the financial crisis can constrain the realization of IONs. A decrease in loans provided by the bank and the urge to contract companies for available land constrains the realization of IONs. *Fourth,* the realization of the ECW at Agriport contributes to the sustainable development. However, the initiative of the ECW is restricted to 8 growers, the ECW and Agriport B.V., which are a homogenous set of actors compared to the other companies. It appears that large-scale sustainable projects are only possible within the larger homogenous set of companies. *Fifth,* the input of "sustainable leaders" has been of large importance at Agriport A7. In the case of geothermal heat Wieringermeer Nursery took, together with Agriport B.V. and ECW, the lead in the geothermal heat project. Companies that take the lead in sustainable development are important, as new practices are examined and executed.

The combined use of ESA and INA provides a more detailed investigation of the events and what their consequences are for the IONs at Agriport A7. By explaining the IONs at Agriport A7, the realization of Agriport A7 can be discussed. The question is, if Agriport is still growing as an EIP as most of the collaborations for the exchange of resources are restricted to a select homogenous set of actors.

By having answered the five sub research questions, it is now possible to answer the main question:

"What contribution can the combination of event sequence analysis and interorganizational network analysis provide to an improved understanding of eco-industrial park realization?"

An EIP is community of companies that collaborate with each other in order to efficiently share resources as information, materials, energy, knowledge and more. The realization process of EIPs is influenced by a multitude of conditions, however this research has focused on the following five conditions:

- Institutional activity
- Technical facilitation
- Economic and financial enablers
- Informational activity
- Company activity

Furthermore, EIPs exist by the virtue of interorganizational network (IONs). Without the presence of IONs the exchange of goods and knowledge is not possible and it is impossible to speak of an EIP. However, events occurring in the previously mentioned conditions can affect the operational variables, showed in the theoretical framework, that determine the realization and structure of IONs. A change in the structure or composition of the IONs at an EIP can have implications for the realization of an EIP. This research focused on investigating the IONs in order to provide an improved understanding of EIP realization.

The event sequence analysis (ESA) offers the opportunity to identify the events that occur in the previously mentioned conditions. These events have an effect on the structure of the network and subsequently on the realization of an EIP. The interorganizational network analysis (INA), with the program UCINET, presents what the consequences of these events are for IONs present at an EIP.

This thesis shows that the combined application of ESA and INA offers the opportunity to investigate the IONs of an EIP. Relationships between an event and the consequences for the collaborations in a network are identified. As EIPs rely on the realization of networks in order to exchange goods, materials and knowledge, the combined use of ESA and INA provides new insights in the IONs of EIPs. Internal- and external events that influence the networks are identified. More collaboration for exchange of resources present at an EIP is an indicator for the realization of and development of an EIP. This thesis showed that the analysis of IONs by ESA and INA can provide an improved understanding of EIPs.
Furthermore, by investigating the events that influence the structure of an ION a researcher can make assumptions on how an EIP is developing and if this is a positive or negative development. The combination of ESA and INA can be applied to multiple other EIPs in order to understand the particular development of that EIP.

8.2 DISCUSSION

This section presents the discussion with clarifications and interpretations of the results concerning the research. The discussion section entails the main findings of the research, how the research follows upon former research, the scientific- and societal relevance, limitations and recommendations for further research.

The focus of this master thesis was to provide a method to gain an improved understanding of eco-industrial park (EIP) realization. To acquire the improved understanding two analysis tools, event sequence analysis (ESA) and interorganizational network analysis (INA), were used to analyze a practical example: Agriport A7. The results of the analysis show that a combination of ESA and INA offers the opportunity to investigate EIPs by researching how IONS are realized, structured and affected by events.
This research follows upon former research that has been conducted on agro-/synergy-/eco-industrial parks by amongst other Saris and Isakhanyan. Saris' research discussed the governance structure of synergy parks, whereas the research of Isakhanyan focused on a stakeholder analysis of agro parks (Saris et al., 2012, Isakhanyan, 2010). In the research performed by Saris et al. a INA is visualized and analyzed with UCINET, providing a cross-sectional analysis of synergy parks.
Furthermore, previous research is performed on ESA by Spekkink (2013), who introduced ESA as a way of analyzing the institutional capacity in the Canal Zone in Zeeland, the Netherlands. In his research ESA is described as: *"an approach that offers a set of methods and techniques for the systematic longitudinal investigation of process phenomena (Spekkink, 2013a)".* Nevertheless, ESA in social sciences is still an under-explored area and needed further research. In each of the former researches one of the analysis tools is used, however a combination of ESA and INA to provide an expanded overview is not found in the scientific literature. This research contributes to new theory and improvement of knowledge on the combined use of ESA and INA applied to EIPs.

The research entails multiple phases to realize valid results. *First,* the literature study was conducted to improve the understanding on EIPs and the role of IONs. Furthermore, scientific articles were used to improve the researcher's knowledge on ESA and INA. The acquired knowledge on ESA was translated in the analysis of events at Agriport A7 based on newspaper articles. In order to conduct the INA, already established questionnaires were used to interview respondents of Agriport A7. The inclusion of various newspapers in the ESA and most of the organization of Agriport A7 in the interviews ensured a good internal validity.
In contrast with the internal validity, the external validity needs more explanation. This research only covered one particular case, Agriport A7. The generalizability of these particular results is limited, because the realization process, together with the specific conditions of Agriport A7, is a unique process. The realization process of Agriport A7 cannot exactly be copied to realize a new EIP. However, the use of the two analysis tools can be generalized for research on other EIPs. The methods that are used in the ESA an INA can also be applied to other EIPs in order to investigate that particular park. If multiple EIPs with the same homogenous setting are investigated, it is possible to make some general recommendations for a successful realization of an EIP with such a setting, for example EIPs based on agribusiness.

The relevance of this research can be divided into two main fields: scientific- and societal relevance. The scientific relevance of this research can be described from several perspectives. *First,* the combination of ESA and INA to investigate EIPs is limited in scientific literature. This research attempts to increase the knowledge and theory on the combination of ESA and INA and the contribution to a better understanding of EIP realization. *Second,* the use of ESA in social sciences is still a relative underexplored area. This research offers a method on how to conduct an ESA on a social process. *Third*, this research attempts to increase the knowledge on EIP realization. The research

presents the crucial processes and decisions for the realization of Agriport A7 and furthermore how this can contribute to a better understanding of eco-industrial park realization. The societal relevance is guaranteed with the use of a Dutch case study: Agriport A7. The used methods could contribute to a better realization of EIPs and provide a healthier environment with a decrease inthe extraction of natural resources.

LIMITATIONS

Although, the research is executed with the upmost precision, it did had some limitations. *First,* the research only covered one case and that makes it difficult to generalize the findings of Agriport A7 to other eco-industrial parks. However, the investigation of Agriport A7 offers a starting point for other researchers who want to conduct a research with the combination of ESA and INA to other agro parks. Namely, the methods used in this thesis could be generalized to examine other EIPs.

Second, as this research explores the opportunity of combining ESA and INA, only five events are investigated that influence the conditions for EIP realization mentioned in the theoretical framework (figure 14). This implies that not every operational factor that influence the realization of IONs is investigated. Furthermore, there are also more events that could be described and that influence the realization of IONs and that can broaden the understanding of EIP realization. However, due to time constrains and other research limitations this is a recommendation for further research.

Third, the INA is constructed with the use of a questionnaire, which was completed in face-to-face interviews. In the first three interviews, the questionnaires were completed behind a laptop together with the respondent. During the interviews it appeared that this way of conducting the interviews took too much time and was perceived boring by the respondents and could possible negatively influence the answers. After this was noticed the set up was adapted, a more interview-style was create during the appointments with the respondents. The exact same questions from the questionnaire were asked, but now in a real conversation and not behind a laptop. After the interviews, the interviewer completed the questionnaires for the respondents and the INA could be conducted. However, the new set up required careful transcription and recording of the interview.

Fourth, in order to conduct an INA it is of vital importance to achieve a response rate that is as high as possible. A high response rate can make the description of the area better. At Agriport A7 it was not possible to interview each company, some companies were not interested in the research, others were not reachable. However, with a response rate of 70% including the most important companies, the greenhouse growers, logistical companies, the project developer and the energy company this research has a sufficient response rate.

Final, as mentioned in the previous sections the ESA is a very data-intensive analysis. In this research the decision is made, due to a lack of time, to only include newspaper articles. In a more extended ESA, websites, documents, books and more existing written documents could be included. This offers the opportunity to extend already described events. However, the ESA of Agriport A7 meets the conditions and covers the realization of Agriport A7 in an adequate fashion. The addition of other written documents only expands the existing ESA and will only extend and explain existing events.

RECOMMENDATIONS

The research provided a method to investigate eco-industrial park realization with the use of event sequence analysis and interorganizational network analysis. The research area is, including this study, still underexplored and as stated previously further research should be executed with this method. *First,* this section provides recommendations for future research in the domain of EIP realization and the use of ESA and INA in this area. *Second,* based on this research recommendations are provided to future researchers on how to execute and ESA and INA.

For further research

Based on the limitations and discussion, recommendations for further research in the domain of EIP realization are provided. This section focusses on recommendations for further research in science.

First, this research is only a first attempt to combine ESA and INA in order to understand the eco-industrial park realization process. Whereas, INA is discussed many times in literature of social sciences, the use of ESA is still underexposed. Further research could study more in-depth the use of ESA in social sciences and specifically the application to EIPs. More sources could be included in the ESA, such as websites, documents and books and the analysis of sources could be executed with quantitative measures. Using programs like SPSS or Atlas to analyze the sources can increase the scientific value of an event sequence analysis.

Second, the combination of ESA and INA could be applied to more EIPs, for example to Biopark Terneuzen or Bergerden. This research shows that the combined use of ESA and INA can provide an improved understanding of EIPs. However, in order to generalize findings on the realization process of an EIP and to make recommendations to which conditions the process should comply, the combination of ESA and INA should be applied to multiple cases. Further research could provide new cases and offer the opportunity to compare cases and develop general conditions for the successful realization of an EIP.

Final, as mentioned in the limitations in order to get a full picture of the realization of an EIP it is necessary to include as many events as possible in the analysis of IONs. However, due to a lack of time this was not possible in this research. This research could function as a basis for further research on Agriport A7 in order to identify all events and how they had an affect on the realization of IONs and finally on the realization of Agriport A7. More new insights in the EIP realization could be derived when more events are investigated and related to the ION realization.

For practitioners

The analysis of EIP realization with the combined use of ESA and INA is a data intensive research. This section provides some recommendations in order to keep the research arranged and organized for future practitioners of the method. Considering the ESA:

- The more sources are included, the more detailed the ESA will be. The provided ESA in this research is adequate, however the more sources are included, the detailed the events will be.
- Provide a clear coding scheme in order to colligate the incidents into events. This is essential in the organization of the data.
- The coding of events can also be done by using statistical programs like SPSS, which offers the opportunity to statistically divide incidents into events.

Based on the INA, some recommendations are:

- Prepare a well-structured interview; this is vital for the outcome of the analysis.
- To achieve a high internal validity make sure the response rate of the interviews is as high as possible.
- Make use of the visual- and statistical approach provided by several computer programs (e.g. UCINET).

With these recommendations, further research can be conducted on ESA and INA, that is applied to EIP realization.

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ANNEXES

The annexes can be found in the separate Annex-booklet:

Annex 1. Complete timeline.

Annex 2. Questionnaire

Annex 3. Interview Agriport A7

Annex 4. Transcribed interviews of Agriport A7