University of Southampton

Faculty of Social Science

Southampton Business School

The Roles of Science and Technology Park in the Entrepreneurial Ecosystem: A Case Study of the Northern Science Park, Thailand.

by

Rom Pairsuwan

ORCID ID https://orcid.org/0009-0007-2902-9471

Thesis for the degree of Doctor of Philosophy

23rd May 2023

University of Southampton

Abstract

Faculty of Social Science

Southampton Business School

Doctor of Philosophy

The Roles of Science and Technology Park in the Entrepreneurial Ecosystem: A Case Study of the Northern Science Park, Thailand

by

Rom Pairsuwan

The purpose of this project is to study the roles and impact of science and technology parks in the entrepreneurial ecosystem. The project consists of three research papers including one conceptual paper and two empirical studies. The empirical studies are based on 31 semi-structured interviews with a wide range of entrepreneurial ecosystem actors and institutions. Each interview lasted between 58 and 173 minutes, for a total of 3,264 minutes, or an average of 105 minutes per session.

The first paper addresses the gap in the entrepreneurial ecosystem literature that commonly overlooks the science and technology parks. Both entrepreneurial ecosystem and science and technology park literature were explored. This study highlights the conceptual roles of science and technology parks in the entrepreneurial ecosystem. The first study also provided the theoretical foundation for the later studies in this project.

The second paper investigates a case study of Northern Science Park and the entrepreneurial ecosystem in Chiang Mai, Thailand. This case study provides not only the interrelationship between the two but also insights into the context of developing entrepreneurial ecosystems which is another gap in the literature. This study demonstrates the case that the science and technology park can play a leadership role in the ecosystem and has a significant influence on the evolution of a developing entrepreneurial ecosystem. The findings also reveal the importance of the entrepreneurial culture in the entrepreneurial ecosystem evolution.

The third paper re-examines the dataset used in the second paper and focuses on how the science and technology park influences the entrepreneurial culture in the ecosystem. We revisit the entrepreneurial ecosystem literature to unpack the dimensions of entrepreneurial culture. Based on the previous work, support mechanisms of science and technology parks are identified. As a result, the model of entrepreneurial culture development is constructed.

Overall, this research brings attention to the importance of the science and technology park, as a leader, in a developing entrepreneurial ecosystem. Moreover, this research highlights the importance of entrepreneurial culture in the entrepreneurial ecosystem evolution. This research provides policy implications by offering a theoretical framework to develop entrepreneurial ecosystem elements, particularly entrepreneurial culture.

Table of Contents

List of Tables

List of Tables

List of Figures

List of Figures

Research Thesis: Declaration of Authorship

Print name: ROM PAIRSUWAN

Title of thesis: The Role of Science and Technology Park in the Entrepreneurial Ecosystem

I declare that this thesis and the work presented in it are my own and has been generated by me as the result of my own original research.

I confirm that:

1. This work was done wholly or mainly while in candidature for a research degree at this University;
2. Where any part of this thesis has previously been submitted for a degree or any other qualification at this University or any other institution, this has been clearly stated;
3. Where I have consulted the published work of others, this is always clearly attributed;
4. Where I have quoted from the work of others, the source is always given. With the exception of such quotations, this thesis is entirely my own work;
5. I have acknowledged all main sources of help;
6. Where the thesis is based on work done by myself jointly with others, I have made clear exactly what was done by others and what I have contributed myself;
7. None of this work has been published before submission

Signature: ..... Date: .....

Acknowledgements

I would like to express my gratitude to my supervisory team, Assoc Prof Dr David Baxter, Prof Dr Vadim Grinevich, and Dr Dorrie Chao, for their contributions to the completion of this research project during my four-year PhD journey. Their consistent encouragement and guidance allowed me to have a deeper understanding of my project and helped me through one of the most challenging goals in my life. I consider myself fortunate to have had such dedicated supervisors.

I would like to thank the Royal Thai government, the Ministry of Higher Education, Science, Research, and Innovation, and the Office of Educational Affairs for their sponsorship. I would also like to thank the Northern Science Park and Chiang Mai University Business School for providing me with an opportunity to be a scholarship student and for making this degree possible for me.

I want to thank all of my research participants for being such valuable sources. I do appreciate their time and patience throughout the very long interview session and the fruitful data they provided.

I would like to thank Dr Tanyanuparb Anantana, and Asst Prof Dr Kasemsak Uthaichana, the Director and Deputy Director of the Northern Science Park, for allowing me to use their institution as a case study and for providing me with a dedicated team to help with my research. I would want to thank the dedicated team at the Northern Science Park, Mr Chanchai Apiromchaikul, Mrs Melin Chuamanochan, Mrs Anutsara Manohan, and Mr Khomcharn Phutthakham, for personally providing me with very useful information about the Northern Science Park and Chiang Mai's entrepreneurial ecosystem. I also want to thank Ms Udjima Lai and Ms Chanyaphak Yotkhampaeng who kindly assisted me in organizing all of the interviews.

I want to thank Dr Takron Opassuwan, my ex-PhD fellow, for inspiring me to pursue my PhD here at Southampton Business School and for assisting me in settling in better. I like to thank all my friends whom I met here in the UK for the wonderful time we have had together.

My devoted wife, Ms Thanawadee Pairsuwan, for her endless love, support, and encouragement. You are always by my side, and I am so glad that you are in my life.

Finally, I would want to thank my parents, Assoc Prof Dr Weerapong Pairsuwan, and Mrs Umpapun Pairsuwan, for their support, encouragement, and unconditional love. My PhD journey would not have started without them.

Rom Pairsuwan

Definitions and Abbreviations

AKH ..... Ang Kaew Holding, Chiang Mai, Thailand.

AKIP ..... Ang Kaew IP Venture, Chiang Mai, Thailand.

AKS ..... Ang Kaew Startup, Chiang Mai, Thailand.

CMU ..... Chiang Mai University, Thailand.

DEPA ..... Digital Economy Promotion Agency, Thailand.

EE ..... Entrepreneurial Ecosystem.

ESO ..... Entrepreneurial Support Organisation.

GDP ..... Gross Domestic Product.

GPP ..... Gross Provincial Product.

KKU ..... Khon Kaen University, Thailand.

MHESI ..... Ministry of Higher Education, Science, Research and Innovation, Royal Thai Government.

NESP ..... Northeastern Science Park, Khon Kaen, Thailand.

NIA ..... National Innovation Agency (Public Organisation), Thailand.

NIS ..... National Innovation System.

NSP ..... Northern Science Park, Chiang Mai, Thailand.

PSU ..... Prince of Songkla University, Thailand.

RIS ..... Regional Innovation System.

SPA ..... Science Park Promotion Agency, Ministry of MHESI.

STeP ..... Science and Technology Park, Chiang Mai University, Thailand.

STP ..... Science and Technology Park.

STSP ..... Southern Science Park, Songkhla, Thailand.

TDCI ..... Technology Development Centre for Industry, Chiang Mai University, Thailand.

TSP ..... Thailand Science Park, Bangkok, Thailand.

Chapter 1 Introduction

1.1 Research Overview

Based on the premise that science and technology parks promote innovation and entrepreneurship in the regional innovation system, this project aims to study the roles of the science and technology park which have been almost ignored in the entrepreneurial ecosystem literature. It is argued that science and technology parks are not necessary for the entrepreneurial ecosystem and these support structures can easily be white elephants (Isenberg, 2011). While science and technology parks, like incubators and accelerators, could be recognized as support services or intermediaries to the entrepreneurial ecosystem (Feld, 2012; WEF, 2013; Stam, 2015; Spigel, 2017), recent studies show that science and technology parks can be key players in creating, developing, and managing entrepreneurial ecosystems in China, and Sweden (Chen *et al.*, 2020; Germain *et al.*, 2022). These arguments make the establishment of science and technology parks in the entrepreneurial ecosystem an extreme scenario and indicate that there is a lack of knowledge of how science and technology parks impact the evolution of the entrepreneurial ecosystem.

In addition, much of the research on the entrepreneurial ecosystem has focused exclusively on developed entrepreneurial ecosystems in large metropolitan cities (Roundy, 2017b). This project provides a conceptualization as well as empirical studies using a case study of the Northern Science Park and the entrepreneurial ecosystem of Chiang Mai, Thailand representing the case of a developing entrepreneurial ecosystem in a developing country context.

Although the entrepreneurial ecosystem has gained ground as a method for studying regional economic development, this research field is yet little understood and theorized (Spigel, 2017). Particularly, the interdependencies among the elements of the entrepreneurial ecosystem that develop the overall ecosystem (Motoyama and Knowlton, 2014).

This PhD project addresses these gaps by exploring the interrelationship between the science and technology parks and the entrepreneurial ecosystem. The project consists of three research papers beginning with a conceptualized paper providing the theoretical foundation for the empirical study in the second paper. In the third paper, we revisited the dataset used in the second study, but we only focused on the effect of science and technology parks on entrepreneurial culture.

1.2 Theoretical Foundations

1.2.1 Science and Technology Park

Since the 1980s, academic publications have produced research on science and technology parks, which is continually growing (Diez-Vial and Montoro-Sanchez, 2017). The United Kingdom Science Park Association (UKSPA) defines a science and technology park as "…a business support and technology transfer initiative that; (1) encourages and supports the start-up and incubation of innovation-led, high-growth, knowledge-based businesses; (2) provides an environment where larger and international businesses can develop specific and close interactions with a particular centre of knowledge creation for their mutual benefit; (3) has formal and operational links with centres of knowledge creation such as universities, higher education institutes, and research organisations." Science and technology parks, in concept, are the organisations that bridge the gap between science, technology, knowledge, education, entrepreneurship, and capital (Mian, Lamine and Fayolle, 2016) and are often discussed in the literature on regional innovation systems as intermediary organisations (Doloreux and Porto Gomez, 2017).

The first science and technology park was initially established in the 1950s. Since then, science and technology parks have undergone several evolutions over the period. The first generation of science and technology parks just provided office space and shared services at a reasonable cost for new ventures. A more comprehensive set of supports such as training programs, mentoring, networking, commercialization enablers, virtual incubation model, and accelerator model were offered by the new generation of science and technology parks. An increasing number of science and technology parks across different contexts around the world has resulted in the development of new types of support mechanisms and varieties of science and technology park models (Mian, Lamine and Fayolle, 2016). Despite the extant literature on science and technology parks, further understanding and theoretical development are required as many gaps remain including the roles of science and technology parks in the entrepreneurial ecosystem literature.

1.2.2 Entrepreneurial Ecosystem

The term 'Entrepreneurial Ecosystem' was first coined by Cohen (2006, p. 3) as *"an interconnected group of actors in a local geographic community committed to sustainable development through the support and facilitation of new sustainable ventures."* Following that, several scholars presented their definitions, and there has yet to be a general agreement on them. As a result, there are numerous variations in what comprises the entrepreneurial ecosystem in the literature. In addition, the literature also has discussions on the strength (weak vs strong) (Leendertse,

Schrijvers and Stam, 2022; Spigel and Harrison, 2018) and the evolution (developing vs developed) (Mack and Mayer, 2016; Spigel and Harrison, 2018; Audretsch *et al.*, 2021) of the entrepreneurial ecosystem.

In this study, we discuss about the science and technology park influences on the evolution of the entrepreneurial ecosystem. The framework of the entrepreneurial ecosystem attributes (Spigel, 2017) was used to examine how each element evolved or fulfilled because of the science and technology park. As such, this study's emphasis is on evolution rather than the strength of the entrepreneurial ecosystem or the outcome of the entrepreneurial ecosystem development (successful vs unsuccessful). In addition, the terms and evolutionary stage were characterised variously in the literature (Mack and Mayer, 2016; Spigel and Harrison, 2018). To eliminate ambiguity in the literature, we defined the terms "developing" and "developed" for the evolution of the entrepreneurial ecosystem in this research in section 3.4.1.

Moreover, the research on entrepreneurial ecosystems emphasizes more on developed entrepreneurial ecosystems rather than developing entrepreneurial ecosystems. The study of developing entrepreneurial ecosystems may give insights into how to further develop entrepreneurial ecosystems, which will be very useful knowledge, particularly for policymakers, or ecosystem leaders.

In the entrepreneurial ecosystem literature, incubators or accelerators are often included in the entrepreneurial components as support services while science and technology parks are less mentioned. The support mechanisms of science and technology parks are generally broader than those of incubators or accelerators, and the impact of science and technology parks is likely to be diverse. For example, recent studies argue that science and technology parks may be key players in the entrepreneurial ecosystem (Chen *et al.*, 2020; Germain *et al.*, 2022), but the understanding of how science and technology parks may influence entrepreneurial ecosystems is currently restricted. In addition, the causality among the entrepreneurial ecosystem elements and the evidence base is another gap in this field of study (Stam, 2015; Spigel, 2017). Therefore, science and technology parks should be investigated in the relationship to the elements of the entrepreneurial ecosystem.

1.2.3 Entrepreneurial Culture

In the entrepreneurial ecosystem approach, "culture" was highlighted by Neck *et al.* (2004, p. 204) as a critical component of the ecosystem, claiming that *"Culture may be the single most important element for a system to develop and also may be the most difficult to replicate and to manage."* A supportive culture that promotes entrepreneurship is recognized as one of the key

success elements and the foundation element that creates a context for entrepreneurship to emerge, especially in the beginning stage of ecosystem development (Mack and Mayer, 2016). The cultural dimensions in the literature on the entrepreneurial ecosystem are often referred to as cultural values that promote innovation, collaboration, tolerance to risk and failure, positive attitude towards entrepreneurship, and success stories of entrepreneurship in the region. In addition, the literature also suggests who may play the role to develop an entrepreneurial culture in the entrepreneurial ecosystem such as a government, anchor firms, incubators or accelerators, and a leader of the ecosystem which could be entrepreneurs, investors, universities, entrepreneurial support organisations, or others. However, the existing literature indicates a lack of knowledge of how these individuals or organisations might affect entrepreneurial culture, especially in a developing entrepreneurial ecosystem context. This project, therefore, examines the relationship between a science and technology park and an entrepreneurial culture.

1.3 Research Aim, and Objectives of the Three Research Papers

The purpose of this PhD project is to create a multi-layered understanding of the relationship between a science and technology park and an entrepreneurial ecosystem. Three research papers were produced in response to gaps in the literature. This section briefly discusses these gaps, as well as the reasons behind the three papers to provide a comprehensive overview.

Table 1.1 Research Objectives and Research Questions.

Main Objective To examine the relationship between a science and technology park and an entrepreneurial ecosystem.		
Research Objectives	**Research Questions**	**Research Paper / Chapter**
To conceptualize the roles of science and technology parks across different entrepreneurial ecosystem contexts.	What roles may a science and technology park play in an entrepreneurial ecosystem?	Paper 1 / Chapter 3
To examine the roles of a science and technology park in a developing entrepreneurial ecosystem.	What are the relationships between the science and technology park and the entrepreneurial ecosystem elements in a developing ecosystem context?	Paper 2 / Chapter 4
To investigate how a science and technology park develops an entrepreneurial culture in a developing entrepreneurial ecosystem.	How can a science and technology park develop an entrepreneurial culture in a developing entrepreneurial ecosystem?	Paper 3 / Chapter 5

The main objective of this PhD project is to examine the relationship between a science and technology park and an entrepreneurial ecosystem. From a broad to a narrow perspective, three research objectives were created. There is a lack of knowledge on the roles and impact of a science and technology park in the entrepreneurial ecosystem literature. As a result, the first research paper's objective is to conceptualize the roles of science and technology parks in entrepreneurial ecosystems across diverse settings based on two streams of literature on science and technology parks, and entrepreneurial ecosystems. The first paper provides a theoretical foundation for our empirical study in the second research paper. The majority of empirical studies on entrepreneurial ecosystems have been undertaken in developed ecosystems while the studies on developing ecosystems are gaps in the literature. Therefore, the second research paper's objective is to conduct a case study to examine the impact of a science and technology park in a developing entrepreneurial ecosystem. The findings from the second research paper show that the science and technology park in this case has a significant impact on almost every element of a developing entrepreneurial ecosystem including the entrepreneurial which is one of the most important elements for a developing entrepreneurial ecosystem. As a consequence, the third research paper's objective is to investigate how a science and technology park promotes an entrepreneurial culture in a developing entrepreneurial ecosystem. In their respective chapters (see Table 1.1), an in-depth literature review, methodology, and key findings of each paper are described.

1.4 Research Contributions

This study contributes to the literature on the entrepreneurial ecosystem in many ways. First, the overall study highlights the interrelationship between a science and technology park and an entrepreneurial ecosystem which is lacking in the literature on the entrepreneurial ecosystem. The thesis also makes comments on the roles and impacts of science and technology parks on the entrepreneurial ecosystem, which have received much less attention than incubators or accelerators. Despite the existing literature's focus on entrepreneurs or the government as the ecosystem's leaders, this thesis's findings show that a science and technology park can play this role.

Second, the thesis proposes that the maturity of the entrepreneurial ecosystem is negatively related to the degree of impact of the science and technology park in the first research paper. At the same time, the thesis also provides evidence to prove that a science and technology park does have a significant impact on a developing entrepreneurial ecosystem in the second research paper and this also partially supports the proposition in the first research paper. Moreover, the thesis also contributes to the limited studies on the causal relationship among elements of the

entrepreneurial ecosystem (Stam, 2015; Spigel, 2017). In addition, the thesis contributes as an empirical study on developing entrepreneurial ecosystems while the extant literature focuses more on developed entrepreneurial ecosystems in large cities (Roundy, 2017b).

Third, the thesis corresponds with existing literature on the relevance of entrepreneurial culture, particularly in a developing entrepreneurial ecosystem. At the same time, the thesis also illustrates that a science and technology park promotes an entrepreneurial culture and proposes a theoretical framework for a science and technology park to develop the entrepreneurial ecosystem in the third research paper.

1.5 Thesis Structure

The following is a breakdown of the three research papers' theses (see Table 1.2). Following this introductory chapter, the research philosophy and methodologies are in Chapter 2. The first research paper in Chapter 3 is a conceptual paper that contrasts the roles of science and technology parks in developing and developed entrepreneurial ecosystems. The second research paper, Chapter 4, is a case study that empirically investigates the impact of a science and technology park on each component of a developing entrepreneurial ecosystem in Chiang Mai, Thailand. The third research paper in Chapter 5 seeks to demonstrate how a science and technology park affects entrepreneurial culture in a case study of Chiang Mai, Thailand. Finally, the conclusion of the project is in Chapter 6.

Table 1.2 Thesis Structure.

Chapter	**Chapter Title**	**Description**
Chapter 1	Introduction	This chapter provides an overview, theoretical foundations, research aim and objectives of the three research papers, research contribution, and thesis structure.
Chapter 2	Research Methodology and Design	This chapter discusses research philosophy, research methodology, data collection, data analysis, and a case study context.
Chapter 3	The Conceptual Roles of Science and Technology Parks in Entrepreneurial Ecosystem	This chapter is the first research paper of the thesis. The conceptual paper.
Chapter 4	The Roles of Science and Technology Park in a Developing Entrepreneurial Ecosystem	This chapter is the second research paper of the thesis. The first empirical study.

Chapter	Chapter Title	Description
Chapter 5	Science and Technology Park in Developing Entrepreneurial Culture	This chapter is the third research paper of the thesis. The second empirical study.
Chapter 6	Conclusions	The final chapter provides the project overview, outcomes, limitations, implications for research, policy, and practice, and personal reflections.

Chapter 2 Research Methodology and Design

2.1 Chapter Overview

The research questions, methods, and interpretation of findings reflect how researchers make assumptions about human knowledge and the nature of the realities (Crotty, 1998). The research philosophy adopted in the study, therefore, can be perceived as an assumption of the researchers (Saunders, Lewis and Thornhill, 2012). The philosophical choices are essential because they will have a considerable influence on the research strategy and how researchers understand what they are exploring (Johnson and Clark, 2006). There are alternative positions of research philosophy and each of them is suitable for different things to achieve. For business research, there are at least four philosophical perspectives to consider including positivism, realism, pragmatism, and interpretivism (Saunders, Lewis and Thornhill, 2012). Thus, the research philosophy must be evaluated their appropriateness for a specific project. Consequently, the research philosophical choice of the project leads to the choice of research approach, the selection of research methodology, strategies, data collection, and data analysis (see Figure 2.1). Moreover, this chapter also provides a context of a case study, the entrepreneurial ecosystem of Chiang Mai, and science and technology parks in Thailand including the Northern Science Park.

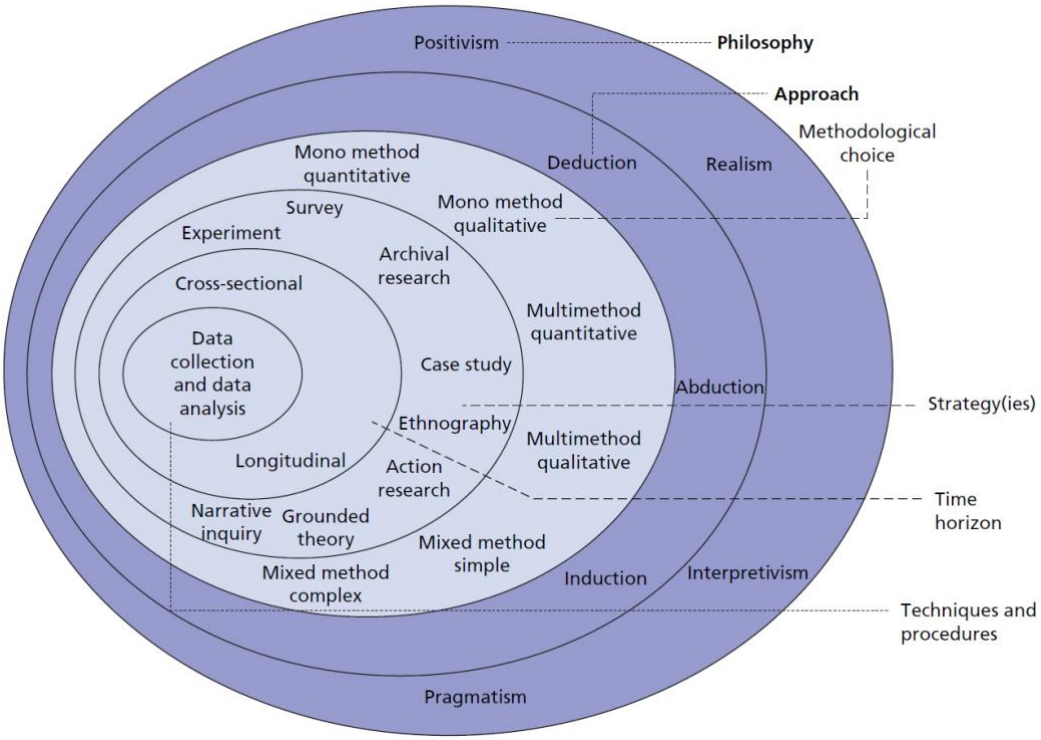


Figure 2.1 The Research Onion

Source: *Saunders, Lewis and Thornhill (2012, p. 160)*

2.2 Research Philosophy

2.2.1 Pragmatism

Pragmatists hold that there are several points of view to interpreting the world and conducting research and no single way can reveal the complete view of the research because there may be multiple realities. The practical consequences of the research findings are the most crucial pragmatist's view. Therefore, it is possible to apply more than one philosophical choice in one study. Additionally, multiple methods are often found to be the most appropriate for pragmatism (Saunders, Lewis and Thornhill, 2012).

2.2.2 Positivism

Positivists are concerned with observable reality and seek causal relationships and consistencies that lead to generalisations. The process of data collection is purely objective and independent of the researchers. The essence of the data collected is difficult to alter, which means that the research is conducted in a value-free way. A highly structured methodology is typically the choice of positivists. Collected data is usually quantifiable, which complies with statistical analysis (Saunders, Lewis and Thornhill, 2012).

2.2.3 Realism

Realism concerns that there is an existence of objects, in reality ,independent from the human mind, which is contrasting with the idealism that only minds and their content exist (Crotty, 1998). Two types of realism that are contrasted: direct realism, and critical realism.

Direct realists claim that reality can be sensed directly whereas critical realists argue that what humans perceive is sensations, not reality. Additionally, critical realists say that human senses can be often deceived, which leads to misinterpretation (Saunders, Lewis and Thornhill, 2012).

2.2.4 Interpretivism

Interpretivism emphasizes the differences between humans and objects as units of study. Positivism is more appropriate to study physical sciences, rather than social sciences from the interpretivism perspective. Humans as social actors play their social roles in a particular way depending on their interpretation of those roles. Therefore, researchers must put themselves in the social world to understand those social actors from their viewpoints (Saunders, Lewis and Thornhill, 2012).

2.3 Research Paradigms

To justify the research philosophical stance for this project, the research paradigms which consist of the nature of reality (ontology), acceptable knowledge (epistemology), and the role of values (axiology) will be addressed and positioned.

2.3.1 Ontology

Ontology refers to the assumption about how researchers perceive the nature of reality which has two positions including objectivism and subjectivism. Objectivism takes the view that social entities externally exist as real and independent of social actors (Crotty, 1998). While subjectivism portrays that social phenomena are constructed by social actors as a result of their actions and perceptions (Saunders, Lewis and Thornhill, 2012).

2.3.2 Epistemology

Epistemology concerns the nature of knowledge, which researchers consider what is acceptable knowledge in the study. Two different epistemological stances are defining the type of researcher: the 'resources' researcher and the 'feeling' researcher (Saunders, Lewis and Thornhill, 2012). The 'resources' researcher concerns reality as objects which exist independently of that of the researcher. The data collected from this perspective can be measured and presented in the form of statistical data. While the 'feeling' researcher studies the social phenomena which have no external reality. The data collected from this view is typically human feelings and attitudes which cannot be easily measured and are frequently presented in the form of narratives.

2.3.3 Axiology

Axiology studies judgements of value. The researchers reflect values through their judgements about what research they are going to do and how the research process will be (Heron, 1996). Besides, researchers with other values may lead to a different conclusion (Saunders, Lewis and Thornhill, 2012). The role of value can be varied from 'value-free' to 'value-bound' depending on the research philosophy held by the researchers. Value-bound means that the researcher is part of what is being studied while value-free means that the researcher is independent of the data.

2.4 The rationale for choosing the interpretivism position

Table 2.1 Comparison of four research philosophies in business and management research.

	Pragmatism	Positivism	Realism	Interpretivism
Ontology: the researcher's view of the nature of reality or being	External, multiple, view chosen to best enable answering of research question	External, objective and independent of social actors	Is objective. Exists independently of human thoughts and beliefs or knowledge of their existence (realist), but is interpreted through social conditioning (critical realist)	Socially constructed, subjective, may change, multiple
Epistemology: the researcher's view regarding what constitutes acceptable knowledge	Either or both observable phenomena and subjective meanings can provide acceptable knowledge dependent upon the research question. Focus on practical applied research, integrating different perspectives to help interpret the data	Only observable phenomena can provide credible data, facts. Focus on causality and law-like generalisations, reducing phenomena to simplest elements	Observable phenomena provide credible data, facts. Insufficient data means inaccuracies in sensations (direct realism). Alternatively, phenomena create sensations which are open to misinterpretation (critical realism). Focus on explaining within a context or contexts	Subjective meanings and social phenomena. Focus upon the details of situation, a reality behind these details, subjective meanings motivating actions
Axiology: the researcher's view of the role of values in research	Values play a large role in interpreting results, the researcher adopting both objective and subjective points of view	Research is undertaken in a value-free way, the researcher is independent of the data and maintains an objective stance	Research is value laden; the researcher is biased by world views, cultural experiences and upbringing. These will impact on the research	Research is value bound, the researcher is part of what is being researched, cannot be separated and so will be subjective
Data collection techniques most often used	Mixed or multiple method designs, quantitative and qualitative	Highly structured, large samples, measurement, quantitative, but can use qualitative	Methods chosen must fit the subject matter, quantitative or qualitative	Small samples, in-depth investigations, qualitative

Source: *Saunders, Lewis and Thornhill (2012, p. 140)*

The entrepreneurial ecosystem as defined by Stam (2015, p. 1765) is "a set of interdependent actors and factors coordinated in such a way that they enable productive entrepreneurship". The entrepreneurial ecosystem is constructed by various social actors and the output of their interactions is also social actors who called themselves entrepreneurs, therefore, this suggests that we should take subjectivism in this study in terms of ontology.

The project objective is to examine the relationship between a science and technology park and an entrepreneurial ecosystem. To find the answer to our research question in Table 1.1, the data has to be presented in the form of narratives rather than statistics. The roles and impact of the science and technology park in this project should be defined by the ecosystem's actors. Therefore, the entrepreneurial ecosystem is a social phenomenon and contains subjective meanings based on the perceptions of the ecosystem's actors. Entrepreneurial culture is a good example to describe our epistemology standpoint. Social values that support entrepreneurship in the region are subjective and difficult to quantify. The interpretation of researchers, or 'feeling', is required to comprehend. This suggests that the epistemology of this project is subjective meanings.

As the ontology and epistemology of this project are subjective. The researcher becomes part of the study and researchers with other values may lead to a different conclusion (Saunders, Lewis and Thornhill, 2012). Therefore, the value of the researchers is bound to the study.

Considering the justification of the ontology, epistemology, and axiology as shown above with four research philosophical positions in Table 2.1, interpretivism is the most suitable to describe the research philosophy for this project. Interpretivism emphasizes the differences between humans and objects as units of study. The interpretivism perspective is more appropriate to study social sciences rather than physical sciences. Humans as social actors play their social roles in a particular way depending on their interpretation of those roles. Therefore, researchers must put themselves in the social world to understand those social actors from their viewpoints (Saunders, Lewis and Thornhill, 2012).

2.5 Research Approach

There are three forms of reasoning to consider, including deductive approach, inductive approach, and abductive approach (see Table 2.2). A deductive approach is used to test the existing theory through a series of propositions, and this approach tends to use a highly structured methodology. Additionally, a deduction is often using a large sample size to generalise. In contrast, an inductive approach is used to formulate a theory or a conceptual framework from the explored phenomenon concerning the specific context (Saunders, Lewis and Thornhill, 2012). Also, the inductive is often using interviews or multi-qualitative methods to collect data from different perspectives (Easter-Smith, Thorpe and Jackson, 2015). While the abductive approach works back and forth between theory and data, it begins with exploring the phenomenon followed by developing a conceptual framework or modifying an existing theory and then testing that new or modified theory (Saunders, Lewis and Thornhill, 2012).

Table 2.2 Research Approaches.

	Deduction	Induction	Abduction
Logic	In a deductive inference, when the premises are true, the conclusion must also be true	In an inductive inference, known premises are used to generate untested conclusions	In an abductive inference, known premises are used to generate testable conclusions
Generalisability	Generalising from the general to the specific	Generalising from the specific to the general	Generalising from the interactions between the specific and the general
Use of data	Data collection is used to evaluate propositions or hypotheses related to an existing theory	Data collection is used to explore a phenomenon, identify themes and patterns and create a conceptual framework	Data collection is used to explore a phenomenon, identify themes and patterns, locate these in a conceptual framework and test this through subsequent data collection and so forth
Theory	Theory falsification or verification	Theory generation and building	Theory generation or modification; incorporating existing theory where appropriate, to build new theory or modify existing theory

Source: Saunders, Lewis and Thornhill (2012, p. 144)

In this project, the first research paper is a conceptual paper that builds propositions about the roles of the science and technology park in the entrepreneurial ecosystem from the extant literature. Therefore, an inductive approach is used for the first research paper. The second research paper is an empirical study that builds on the theoretical foundation of the first research paper. To study the roles and impact of the science and technology park in the entrepreneurial ecosystem, the existing theory on the elements of the entrepreneurial ecosystem is used to develop an initial coding template and to develop the structure of questionnaires for the interview. The second research paper aims to expand the existing theory to include science and technology parks as part of the ecosystem elements. Thus, an abductive approach is used for the second research paper. Finally, the third research paper focuses on the relationship between the science and technology park and the entrepreneurial culture. In the third research paper, we explored the dimensions of an entrepreneurial culture and the support mechanisms of a science and technology park from the previous literature and use them as an initial coding template. The third research paper aims to unfold the most critical findings from the second research paper in our view to developing a conceptual framework to describe how the science and technology park develops the entrepreneurial culture in the ecosystem.

2.6 Research Methodology

The two main research design consists of quantitative and qualitative. However, a research design is not only limited to a single method, multiple methods are also possible. Saunders, Lewis and

Thornhill (2012) conclude methodological choices as shown in Figure 2.2. Quantitative research design is typically used to analyse numeric data. This methodology is usually associated with the philosophy of positivism and a deductive approach (Saunders, Lewis and Thornhill, 2012). In contrast, the qualitative research design is generally used to analyse non-numeric data and is often related to interpretive philosophy since researchers have to investigate and interpret the subjective and socially constructed meaning of the phenomenon (Denzin and Lincoln, 2005). This method is typically related to an inductive to develop a new theory or abductive approach beginning with developing a theory using an inductive approach followed by testing a developed theory using a deductive approach (Saunders, Lewis and Thornhill, 2012).

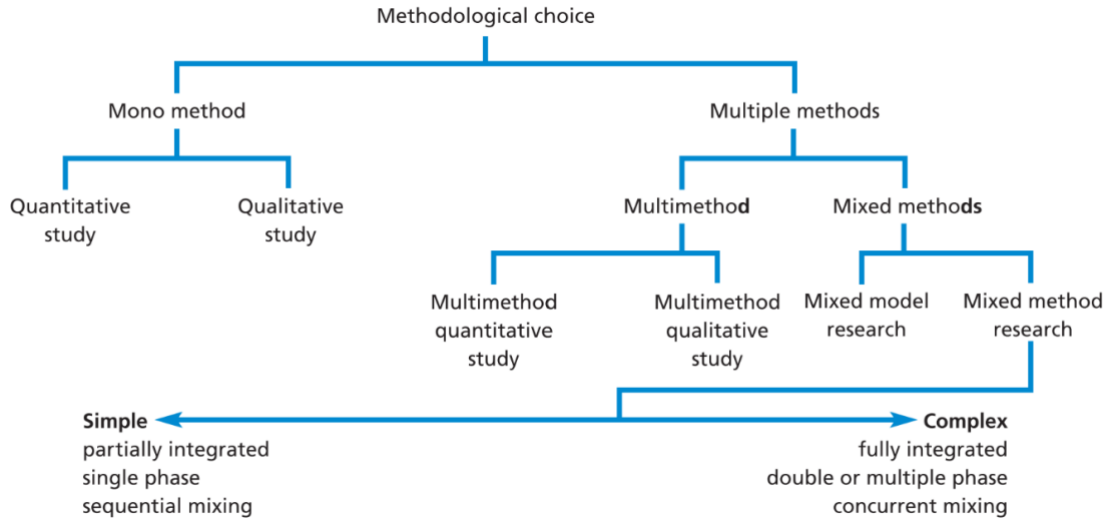


Figure 2.2 Methodological choice.

Source: Saunders, Lewis and Thornhill (2012, p. 165)

Therefore, a qualitative research design is appropriate for this study and associated with the interpretive philosophy this study takes (see Table 2.1) as well as the abductive approach in the second and the third research papers. Because the first research paper is a conceptual paper aimed at providing a theoretical framework for subsequent studies, it cannot be categorized into any methodological options. In terms of methodological choice, the design of this project can be described as multi-method qualitative research since the study involved more than one data collection method which will be described later in the data collection section.

2.7 Research Strategy

A research strategy is a plan of action that describes how a researcher will answer the research question. A particular research strategy is usually associated with a particular research philosophy and research methodology. Experiments and surveys, for example, are associated with a

quantitative research design, whereas ethnography, action research, grounded theory, and narrative inquiry are associated with a qualitative research design. However, some research strategies are associated with quantitative or qualitative, or mixed methods such as archival research, and case study (Saunders, Lewis and Thornhill, 2012).

Regarding the research questions and research objectives in Table 1.1, this project intends to explore the roles and impact of a science and technology park in a developing entrepreneurial ecosystem context. Because a science and technology park is not widely discussed in the literature on the entrepreneurial ecosystem. Furthermore, there are entrepreneurial ecosystems that do not contain science and technology parks. Therefore, it is case-specific to what we intend to study. Furthermore, we also have an assumption that a context of an entrepreneurial ecosystem may either hamper or enhance the impact of a science and technology park.

Due to the varieties and dynamics of the entrepreneurial ecosystems, the boundaries between the phenomenon and the context cannot be easily separated. A case study is the most appropriate strategy to get a deep understanding of the context of that being studied (Eisenhardt and Graebner, 2007). A case study may use mixed methods to collect data such as interviews, observation, documentaries, and questionnaires (Saunders, Lewis and Thornhill, 2012; Yin, 2018).

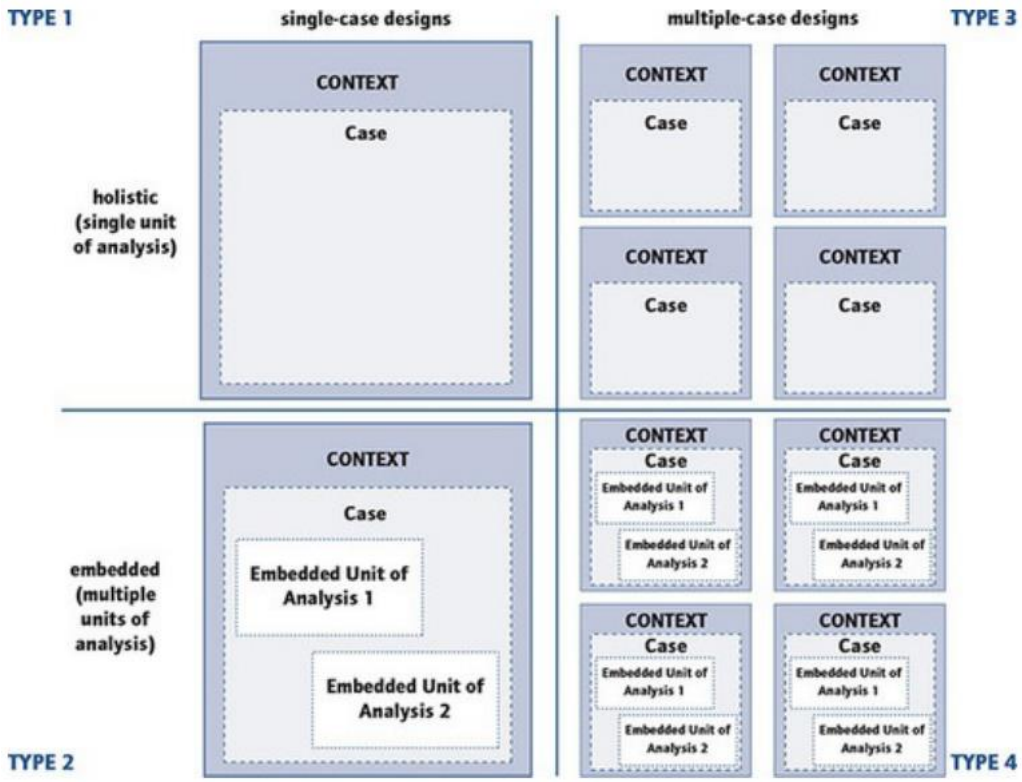


Figure 2.3 Four types of case study design.

Source: Yin (2018)

Yin (2018) classified case study research designs into four types including (Type 1) single-case (holistic) designs, (Type 2) single-case (embedded) designs, (Type 3) multiple-case (holistic) designs, and (Type 4) multiple-case (embedded) designs as shown in Figure 2.3. First, the researcher must determine whether to do a single-case or multiple-case study and the selection of the case should be related to theory or theoretical propositions (Yin, 2018). In the first research paper, we have made a theoretical proposition that the roles and impact of science and technology parks are negatively correlated with the growth of the entrepreneurial ecosystem. Therefore, a single case of a developing entrepreneurial ecosystem that has a science and technology park can represent a critical case for the proposition while contributing significantly to knowledge and theory development. Second, the researcher must consider whether to do a holistic or an embedded design. The entrepreneurial ecosystem is a complex system that consists of different actors and institutions. Although the main unit of analysis is the ecosystem level, it is still required several subunits of analysis represent different actors and institutions. Therefore, this project is considered to be a (Type 2) single-case (embedded) design regarding the typology of case studies in Figure 2.3.

2.8 Sampling Technique

Ideally, the study should collect data from all members of the group, as in a census. However, it may be impossible for researchers to collect all data due to limitations such as time, money, or access. Instead of collecting data from all possible cases, the amount of data to collect can be reduced by using sampling techniques and still representing the full set of cases or the entire population.

Sampling techniques can be categorized into two groups which are probability and non-probability samplings. Probability sampling is usually associated with survey strategies. This technique requires a complete list of the population or the sampling frame; otherwise, it is impossible to select a probability sample. In this study, the main research aim is to examine the roles of a science and technology park in a developing entrepreneurial ecosystem, therefore, the conceptual boundary can be identified. Nevertheless, it is still impossible to collect data from the whole entrepreneurial ecosystem of Chiang Mai, Thailand. Hence, non-probability techniques are a more practical solution for the project.

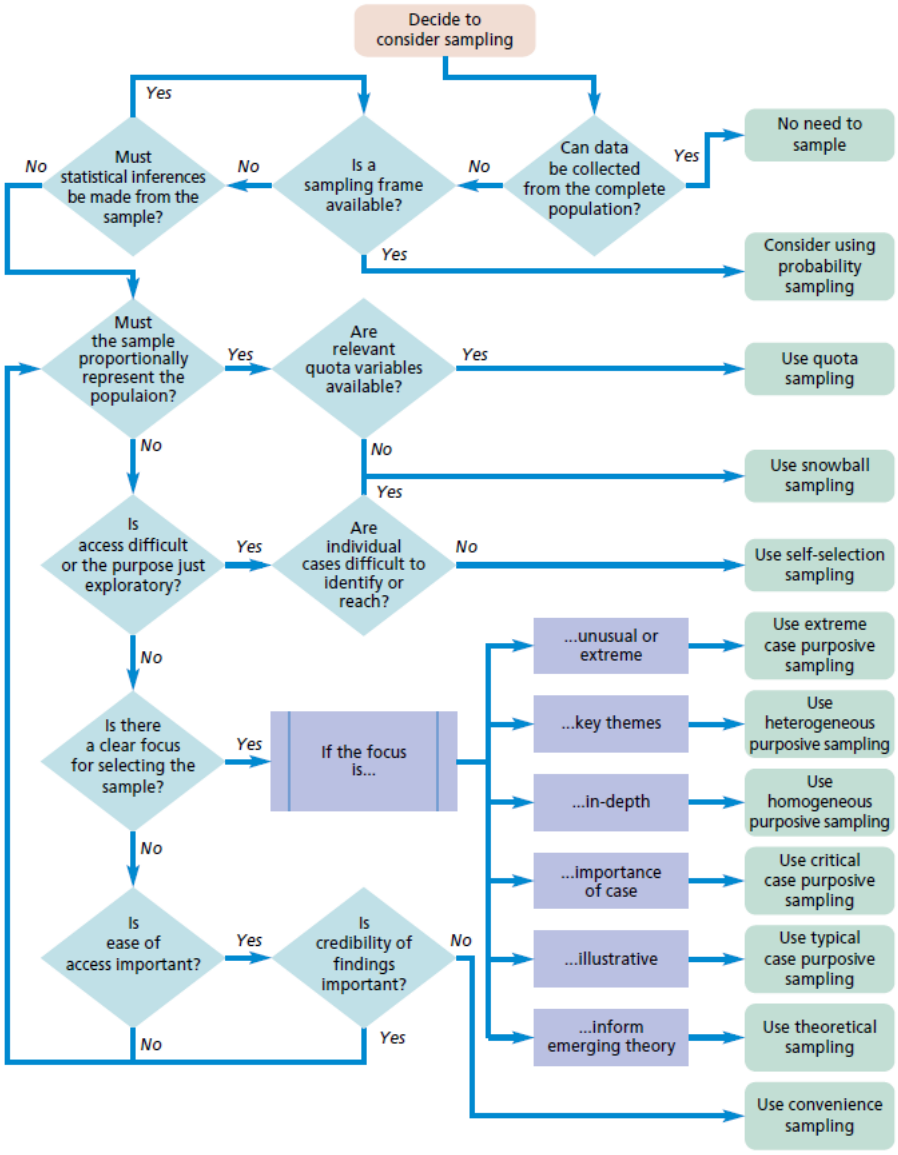


Figure 2.4 Selecting sampling technique.

Source: Saunders, Lewis and Thornhill (2012, p. 271)

According to the logic for selecting sampling techniques in Figure 2.4, theoretical sampling is the best fit for this study since the research objectives state that the project will investigate the roles of the science and technology park in the entrepreneurial ecosystem. Therefore, the focus of the case study is the entrepreneurial ecosystem theory. With this sampling technique, the participants are selected from different actors and institutions, as subunits of analysis of the entire entrepreneurial ecosystem, to provide the maximum variation possible from the data. In the initial meetings with our main contact at the Northern Science Park, the purposes of this study and the attributes of entrepreneurial ecosystems (see Appendix C.1.4) were explained. The list of the ecosystem's actors was identified after the initial meeting. The author then verified the list to ensure that the participants in the list represent different ecosystem actors and meet the following criteria. Since the main research aim is to examine the roles of a science and technology

park in a developing entrepreneurial ecosystem, the first selection criterion is that participants who are the ecosystem actors must have a connection to Northern Science Park. As a result, the samplings in this study may not represent the entire entrepreneurial ecosystem since other members of the ecosystem may never interact with Northern Science Park. Second, the diversity of participants must be able to link to all elements of the entrepreneurial ecosystem. To ensure that the sample is still sufficient to describe the relationship between the science and technology park and the entrepreneurial ecosystem elements in theory, the mapping between the participants and the related elements of the entrepreneurial ecosystem was created as shown in Figure 2.5. Third, participants must be active ecosystem actors in Chiang Mai's entrepreneurial ecosystem.

Each ecosystem player has unique interactions with the elements of the entrepreneurial ecosystem, which were created from data. Participants' groups in this study included the Northern Science Park, entrepreneurs, successful entrepreneurs, public and private entrepreneurial support organisations, and universities in Chiang Mai, Thailand.

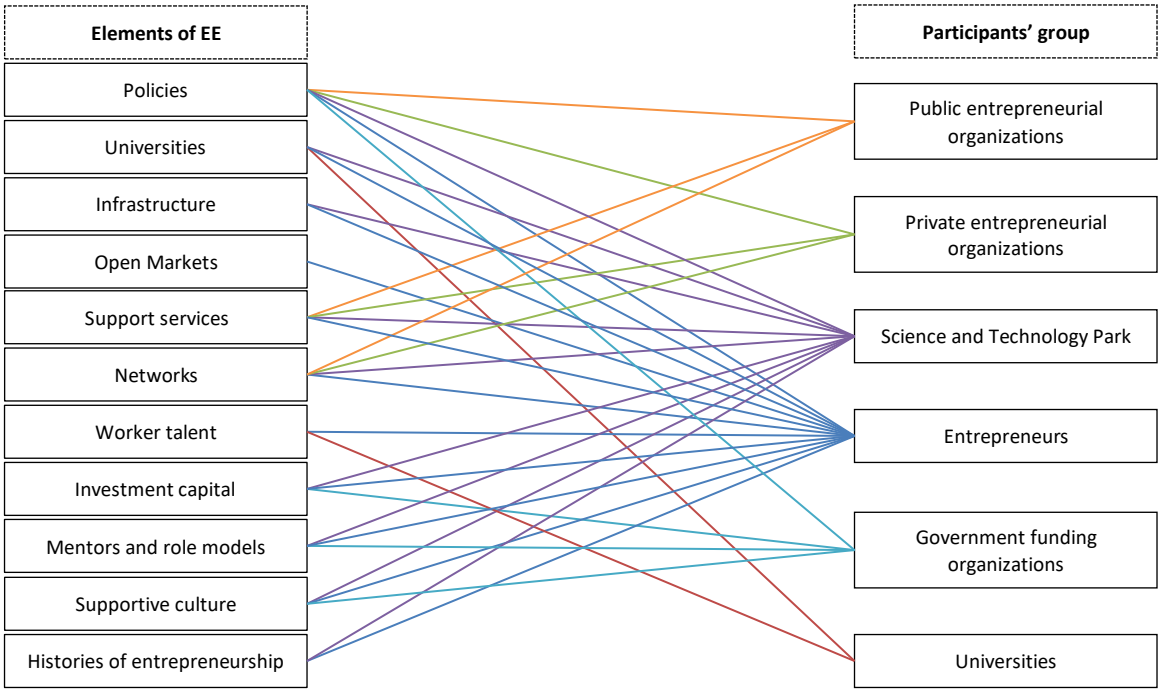


Figure 2.5 The mapping between the ecosystem's actors and related elements of the entrepreneurial ecosystem.

In terms of the sample size, there are no rules for non-probability samplings except for quota samples (Saunders, Lewis and Thornhill, 2012). Therefore, the sample size in non-probability sampling techniques depends on the research questions and objectives. The primary goal of this study is to investigate the interaction between Northern Science Park and Chiang Mai's entrepreneurial ecosystem. As a result, the ideal sample size for this research must cover all

active ecosystem actors and be large enough to capture all elements of the entrepreneurial ecosystem, which we determined to be 30 interviews from 6 distinct entities. In addition to that, Saunders, Lewis and Thornhill (2012) provide a guideline for the minimum sample size for non-probability in Table 2.3. This project made use of semi-structured interviews; therefore, 31 cases are reasonable sample sizes.

Table 2.3 Minimum non-probability sample size.

Nature of study	Minimum sample size
Semi structure/in-depth Interviews	5–25
Ethnographic	35–36
Grounded theory	20–35
Considering a homogeneous population	4–12
Considering a heterogeneous population	12–30

Source: Saunders, Lewis and Thornhill (2012, p. 283)

2.9 Data Collection

This section presents the inner layers of the research onion (see Figure 2.1) including time horizon and data collection. As mentioned in the previous section, this study will be undertaken using a multimethod to collect data. The original plan for the data collection was to do face-to-face interviews and observations for primary data. However, the COVID-19 pandemic has compelled researchers to restrict data-collecting methods. As a consequence, the primary data for this study comes from online interviews only. Secondary data sources were also used, as outlined in section 2.9.3, to provide the context of the case study.

2.9.1 Time Horizon

In terms of time horizon, there are two distinct types including cross-sectional and longitudinal studies. Depending on the research question, longitudinal studies usually study change and development which takes time and resources to complete. While the cross-sectional focuses on the phenomenon at a particular time.

This project falls into a cross-sectional category based on the research questions, objectives, and time limits since it focuses on the roles and influence of the science and technology park in the entrepreneurial ecosystem rather than the evolutionary approach.

2.9.2 Primary Data

A discussion between two or more persons in which the interviewer asks meaningful questions of the interviewee, who listens and answers thoughtfully (Saunders, Lewis and Thornhill, 2012). Interviews can be used to collect relevant data to the research questions and objectives. Interviews can be classified into three types which are structured interviews, semi-structured interviews, and unstructured interviews. For structured interviews, all participants will be interviewed using an identical set of questions or questionnaires. It is often used to collect quantifiable data. While unstructured interviews, by contrast, there is no predetermined set of questions. Interviewees will be given a topic and they can discuss the topic freely. Lastly, semi-structured interviews are in the middle between the two which means that the interviewer will have a set of predetermined questions. However, this type of interview focuses on the flow of the conversation. Therefore, additional questions may emerge during the discussion, the sequence of questions may change, or even be removed from interview to interview.

Table 2.4 Uses of different types of interviews in each of the main research categories.

	Exploratory	Descriptive	Explanatory
Structured		✓✓	✓
Semi-structured	✓		✓✓
Unstructured	✓✓		

✓✓ = more frequent, ✓ = less frequent.

Source: Saunders, Lewis and Thornhill (2012, p. 377)

Semi-structured interviews are suitable for an exploratory study (see Table 2.4) that aim to explain the relationships between variables (Saunders, Lewis and Thornhill, 2012). Interviews may be conducted on one-to-one or group interviews depending on the convenience of participants. The semi-structured interviews may lead to concerns about reliability due to the nature of non-standardization. Therefore, any potential bias, including interviewer bias, interviewee bias, and participation bias should be avoided during the preparation and interview processes to ensure the data quality.

Given the theoretical basis of the elements of the entrepreneurial ecosystem that has been established, semi-structured interviews are the best fit for the research questions. The phenomenon we want to explain is how the science and technology park influences those elements. As a result, the elements of the entrepreneurial environment are key themes to examine. A list of themes and key questions are prepared regarding the theory on elements of the

entrepreneurial ecosystem and our theoretical propositions build in the first research paper. To record the discussion, both notetaking and videorecording are employed.

In this project, the interview questions queried participants about their opinion about Chiang Mai's entrepreneurial ecosystem in general and how they have experienced the Northern Science Park. The semi-structured interviews were carried out using broad sets of questions that led the interviews, with the possibility of additional questions arising throughout the conversation. A wide range of questions was created for various affiliations such as entrepreneurs, Northern Science Park, universities, and public-, and private-entrepreneurial support organisations depending on their roles and how they interact with the Northern Science Park or the elements of the entrepreneurial ecosystem. The interview questions are provided in Appendix B. Online interviews or conference calls were the main data collection due to the COVID-19 restriction.

A pilot interview was conducted with two members of Northern Science Park's management team to ensure that the key questions are relevant and simple to understand. In addition, a pilot interview also gave knowledge of the context setting of the case study, allowing the researcher to elaborate on the key questions further. A pilot interview is often not meant to be part of data collection because it is designed to assist researchers in designing or redesigning the questionnaire. However, the researcher discovered that the discussion in a pilot interview produced a wealth of useful information, and there was no chance for the researcher to do another interview with this management team. As a result, the pilot interview conversation was included for further analysis.

In total, 31 interviews with 33 participants were conducted for this study as shown in Table 2.5. The interview was carried out between 2020 and 2021, and most interviews were conducted one-to-one basis except for only one interview session that was conducted in a group of two participants from the same organisation. Altogether, 3,264 minutes of interviews were conducted, each interview lasted between 58 and 173 minutes, with an average of 105 minutes per session.

Table 2.5 Interview Participants.

Participants	**Types**	**Interview Duration (Minutes)**
STP-p1, STP-p2	Pilot Interview – Science and Technology Park	140
Startup01	Entrepreneurs	98
Startup02	Entrepreneurs	132

Participants	Types	Interview Duration (Minutes)
Startup03	Entrepreneurs	106
Startup04	Entrepreneurs	59
Startup05	Entrepreneurs	58
Startup06	Entrepreneurs	64
SocialENT01	Social Entrepreneurs	85
SocialENT02	Social Entrepreneurs	90
SME01	SMEs	76
SME02	SMEs	114
SME03	SMEs	117
SuccessENT01	Successful Entrepreneurs	90
SuccessENT02	Successful Entrepreneurs	60
SuccessENT03	Successful Entrepreneurs	173
SuccessENT04	Successful Entrepreneurs	139
STP-01	Science and Technology Park	166
STP-02	Science and Technology Park	132
STP-03	Science and Technology Park	147
STP-04	Science and Technology Park	149
STP-05	Science and Technology Park	106
STP-06	Science and Technology Park	124
Uni01	University	103
Fin01-1, Fin01-2	Government Fundings for Startups	123
PublicOrg01	Public Entrepreneurial Support Organisations	100
PublicOrg02	Public Entrepreneurial Support Organisations	114
PublicOrg03	Public Entrepreneurial Support Organisations	70
PublicOrg04	Public Entrepreneurial Support Organisations	71
PrivateOrg01	Private Entrepreneurial Support Organisations	79

Participants	Types	Interview Duration (Minutes)
PrivateOrg02-1	Private Entrepreneurial Support Organisations	102
PrivateOrg02-2	Private Entrepreneurial Support Organisations	77

2.9.3 Secondary Data

In this project, secondary data from websites, public documents, and proprietary reports were collected to have a better understanding of the context of this study, in section 2.12, which are the outlook of Chiang Mai's entrepreneurial ecosystem, science and technology parks in Thailand, and the Northern Science Park. The data was compiled from multiple sources to provide knowledge of the background of the case study as shown in Table 2.6.

Table 2.6 Secondary Data and Sources of Data.

Secondary Data	Sources of Data	Type of data
Chiang Mai Municipality, then and now	Chiang Mai Municipality	Website
Entrepreneurship in Regional Innovation Clusters: Case Study of Chiang Mai and Chiang Rai, Thailand	Organisation for Economic Co-operation and Development	Online Report
French model applied for Chiang Mai smart city	Bangkok Post	Online News
Gross Regional and Provincial Product Chain Volume Measures 2019	Office of the National Economic and Social Development Council	Government Survey
Innovation districts in Bangkok	National Innovation Agency, Thailand	Government Website
Making a home for digital nomads	Bangkok Post	Online News
Northern Science Park Presentation	Northern Science Park, Thailand	Document
Number of Thai populations by sex, region, and municipality in 2000 and 2010	National Statistical Office, Thailand	Government Survey
Registered companies by province 2021	Department of Business Development	Government Survey
Science Park Promotion Agency, Ministry of Higher Education, Science, Research and Innovation, Thailand	A study of strategic factors to develop a successful science park – international practices	Government Report

Smart City Thailand	Digital Economy Promotion Agency	Government website
Strategy and Action Plan of the 3rd Term of Management (2020-2023)	Northern Science Park, Thailand	Report
Target Innovation Profile as of 2021	Northern Science Park, Thailand	Report
Thailand Moving Ahead with Cluster Development	Thailand Board of Investment	Website
Thailand Tourism Statistics Report 2017	Ministry of Tourism & Sports	Government Report
Thailand's population by province 2021	Department of Provincial Administration	Government Survey
The 2017 Business and Industrial census	National Statistical Office, Thailand	Government Census
The Global Startup Ecosystem Index Report 2021	StartupBlink	Report
Why Digital Nomads & Entrepreneurs Keep Choosing Chiang Mai	Forbes	Online Article
World Tourism Organization	International Tourism Highlights 2019	Online Report

2.10 Data Analysis

A case study protocol was developed, including interview questions and lists of participants, transcribed cases one by one, and created a case study database using NVivo. Multiple analytical methods were engaged to analyse the data. The coding processes began after the data had been collected and transcribed. NVivo was used to help in the coding process.

First, the data was assessed for its relevance to the focused entrepreneurial ecosystem, Chiang Mai. During interviews, for example, participants might discuss topics unrelated to Chiang Mai. For the second paper, the data collection was designed to capture all elements of the entrepreneurial ecosystem. Discussions were removed if they were not related to Chiang Mai's entrepreneurial ecosystem before coding. In the third paper, discussions were further removed if they were not directly related to the entrepreneurial culture before it was re-coded. The data screening in the first phase ensured that the case study maintained clear boundaries and was relevant to the research concern for each study.

In the second paper, initial coding was implemented to break down raw data in the first cycle. Then provisional coding (Saldaña, 2013) was conducted to combine separated data during the

first cycle of coding into broader categories using a predetermined set of codes that were derived from the literature on the entrepreneurial ecosystem to classify the entrepreneurial ecosystem elements from the previous research (Spigel, 2017). Finally, axial coding was used to portray the dimensions, or the roles of the Northern Science Park contributing to Chiang Mai's entrepreneurial ecosystem. Multiple conceptual frameworks were developed as a result.

While in the third paper, the dimensions of entrepreneurial culture were taken from various authors (Feld, 2012; Isenberg, 2011; WEF, 2013; Spigel, 2017; Motoyama and Knowlton, 2014; Neck *et al.*, 2004; Cohen, 2006), and the science and technology park's support mechanisms were modified from the previous research (van Rijnsoever, 2020). These two sets of codes were simultaneously coded using causation coding (Saldaña, 2013) to examine the interrelationship and causality between the science and technology park support mechanisms and the dimensions of entrepreneurial culture. This coding method is suitable for this study since multiple causes and multiple outcomes do exist in the entrepreneurial ecosystem. Thereby, the science and technology park support mechanisms were recognized as causes while the dimensions of entrepreneurial culture were outcomes. The codes were then grouped into coherent categories or themes using thematic analysis which constructed a theory of how the Northern Science Park influences the entrepreneurial culture in the entrepreneurial ecosystem of Chiang Mai, Thailand as a result.

2.11 Ethical Considerations

When undertaking human affairs research, ethical concerns are essential. This is to ensure that no one gets harmed as a result of participating in the research. This study adhered to the University of Southampton's ethical compliance policy. The researcher must complete an ethics form, a consent form, a participant information sheet, a debriefing, and an interview guideline before receiving the first assessment from the supervisors. After that, all forms were submitted through the ERGO system (Ethics and Research Governance Online), and the project was thoroughly reviewed and approved by the Ethics Committee. The researcher is not permitted to conduct interviews unless the committee approves. This is to guarantee that the researcher has addressed all ethical concerns that may arise as a result of the research and that the researcher has followed all guidelines provided in the ERGO system. Appendix A contains a list of the forms discussed in this section.

Before the interview, consent forms, participant information sheets, and interview guidelines were provided to all participants which contained information about who the researcher is, the purpose of the research to declare that their responses are seen and used by the researcher only,

and the key questions during the interview. Confidentiality and anonymity of participants are concerned as a priority, which means that no harm should result from involving the research. Participation is completely voluntary; participants may refuse to take part in the study or withdraw from the study at any time without penalty or loss of benefits to which they are otherwise entitled. Personal information is kept securely and viewed by only the researchers involved in the study. If participants have further questions about the study, they may contact the researcher through the provided contact information.

Following the interview, participants were given a debriefing sheet containing detailed information about the research as well as contact information. If participants have any further questions about their rights or wish to file a complaint or concern, they may directly contact the Head of Research Governance, Research Governance Office, University of Southampton.

2.12 A Case Study Context

This section provides a brief overview of the context of our empirical study, including the entrepreneurial ecosystem of Chiang Mai in comparison to Bangkok, Thailand's capital city, an overview of science and technology parks in Thailand, and the Northern Science Park in Chiang Mai, Thailand.

2.12.1 Entrepreneurial Ecosystem of Chiang Mai, Thailand

Chiang Mai province has a total area of 20,107 km^2 which is the second largest province in Thailand (NSO, 2010). However, it has a municipal area of only about 40.22 km^2 compared to 1,568.74 km^2 in Bangkok (Chiang Mai Municipality, 2022). In 2019, Chiang Mai's GPP is 259,026 Million baht, accounting for 1.5 % of the national GDP, whereas Bangkok's GPP is 5,709,940 Million baht, accounting for 33.8 % of the national GDP. In addition, it is the largest GPP in the northern area, ranking 13th out of 77 provinces in Thailand. (NESDC, 2019). As of 2019, there are 66.6 million people in Thailand. About 1.8 million people live in Chiang Mai province and just over half of the population live in a municipal area. Additionally, Chiang Mai ranks as the 5th largest province in terms of population in Thailand (DOPA, 2021). Chiang Mai has 25,239 registered firms in 2021, which is more than 10 times lower than Bangkok (DBD, 2021). A statistical snapshot of Chiang Mai and Bangkok is shown in Table 2.7.

Table 2.7 Chiang Mai and Bangkok - statistical snapshot 2021 or the latest year available.

	Chiang Mai	Bangkok
Land Area (km²)[1]	20,107.06	1,568.74
Municipal Area (km²)[1,2]	40.22	1,568.74
Population[3]	1,803,331	8,958,219
GPP (million THB)[3]	259,026	5,709,940
GPP per capita (THB)[3]	143,637	637,397
Share of GPP by industry[3]	• Agriculture 19.23% • Industrial 10.24% • Service 70.53%	• Agriculture 0.04% • Industrial 12.23% • Service 87.83%
GDP as a share of Thailand[3]	1.5%	33.8%
Employment[4]	1,003,677	5,180,324
Registered employees[4]	380,627	4,046,768
Number of registered companies[5]	25,239	296,167
Number of newly registered companies[5]	2,988	19,732
Number of liquidated companies[5]	856	7,397
Innovation areas and infrastructure	• Northern Science Park • Suandok Medical Innovation District (SMID) • Food Innovation and Packaging Centre (FIN) • Smart City	• Thailand Science Park • Yothi Innovation District • Rattanakosin Innovation District • Pathumwan Innovation District • Klongsan Innovation District • Kluaynamthai Innovation District • Lat Krabang Innovation District • Ari Innovation District • Food Innopolis • Smart City

Notes: Data as of 2021 or the latest year available, [3]Data are for 2019

Source: [1,4]National Statistical Office [2]Chiang Mai Municipality, [3]Office of the National Economic and Social Development Council, [5]Department of Business Development, National Innovation Agency

Table 2.8 Number of establishments and persons engaged in Chiang Mai and Bangkok by the size of establishment, 2017.

	Chiang Mai			Bangkok		
Size of the establishment (no. persons)	No. establishments	No. persons engaged	% persons engaged	No. establishments	No. persons engaged	% persons engaged
1 - 5	74,419	132,262	46.56%	287,726	594,095	23.73%
6 - 10	4,955	37,506	13.20%	35,789	276,926	11.06%
11- 15	1,680	21,326	7.51%	12,833	164,479	6.57%
16 - 20	660	11,832	4.17%	6,231	115,039	4.60%
21 - 25	380	8,610	3.03%	3,269	75,197	3.00%
26 - 30	212	5,982	2.11%	2,541	73,563	2.94%
31 - 50	360	13,825	4.87%	4,319	174,709	6.98%
51 - 100	201	13,806	4.86%	2,777	202,680	8.10%
101 - 200	97	13,211	4.65%	1,427	207,632	8.30%
201 - 500	40	11,580	4.08%	658	207,397	8.29%
501 - 1,000	17	11,320	3.99%	176	125,515	5.01%
> 1,000	2	2,800	0.99%	101	285,822	11.42%
Total	**83,023**	**284,060**	**100.00%**	**357,847**	**2,503,054**	**100.00%**

Source: The 2017 Business and Industrial census, National Statistical Office

Chiang Mai is one of the thirty provinces that the government declared a smart city that incorporates innovation and technology to enhance the city in many areas, such as digital infrastructure, transportation system, social services, housing, recreational areas, and commercial resources, with the development goal of sustainably improving the quality of life of the residents (DEPA, 2022). Moreover, the National Innovation Agency (NIA) plans to apply the Paris & Co model in France on Tha Phae Road to attract foreign digital talent into Chiang Mai and make the city an Innovation District for tech-based entrepreneurs (Leesa-nguansuk, 2018). Chiang Mai is one of the top global destinations for digital nomads because of its affordable cost of living, supportive infrastructure such as co-working spaces, coffee shops with fast internet speeds, and a large ex-pat community (Hynes, 2016; Hicks, 2018; Leesa-nguansuk, 2018). In terms of tourism, Thailand is one of the top ten most popular tourist destinations worldwide (WTO, 2019) and Chiang Mai is always one of the top five places to visit in Thailand with an average of 10 million visitors per year (MOTS, 2017). Additionally, the international airport located near the city drives tourism growth. Seven universities and many international schools can be sources of knowledge and talented workers.

The cabinet and the Thailand Board of Investment (BOI) launched the cluster-based special economic development zone policy in 2015 to increase industrial competitiveness in high-

potential areas using advanced technology and assigned Chiang Mai to the Digital Economy Cluster and Agro-processing Industrial Cluster (BOI, 2015).

Although Chiang Mai's ecosystem has the potential to become one of the most flourishing entrepreneurial ecosystems, it is still developing and not yet self-sustaining (for a detailed discussion of these terms see pages 55-57 / section 3.4.1). According to StartupBlink (2021), the Global Startup Ecosystem Index 2021 reveals that there are 4 cities in Thailand among the top 1,000 cities globally, including Bangkok, which is rated 71st, Chiang Mai, which is ranked 397th, Phuket, which is ranked 442nd, and Pattaya, which is placed 833rd. Despite being placed second in Thailand, the difference in worldwide rankings implies that Chiang Mai's ecosystem remains noticeably weaker than Bangkok's.

2.12.2 Science and Technology Parks in Thailand

Regarding the science and technology parks' network in Thailand, there are four main science and technology parks with dedicated infrastructure to provide full functional services and other ten as branches of regional science and technology park network with limited services in operation across the country. One main science and technology park located in Bangkok in the central region is Thailand Science Park (TSP) and the three main regional science and technology parks are all university-based science and technology parks (see Figure 2.6) including the Northern Science Park (NSP) located in Chiang Mai University (CMU), the North-eastern Science Park (NESP) located in Khonkaen University (KKU), and the Southern Science Park (SSP) located in Prince of Songkla University (PSU). Moreover, there are two more university-based science and technology parks currently in the set-up phase in the eastern region and the lower north-eastern region. For regional science and technology parks, there are 16 founder universities in the network and will expand into 44 universities soon. This study will draw on Chiang Mai province as an entrepreneurial ecosystem that is also the home of the Northern Science Park.

Northern Science Park network consists of fourteen joint universities from different provinces in the northern region including seven founder universities; Chiang Mai University, Maejo University, Mae Fah Luang University, University of Phayao, Naresuan University, Pibulsongkram Rajabhat University, and Uttaradit Rajabhat University; and seven new universities (see Figure 2.6).

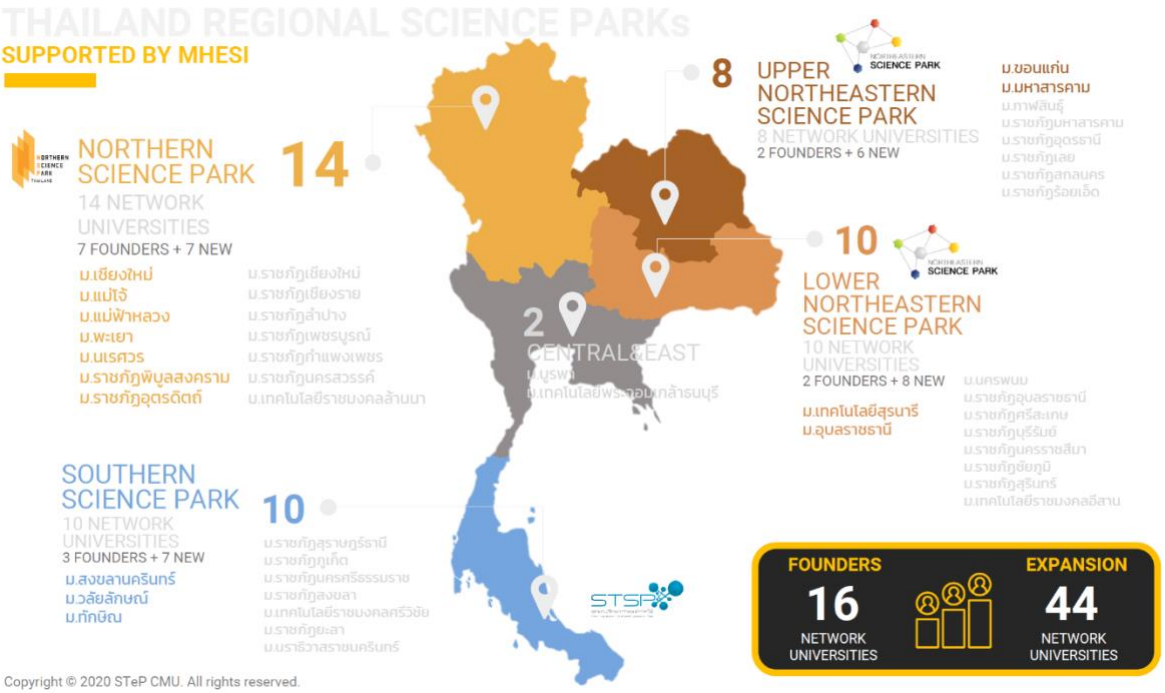


Figure 2.6 Regional Science Parks in Thailand.

Source: Northern Science Park presentation documents

2.12.3 Northern Science Park, Chiang Mai, Thailand

Technology Development Centre for Industry, Chiang Mai University (TDCI) was founded in 2011 in partnership with seven faculties of Chiang Mai University comprising the faculty of Engineering, Science, Agro-Industry, Agriculture, Business administration, Architecture, and College of Art, Media, and Technology. The name of TDCI was changed to Chiang Mai University Science and Technology Park (STeP) in 2012 which then became the central operation of the Northern Science Park (NSP) in 2013. In terms of ownership and governance, the Northern Science Park and all other regional science and technology parks in Thailand are all public university-based science and technology parks governed by the Science Park Promotion Agency (SPA) of the Royal Thai Government's Ministry of Higher Education, Science, Research, and Innovation (MHESI), which also serves as the primary source of public funding for the operation of all regional science and technology parks in Thailand.

Table 2.9 Characteristics of Northern Science Park, Thailand.

Year of establishment	2011: Technology Development Centre for Industry, Chiang Mai University 2012: Science and Technology Park, Chiang Mai University 2013: Northern Science Park, Thailand
Location	Mae-Hia campus, Chiang Mai University, Chiang Mai, Thailand
Main sources of funding	Ministry of Higher Education, Science, Research and Innovation (MHESI), Royal Thai Government
Governance	Board of Science Park Promotion Agency (SPA); Chaired by the Ministry of Higher Education, Science, Research and Innovation (MHESI)

Source: Northern Science Park presentation documents

Figure 2.7 Northern Science Park, Chiang Mai, Thailand.

Source: Northern Science Park presentation documents

Since May 2018, the Northern Science Park building (see Figure 2.7) has been fully operational (NSP, 2020). The NSP building has 20,750 square meters of useable area and includes office spaces, co-working spaces, meeting rooms, FABLAB, a 440-seat auditorium, an exhibition hall, an innovative food fabrication pilot plant, RF technology pilot plant, a service laboratory for R&D,

and ion beam service laboratory among other facilities. There are also convenience stores, shops, a food hall, banks, and a fitness centre (see Figure 2.8).

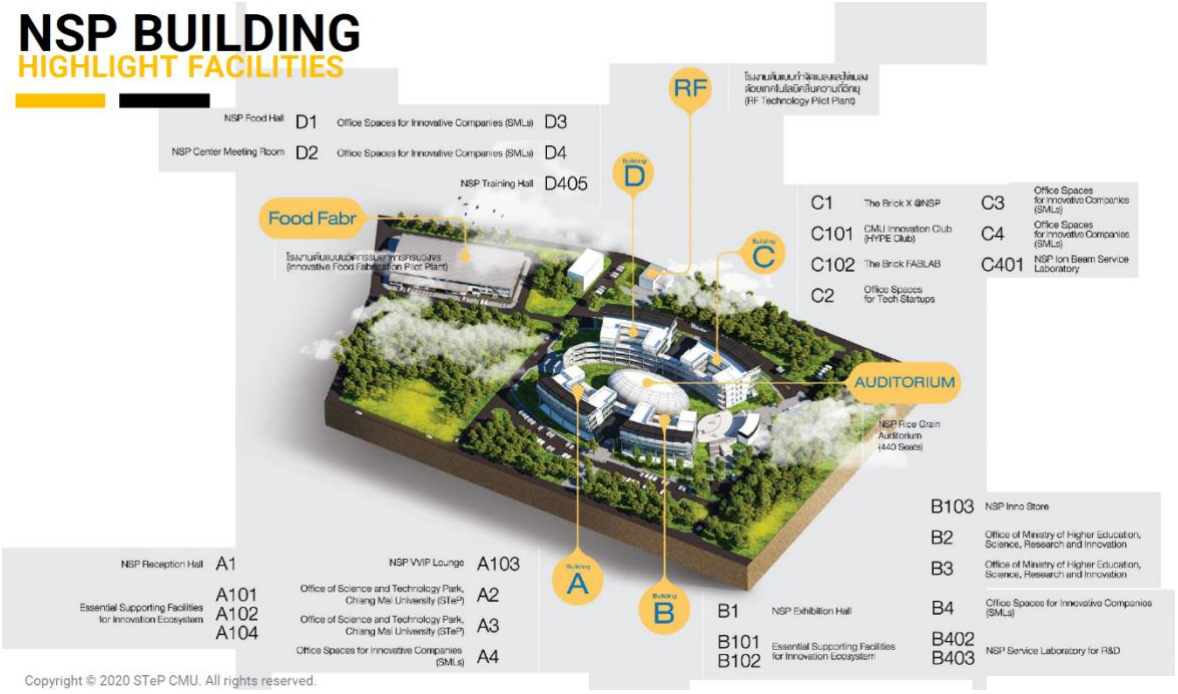


Figure 2.8 Highlight Facilities in Northern Science Park Building.

Source: Northern Science Park presentation documents

As of July 2020, the NSP building has a 97% of occupancy rate or 48 organisations consisting of SMEs and Large Enterprises at 52%, Startups at 19%, Strategic Partners at 19%, and an Ecosystem Supporting at 10% (see Figure 2.9). The NSP building is located at the Mae-Hia campus, Chiang Mai University.

Regional science and technology parks have different focus clusters depending on the research focus of the universities in their region. The Northern Science Park's focus clusters include IT software and digital content, agriculture and food, energy and material technology, and medical and biotechnology, with 63%, 15%, 13%, and 9% of clients belonging to each (see Figure 2.9).

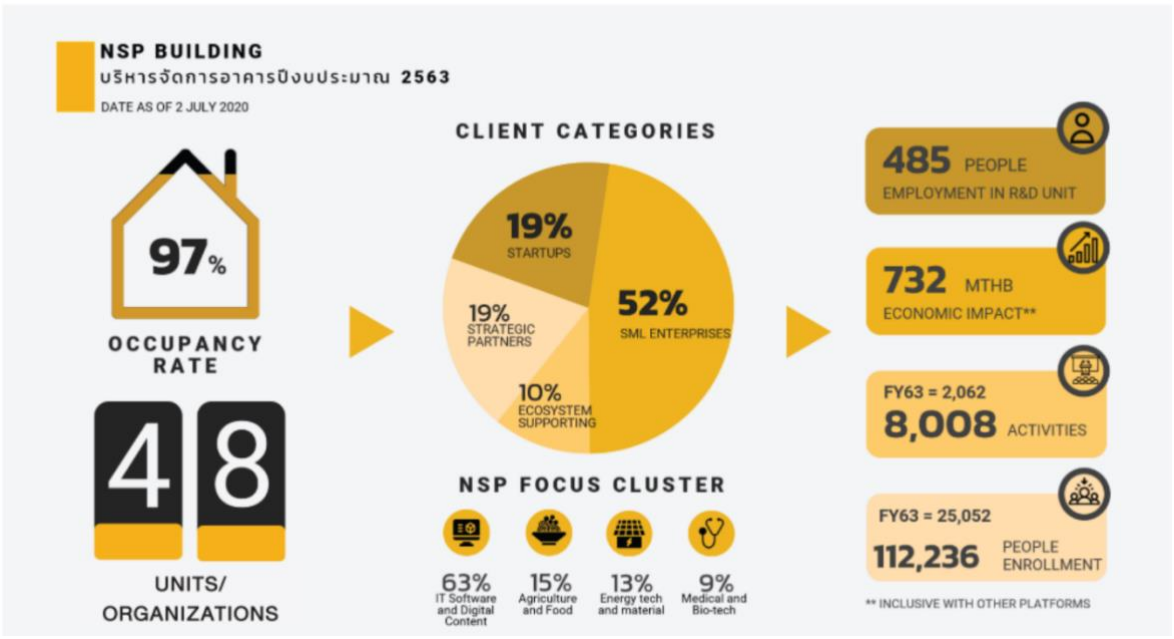


Figure 2.9 Clients Profiles of Northern Science Park Building.

Source: NSP (2020, p. 30)

Northern Science Park has three main process approaches as presented in Figure 2.10. Northern Science Park plays the role of intermediary organisation between the university and private sector including the startup approach, inside-out approach (IP Management & Licensing), and outside-in approach (Collaborative Research).

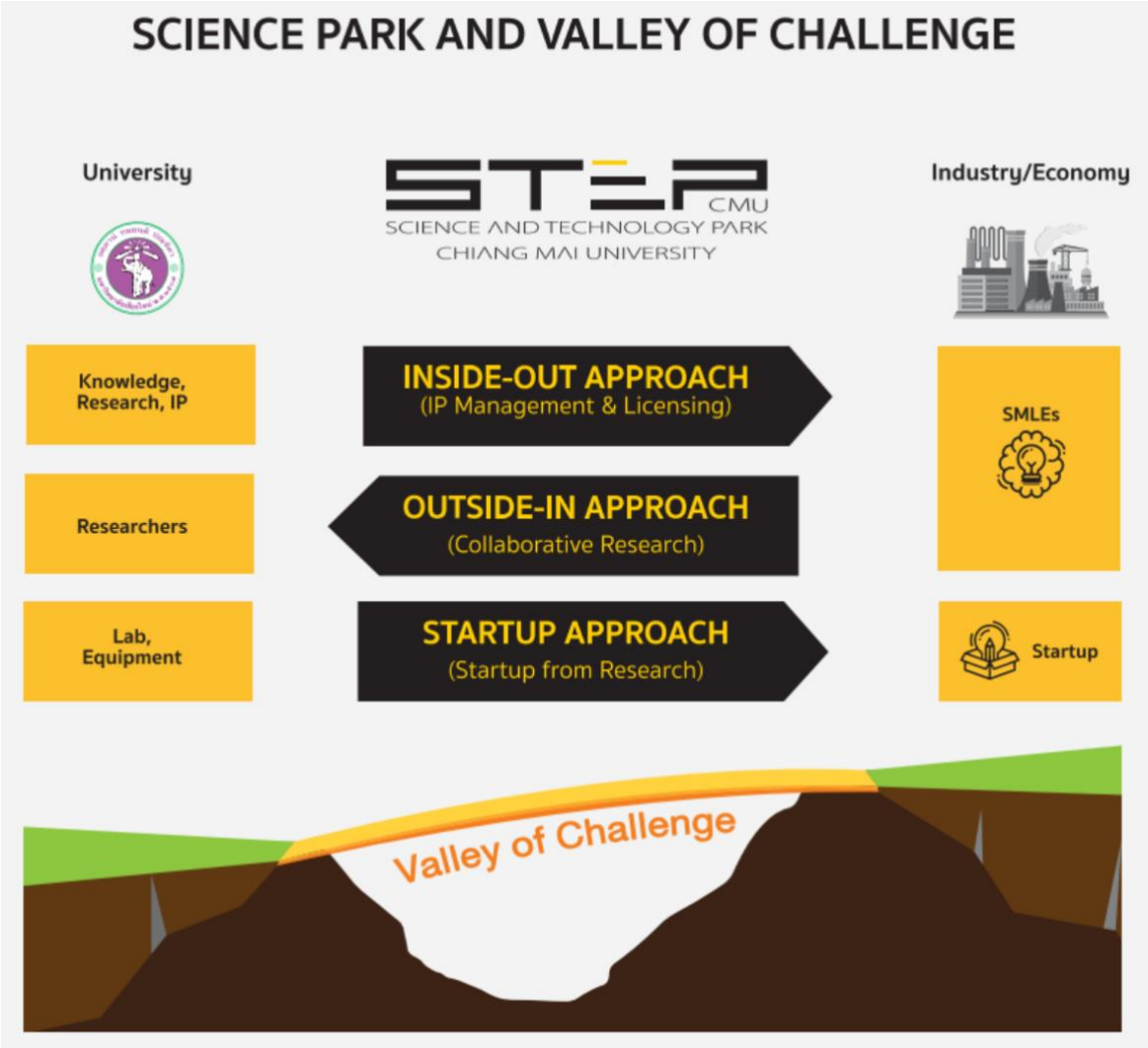


Figure 2.10 Process Approach.

Source: NSP (2020, p. 21)

In terms of the contributions to the region, the Northern Science Park has a set of key performance indexes called 'Target Innovation Profile'. Table 2.10 shows the Target Innovation Profile for the four-year management period from 2020 to 2023, and Figure 2.11 shows the actual performance in percentage terms compared to the target for the year 2021.

Table 2.10 Target Innovation Profile for 2020-2023.

TARGET INNOVATION PROFILE	2020	2021	2022	2023	ACCUMULATE 2020 - 2023
TOTAL VALUE CREATION (UNIT: MTHB)	442	454	470	488	1,854
INDUSTRIAL INCOME (UNIT: MTHB)	28	32	36	40	136
NO. OF COLLABORATION PROJECT WITH INDUSTRY (UNIT: PROJECT)	180	210	264	340	994
NO. OF RESEARCHERS WORK WITH INDUSTRY (UNIT: PERSON)	120	135	165	200	620
NO. OF STUDENTS WORK WITH INDUSTRY (UNIT: PERSON)	350	360	410	520	1,640
NO. OF TECHNOLOGY STARTUPS FROM RESEARCH AND TECHNICAL EXPERTISE (UNIT: COMPANY)	30	50	70	95	245
NO. OF IP REGISTRATION AND MANAGEMENT (UNIT: PROJECT)	108	112	118	126	464
NO. OF RESEARCH COMMERCIALIZATION (UNIT: PROJECT)	16	20	28	46	110
ECONOMIC AND SOCIAL CONTRIBUTION & IMPACT (UNIT: MTHB)	1,700	1,750	1,850	2,096	7,396

Source: NSP (2020, p. 41)

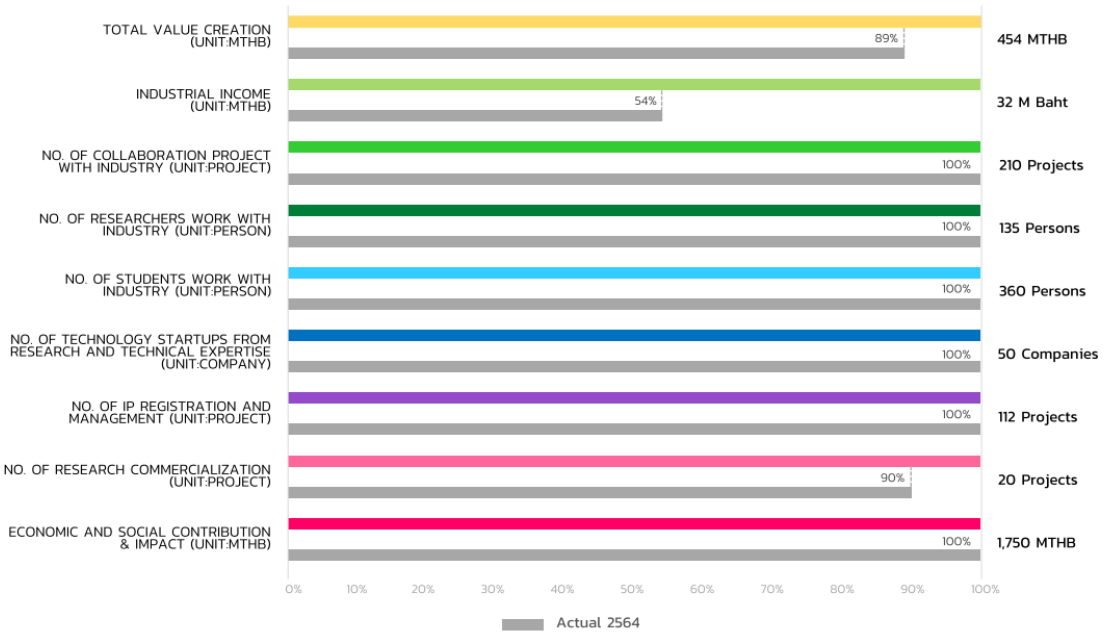


Figure 2.11 Target Innovation Profile and Actual as of 2021.

Source: Open Data Integrity and Transparency Assessment, NSP (2021)

2.13 Chapter Summary

The research philosophy, methodology, and case study context have been discussed in this chapter. This research has taken the interpretive viewpoint since the entrepreneurial ecosystem is a socially constructed phenomenon and it is also involving with different ecosystem actors from different organisations. Therefore, it tends to be subjective depending on how each actor's perception and interpretation. For the second and the third research papers, they employed the abductive approach which aims to expand or modify an existing theory on the entrepreneurial ecosystem. Multi-method qualitative research is the best fit for this project since it needs primary data to answer specific questions on the relationship between the science and technology park and the entrepreneurial ecosystem and also secondary data from multiple sources to provide a context of the case. In terms of data analysis, the second and the third research papers both used the existing theory or previous works to develop a provisional coding in the first step. Then thematic analysis was employed to develop multiple conceptual frameworks as a result.

Chapter 3 The Conceptual Roles of Science and Technology Parks in Entrepreneurial Ecosystems

3.1 Abstract

The literature on the entrepreneurial ecosystem tends to overlook the role and impact of science and technology parks in entrepreneurial ecosystems. While science and technology parks play an important role in the regional innovation system literature as intermediary organisations. Both regional innovation systems and entrepreneurial ecosystems are considered to be related concepts in the extant literature. Therefore, this study examines the literature on science and technology parks as well as the entrepreneurial ecosystem. Furthermore, the paper also categorizes the entrepreneurial dynamics into two distinct types, a developing and a developed entrepreneurial ecosystem including their characteristics to theorize the role and impact of science and technology parks and their relationships with the elements of the entrepreneurial ecosystem. The conceptualizations offer the theoretical foundation for a future empirical investigation.

3.2 Introduction

This paper examines the potential of science and technology parks to influence the evolution of the entrepreneurial ecosystem by exploring the extent to which science and technology parks are substitutes for or complementary to elements of the entrepreneurial ecosystem and how the importance of science and technology parks may alter in related to the dynamic of the entrepreneurial ecosystem from a conceptual perspective.

The concept of the entrepreneurial ecosystem describes the interactions between entrepreneurial, economic, social, political, and cultural elements that support growth-oriented entrepreneurship (Cohen, 2006; Isenberg, 2010; Feld, 2012; Brown and Mason, 2017). Given the increasing number of publications, the entrepreneurial ecosystem has recently drawn significant attention from many researchers (Alvedalen and Boschma, 2017; Cavallo, Ghezzi and Balocco, 2019). Despite decades of entrepreneurial ecosystem studies, there still are many gaps and unanswered questions. Two areas that tend to be overlooked are the interactions among the elements of the entrepreneurial ecosystem (Stam and Spigel, 2017; Chen *et al.*, 2020) and the dynamics of entrepreneurial ecosystems (Audretsch *et al.*, 2021), particularly in the context of

developing entrepreneurial ecosystems with limited entrepreneurial resources (Harima, Harima and Freiling, 2021). A considerable body of research has identified a list of attributes that are essential for entrepreneurial ecosystem evolution (see, e.g., Isenberg, 2011; Feld, 2012; WEF, 2013). Nevertheless, very few studies have investigated and described the interdependencies among these elements (see, e.g., Stam, 2015; Mack and Mayer, 2016; Spigel, 2017), or explained how different elements play different roles and in which contexts (Ryan *et al.*, 2021), how different configurations of entrepreneurial ecosystems promote different types of the entrepreneur (Scheidgen, 2021), and how different elements have influenced the evolution of the entrepreneurial ecosystem.

Science and technology parks play important roles in regional economic development; one such role is bridging organisations that facilitate technology transfer between universities, research institutions, and innovative firms (Autio *et al.*, 2018). Although not explicitly mentioned, science and technology parks seem to be associated with the entrepreneurial ecosystem as several elements of entrepreneurial ecosystems in the literature are related to a science and technology park entity. For example, Isenberg (2011, p. 7) presents the six domains of the entrepreneurial ecosystem (see Appendix C.1.2) which consists of 51 sub-elements such as incubation centres, technical experts, advisors, specific entrepreneurship training, entrepreneurs' networks, financial support, and research institutions. Feld (2012) suggests participants in a start-up community include entrepreneurs, government, universities, investors, mentors, service providers, and large companies. Other entrepreneurial ecosystem frameworks (see Appendix C.1) such as the eight pillars of the entrepreneurial ecosystem (WEF, 2013) and the attributes of the entrepreneurial ecosystem (Spigel, 2017) have several elements that overlap with the prior mentioned such as financial support, mentors, advisors, incubators and entrepreneurial networks, entrepreneurship training, and cultural support. Science and technology parks can either directly provide some of these entrepreneurial ecosystem elements or play a facilitator role in the development of the entrepreneurial ecosystem elements. Still, the roles of science and technology parks in the entrepreneurial ecosystem have been largely overlooked in the entrepreneurial ecosystem literature with some exceptions (see, e.g., Cohen, 2006; Isenberg, 2011; Mason and Brown, 2014; Chen *et al.*, 2020; Germain *et al.*, 2022).

Although the roles of science and technology parks in entrepreneurial ecosystems remain underexplored in the literature, science and technology parks are well recognized as intermediary organisations whose goals are to act as a bridge between different organisations. For instance, universities demand science and technology parks commercialize their technologies through patenting, licensing, and collaborative research with private firms and academic spin-off firms while entrepreneurs expect science and technology parks to provide access to support services,

infrastructures, and technical and entrepreneurial knowledge that flows within the network (Diez-Vial and Montoro-Sanchez, 2017). Discussions on the role of a boundary-spanning institution in the literature on the entrepreneurial ecosystem have been undertaken such as university technology transfer offices (see, e.g., Bramwell and Wolfe, 2008; Schaeffer and Matt, 2016) and business incubators (Fernández Fernández, Blanco Jiménez and Cuadrado Roura, 2015); however, research on this perspective is still limited. Besides, different types of intermediary organisations have different impacts due to their distinct strategies (Villani, Rasmussen and Grimaldi, 2017).

The disparity in the strength of the entrepreneurial ecosystem ranging from a developing entrepreneurial ecosystem such as Hull in the UK to a well-developed entrepreneurial ecosystem such as Silicon Valley in the US (Spigel and Harrison, 2018) is another factor to be considered. In a developing entrepreneurial ecosystem, the role and importance of intermediary institutions may be different than in a developed entrepreneurial ecosystem. According to this viewpoint, science and technology parks can support the growth of the entrepreneurial ecosystem by acting as an intermediary organisation that develops mechanisms to articulate the flow of entrepreneurial resources and knowledge between entrepreneurs and other elements within the entrepreneurial ecosystem or between entrepreneurial ecosystems. This research addresses these gaps and contributes to the existing literature by conceptualizing how science and technology parks may affect the growth of entrepreneurial ecosystems.

3.3 Literature Review

3.3.1 Science and Technology Park

The science and technology park literature has been published in academic journals since the 1980s and is still increasing (Diez-Vial and Montoro-Sanchez, 2017; Hobbs, Link and Scott, 2017). Science and technology park literature comprise multi-disciplinary studies including innovation, entrepreneurship, economics, and others (Mian, Lamine and Fayolle, 2016).

The evolution of the science and technology park begin in the early 1950s, when the world's first university research park, Stanford Research Park, Palo Alto California-Silicon Valley, was founded in the United States. Regarding its success, the science and technology park is perceived as a catalyst tool in regional economic development. Thereby, several governments have tried to replicate it in their region (Diez-Vial and Montoro-Sanchez, 2017). Between the 1960s and the 1970s, science and technology parks were expanded into Japan and England followed by France, Germany, Sweden, Finland, Belgium, and others in Southeast Asia in the 1980s (Zhang, 2005).

The 1980 Bayh-Dole Act, the 1980 Stevenson-Wydler Act, and the 1985 Federal Technology Transfer Act led to significant transformations in how universities commercialized their innovations developed by academic scientists or researchers in the US (Grimaldi *et al.*, 2011). The amount of entrepreneurial activity by universities such as licensing, patenting, research joint venturing, and academic spin-offs increased dramatically in the US as a result (Link and Siegel, 2005; Diez-Vial and Montoro-Sanchez, 2017). Many universities have now established science and technology parks, incubators, or technology transfer offices to support the creation of academic spin-offs, and to facilitate the licensing of university-based technologies (Link and Siegel, 2005; Siegel, Wright and Lockett, 2007). Accordingly, science and technology parks have become an international phenomenon (Phan, Siegel and Wright, 2005), influenced by the success of Silicon Valley and Route 128. Science and technology park has been recognized by various terms; for example, science park, science city, science city, science town, innovation centre, cyber park, hi-tech (industrial) park, R&D park, university research park, research and technology park, technology park, technopark, technopole, technopolis, technology incubator, and technology business incubator (UNESCO, 2017). A variety of terminology used to describe science and technology parks reflect their different incubation support processes, which include pre-incubation, incubation and acceleration, and post-incubation (see D.2). While most science and technology parks do not provide entire incubation support, there are notable exemptions (Mian, Lamine and Fayolle, 2016).

Table 3.1 illustrates the definitions of science and technology parks adopted by different organisations. Although different organisations define the science and technology park differently, there are several aspects that they all share in common. Science and technology parks can therefore be described as *an innovation- and technology-related infrastructure that supports the growth of innovative firms through incubation and facilitates the flow of knowledge between firms and other actors, particularly universities and research organisations.*

In general, science and technology parks are discussed in the regional innovation system literature (see, e.g., Zhu and Tann, 2005; Minguillo, Tijssen and Thelwall, 2015; Gkypali *et al.*, 2016) whereas regional innovation system is referred to as an antecedent or a related concept in the entrepreneurial ecosystem literature (Mason and Brown, 2014; Spigel and Harrison, 2018). The contribution of science and technology parks in fostering innovative firms through incubation mechanisms has been widely recognized by scholars, policymakers, and practitioners (Mian, Lamine and Fayolle, 2016), and science and technology parks have also been credited with accelerating economic growth and international competitiveness (National Research Council, 2009). Science and technology parks, in concept, are intermediary organisations that connect science, technology, knowledge, education, entrepreneurship, and capital (Mian, Lamine and

Fayolle, 2016). They are rooted in a regional ecosystem among other key stakeholders – for instance, firms, universities, research institutions, and financial bodies (Lamine *et al.*, 2018).

Table 3.1 Science and Technology Park Definitions.

Organisations	Definition
The International Association of Science Parks and Areas of Innovation (IASP)	*"A science park is an organisation managed by specialised professionals, whose main aim is to increase the wealth of its community by promoting the culture of innovation and the competitiveness of its associated businesses and knowledge-based institutions.* *To enable these goals to be met, a Science Park stimulates and manages the flow of knowledge and technology amongst universities, R&D institutions, companies and markets; it facilitates the creation and growth of innovation-based companies through incubation and spin-off processes; and provides other value-added services together with high-quality space and facilities.* (IASP, 2022)
The United Kingdom Science Parks Association (UKSPA)	*"A Science Park is a business support and technology transfer initiative that; (1) encourages and supports the start-up and incubation of innovation-led, high-growth, knowledge-based businesses; (2) provides an environment where larger and international businesses can develop specific and close interactions with a particular centre of knowledge creation for their mutual benefit; (3) has formal and operational links with centres of knowledge creation such as universities, higher education institutes and research organisations."* (UKSPA, 2019)
The Association of University Research Parks (AURP)	*"University research parks are physical environments that can generate, attract and retain science and technology companies and talent in alignment with sponsoring research institutions that include, universities, as well as public, private and federal research laboratories. Research parks enable the flow of ideas between innovation generators such as universities, federal labs, and non-profit R&D institutions and companies located in both the research park and the surrounding region."* (AURP, 2022)

In the 1990s, the systems of innovation concept (Lundvall, 2010; Nelson, 1993; Edquist, 1997) took over the linear model of innovation regarding the nature of innovation that stemmed from the non-linear and interactive process, and the collaboration between several actors (Tödtling and Trippl, 2005). Initially, the concept of the innovation system was focused on a national level (Freeman, 1987; Lundvall, 2010; Nelson, 1993), a single geographical boundary where there are cultural homogeneity and one central state authority (Lundvall, 2010). The national innovation

system is the interactive system of institutional spheres from which private or public firms, universities, and governmental agencies generate science and technology within a nation (Intarakumnerd, Chairatana and Tangchitpiboon, 2002). Discussion on the relationships between firms, universities, and governmental institutions, known as “triple-helix” relationships, is quite common in the innovation system literature (Doloreux and Porto Gomez, 2017). The national innovation system is a social system and the core activity is learning, which is a social interaction between various actors that are fundamental to the process of innovation (Lundvall, 2010). Therefore, the government plays a crucial role in the national innovation system to intervene by using public policies as mechanisms to promote both the innovativeness and competitiveness of a nation. The approach is used to study the technological capabilities of countries in terms of production and exploitation (Fagerberg and Srholec, 2008).

According to new findings from a more recent study of the Italian national innovation system, the system frequently allocates R&D funding to large firms, whereas innovation frequently occurs in subnational and local clusters where SMEs are located and unaffected by the national innovation system (Malerba, 1993). As a result, scholars are beginning to explore the regional dimension in the innovation system literature. Regional innovation system emerges for several reasons, for example, knowledge spill-overs are commonly restricted within a region, particularly tacit knowledge that is the essence of innovation development; direct communication is needed to exchange the knowledge; and different regions have their industrial specialization (Tödtling and Trippl, 2005). While the national innovation system aims at both national and international levels, the regional innovation system focuses on the interactions between discrete elements within a region which encourage innovation and entrepreneurship (Mason and Brown, 2014; Cooke, Gomez Uranga and Etxebarria, 1997). The interactions can be specified as flows of knowledge and information, flows of investment funding, flows of authority, or other informal forms such as networks, clubs, and forums (Cooke, Gomez Uranga and Etxebarria, 1997). The elements in the regional innovation system concept mostly refer to key organisations; for instance, universities, research institutes, financial institutions, technology-transfer agencies, consultants, training organisations, public and private organisations, intermediary organisations, large and small firms, and non-firm organisations (Doloreux and Porto Gomez, 2017; Cooke, Gomez Uranga and Etxebarria, 1997). Autio (1998) illustrated the regional innovation system framework including two subsystems in the regional innovation system surrounded by a regional socioeconomic and cultural setting (see D.1). The *knowledge application and exploitation* subsystem contain the industrial companies and their customers, contractors, collaborators, and competitors. The second subsystem, *knowledge generation and diffusion*, consists of technology-mediating institutions, public research institutions, workforce-mediating institutions, and educational

institutions. There are flows of knowledge, resources, and human capital between these two subsystems and there are also external links to other regional, national, and international actors. Regarding the regional innovation system framework, science and technology parks act as technology-mediating institutions that mediate the knowledge flow between the two subsystems. Moreover, science and technology parks can facilitate the connection with other institutions, such as universities and public research institutions, inside the knowledge generation and diffusion subsystem.

So far, science and technology park literature has been studied from many different theoretical perspectives at multiple levels of analysis including the *national innovation* level, the *regional innovation* level, the *science and technology park* level, the *firm* level, and the *individual entrepreneurs* level (Phan, Siegel and Wright, 2005). Science and technology parks serve as business development organisations by offering a range of services and a cultivating environment for new innovative firms. Moreover, they mediate the relationship between entrepreneurs and key stakeholders such as universities, financial bodies, and large companies. The science and technology park ideally serves as a catalyst for regional development. Nevertheless, the contribution of science and technology parks in fostering regional development has been inconclusive as the evidence in previous studies still reveals mixed outcomes (Bakouros, Mardas and Varsakelis, 2002; Chan and Lau, 2005). The inconsistencies in the impact of science and technology parks have focused the discussion on structures and factors that influence the performance of science and technology parks. In the beginning, most research discussed the effect of the science and technology park's internal factors, such as the governance structure, the strategies, the internal resources and capabilities, the availability of investment capital, and the brand identity of the science and technology park (McCarthy *et al.*, 2018). Meanwhile, the impact of the external factors of the science and technology park such as the level of existing entrepreneurial activities and resources in the region, and the local-focused industry have gained the attention of scholars more recently.

As such, the emphasis on the interactions of local systemic factors in supporting knowledge development in local companies of the regional innovation system strongly coincides with the newer concept of the entrepreneurial ecosystem, particularly the focus on the interdependence of ecosystem elements (Mason and Brown, 2014). According to the study on the importance of science and technology parks in the regional innovation system, there is a high possibility that science and technology parks will play roles and have an influence on the entrepreneurial ecosystem as well as the regional innovation system.

3.3.2 Entrepreneurial Ecosystem

Since the work of Moore (1993), who introduced the business ecosystem concept, the term "ecosystem" became widespread in the social sciences, including the entrepreneurial ecosystem (Malecki, 2018). The entrepreneurial ecosystem literature emerges from diverse origins; entrepreneurship, economic geography, and innovation (Autio *et al.*, 2018; Malecki, 2018; Spigel and Harrison, 2018). While the entrepreneurial ecosystem has some similarities that are adopted from these related approaches such as industrial districts, clusters, and innovation systems (Malecki, 2018), it has unique features that make it distinct from those related concepts (Stam and Spigel, 2017). What the entrepreneurial ecosystem has in common with other antecedent approaches is the emphasis on the external business environment such as social and economic contexts, and the complex relationships between various institutional actors whereas the difference is that the entrepreneur plays an active role in driving the ecosystem rather than the institutions or the structure as seen in the innovation literature (Autio *et al.*, 2014; Stam, 2015; Spigel and Harrison, 2018). Therefore, the entrepreneurial ecosystem is not just a reformation of existing theories as it aims to improve the ways that the phenomenon of entrepreneurial regions can be approached (Spigel and Harrison, 2018).

Cohen (2006) was the first to use the term "Entrepreneurial Ecosystem" (Alvedalen and Boschma, 2017). Although Cohen was the first to coin the term entrepreneurial ecosystem, its recent popularity among practitioners and policymakers has been inspired by the following two authors; Isenberg (2010) in the Harvard Business Review article, *How to start an entrepreneurial revolution*, and Feld (2012) in the book "*Start-up communities: Building an Entrepreneurial Ecosystem in your city*" (Alvedalen and Boschma, 2017; Spigel and Harrison, 2018). Isenberg presents the nine prescriptions to create an entrepreneurial ecosystem using case studies from many countries around the world. Feld shows how to create a long-term, vibrant, sustainable start-up community from his 16 years of experience in the Boulder (US) start-up community. Following then, academics provided many definitions as shown in Table 3.2. However, there is still no universal agreement on the definition of the entrepreneurial ecosystem (Stam, 2015; Alvedalen and Boschma, 2017).

Table 3.2 Entrepreneurial Ecosystem Definitions.

Authors	Definitions
Cohen (2006, p. 3)	*"an interconnected group of actors in a local geographic community committed to sustainable development through the support and facilitation of new sustainable ventures."*
Isenberg (2010, p. 43)	*"a set of individual elements – such as leadership, culture, capital markets, and open-minded customers – that combine in complex ways."*
Mason and Brown (2014, p. 5)	*"a set of interconnected entrepreneurial actors (both potential and existing), entrepreneurial organisations (e.g. firms, venture capitalists, business angels, banks), institutions (universities, public sector agencies, financial bodies) and entrepreneurial processes (e.g. the business birth rate, numbers of high growth firms, levels of 'blockbuster entrepreneurship', number of serial entrepreneurs, degree of sellout mentality within firms and levels of entrepreneurial ambition) which formally and informally coalesce to connect, mediate and govern the performance within the local entrepreneurial environment."*
Stam (2015, p. 1765)	*"a set of interdependent actors and factors coordinated in such a way that they enable productive entrepreneurship within a particular territory*."
Roundy (2016, p. 233)	*"the sets of actors, institutions, social structures and cultural values that produce entrepreneurial activity."*
Spigel (2017, pp. 49-50)	*"…the union of localized cultural outlooks, social networks, investment capital, universities, and active economic policies that create environments supportive of innovation-based ventures."* *"…combinations of social, political, economic, and cultural elements within a region that support the development and growth of innovative startups and encourage nascent entrepreneurs and other actors to take the risks of starting, funding, and otherwise assisting high-risk ventures."*
Spigel and Harrison (2018, p. 151)	*"…the types of cultural, social, economic, and political environments within a region that supports high-growth entrepreneurship."*
Thomas and Autio (2020, p. 38)	*"A regional community of hierarchically independent, yet interdependent heterogeneous participants who facilitate the start-up and scale-up of entrepreneurial new ventures who compete with innovative business models."*

3.3.2.1 The elements of an entrepreneurial ecosystem

The definition of the entrepreneurial ecosystem only gives a broad overview rather than a specific explanation of what comprises the ecosystem. As a result, many entrepreneurial ecosystem frameworks have been developed describing the ingredients or elements of the entrepreneurial ecosystem. Cohen (2006) discusses how a community can be transformed into a "sustainable valley" using one community, Victoria, British Columbia, as an example to illustrate the components of the entrepreneurial ecosystem which consist of a formal network, informal network, university, government, professional and support services, capital services, and talent pool (see Appendix C.1.1). Isenberg (2011) introduces the six domains of entrepreneurship, that consist of 51 attributes in 12 subcategories of the entrepreneurial ecosystem, including policy, finance, culture, supports, human capital, and markets (see Appendix C.1.2). Feld (2012) describes a start-up community consists of the following elements: entrepreneurs, government, universities, investors, mentors, service providers, and large companies. In addition, Feld also mentions the community's culture such as 'give before you get', 'everyone is a mentor', and 'be open to any idea'.

Many frameworks just present a list of ingredients without indicating which elements are more significant and must be created first to further develop the entrepreneurial ecosystem. Figure 3.1 shows the entrepreneurial ecosystem attributes proposed by many authors, as well as the fact that several elements of the entrepreneurial ecosystem overlap, even though some of them were introduced in different terms. For example, Isenberg includes entrepreneur's networks, large companies, and early customers under the domain of the market while Cohen refers to the entrepreneur's network as the informal network and the large corporations under the formal network.

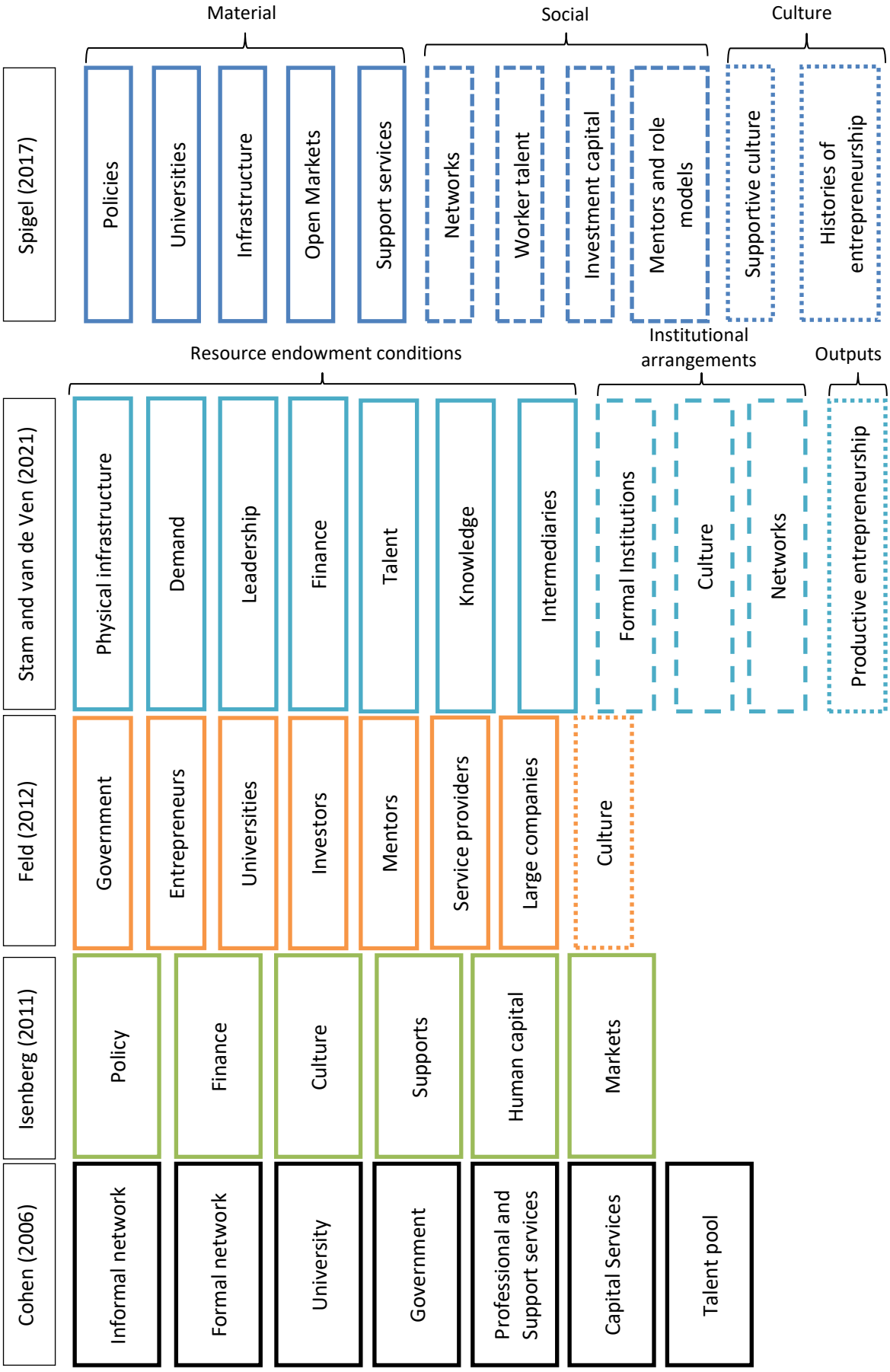


Figure 3.1 Entrepreneurial Ecosystem attributes by various authors.

3.3.2.2 The causal relationship among the elements of an entrepreneurial ecosystem

The aforementioned entrepreneurial ecosystem frameworks address what makes up the ecosystem, however, it is unclear how the elements in the ecosystem are interconnected. The authors that follow fill this gap by presenting frameworks not just the attributes of the entrepreneurial ecosystem but also illustrating the causal relationship between the elements. Stam and van de Ven (2021) suggest that the model of an entrepreneurial ecosystem consists of ten elements, and entrepreneurial outputs (see Appendix C.2.2). The ten elements in this framework are categorized into two groups including institutional arrangements and resource endowments. *Institutional arrangements* include formal institutions, culture, and networks while *resource endowments* include physical infrastructure, demand, intermediaries, talent, knowledge, leadership, and finance. They further propose that the causal relationship can occur in three ways. First, the ten elements in the entrepreneurial ecosystem are interconnected and influence each other in the process of evolution. Second, the entrepreneurial ecosystem elements increase the level of entrepreneurial activity in the ecosystem or generate output as productive entrepreneurship. Third, the output of the ecosystem or productive entrepreneurship also affects the entrepreneurial ecosystem as a positive feedback loop. As a consequence, the entrepreneurial ecosystem is growing further. Successful entrepreneurs may become angel investors, venture capitalists, mentors, or role models which further enhance the finance, network, and cultural elements of the entrepreneurial ecosystem, for example. Another entrepreneurial ecosystem framework was suggested by Spigel (2017). The attributes of the entrepreneurial ecosystem, which consists of eleven elements, can be divided into three categories, as follows: material, social, and cultural (see Appendix C.1.4). First, the *material* attributes consist of policies, universities, infrastructure, open markets, and support services. Second, the *social* attributes include networks, worker talent, mentors and role models, and investment capital. Last, the *cultural* attributes comprise supportive culture and histories of successful entrepreneurship. In terms of causal relationship among elements of the entrepreneurial ecosystem, Spigel (2017) suggests that the interrelationship between these three categories can be supportive or reinforce each other (see Appendix C.2.1). For example, in the ecosystem, a supportive culture and a history of successful entrepreneurship may create a setting that attracts investors, talent workers, mentors, and role models, as well as develop dense networks that connect entrepreneurs and other ecosystem elements. Furthermore, material attributes such as policy, support services, and infrastructure that support entrepreneurship would be worthless without the presence of social and cultural attributes. Aside from the causal relationship among elements of the entrepreneurial ecosystem, Spigel (2017) also concludes from his empirical study that the configurations for each ecosystem are unique depending on its contextual specifics. For instance, Spigel (2017) illustrates

the two different case studies of Waterloo, Ontario, and Calgary, Alberta, Canada. Calgary's ecosystem is driven by a strong market that provides many entrepreneurial opportunities to be exploited and attracts skilled labour into the region although the network connections between entrepreneurs are poor. Meanwhile, in Waterloo's ecosystem, some organisations encourage dense networking between entrepreneurs and other stakeholders. The local successful entrepreneurs inspire others to pursue entrepreneurship and to act as advisors or mentors for start-ups. Therefore, the high level of entrepreneurial activity in the region is supported by a strong entrepreneurial culture. These frameworks are included in Figure 3.1.

3.3.2.3 The evolution of an entrepreneurial ecosystem

Another shortcoming in the research on the entrepreneurial ecosystem is that most frameworks are provided in a static perspective and cross-sectional design rather than an evolutionary perspective and longitudinal design (Spigel and Harrison, 2018; Mack and Mayer, 2016; Mason and Brown, 2014; Alvedalen and Boschma, 2017). Thus, little is known about how the entrepreneurial ecosystem emerges and evolves. Spigel (2017) observed that successful entrepreneurial ecosystems may comprise a variety of element configurations and that not every element of an entrepreneurial ecosystem is necessary to exist. As a result, there are several approaches to developing a successful entrepreneurial ecosystem. So, what are the critical elements of entrepreneurial ecosystems that must be present for the ecosystem to evolve into a successful ecosystem? The evolutionary perspective is essential for the fact that the elements and the formation of the entrepreneurial ecosystem evolve. Understanding the evolution of the entrepreneurial ecosystem, as well as the role and importance of each element of the entrepreneurial ecosystem, can enhance resource allocation, allowing the entrepreneurial ecosystem to grow even further.

The following scholars have examined the evolutionary perspective. Mack and Mayer (2016) illustrate the evolution of an entrepreneurial ecosystem that incorporated the concept of life cycle stages; birth, growth, sustainment, and decline; with the six domains of the entrepreneurial ecosystem which was proposed by Daniel Isenberg (see Appendix C.3.1). Although there is a possibility that the entrepreneurial ecosystem may decline over time, there is also the possibility that the entrepreneurial ecosystem may reach a 'tipping point' where the ecosystems become self-sustaining (Isenberg, 2011). While the entrepreneurial ecosystem life cycle model adds an evolutionary viewpoint to the literature, it does not portray the self-sustaining nature of successful entrepreneurial ecosystems properly as well as the potential that each element of the entrepreneurial ecosystem may not develop equally at each phase of evolution. The research on the entrepreneurial ecosystem assessment is an excellent illustration of the uneven growth of the

elements of the entrepreneurial ecosystem (see, e.g., Autio *et al.*, 2019; Leendertse, Schrijvers and Stam, 2022). Furthermore, this conceptual framework fails to adequately depict the fact that a successful entrepreneurial ecosystem can have a variety of element combinations, and not all elements are essential.

Spigel and Harrison (2018) propose a process-based view that shows the evolution and transformation of the entrepreneurial ecosystem in three stages; nascent, strengthening, and either resilient or weakened entrepreneurial ecosystems (see Appendix C.3.2). This evolution of the entrepreneurial ecosystem framework better illustrates the sustainability of successful entrepreneurial ecosystems as seen in the final stage of evolution where there are two potential pathways. The entrepreneurial ecosystem can be either resilient and become self-sustaining with high levels of entrepreneurial activity or it may be weakened by internal or external shocks such as an economic shock or a change in a technological paradigm that results in the loss of firms and entrepreneurial resources due to collapse or migration. The framework also illustrates the levels of connectivity that allow the entrepreneurial resources to flow between entrepreneurs and other ecosystem actors, which is low in both nascent and weakened entrepreneurial ecosystems, and high in both strengthening and resilient entrepreneurial ecosystems. Furthermore, in nascent and weakened entrepreneurial ecosystems, the framework depicts the leakage of entrepreneurial resources, whereas, in strengthening and resilient entrepreneurial ecosystems, the framework describes the attraction of entrepreneurial resources from outside the ecosystems. Nonetheless, the framework describes particular elements of the entrepreneurial ecosystem, such as high-growth firms, anchor organisations, and other ecosystem actors, and their formation at various stages of the evolution. As a result, this framework does not describe the evolution of other key elements such as policy and governance, open markets, and physical infrastructure.

Besides the conceptual frameworks of the entrepreneurial ecosystem, Thompson, Purdy and Ventresca (2018) examine data from 14 years – 2000 to 2014 – using archival documents and electronic media sources, and also two years of interviews in Seattle, Washington, to examine the pattern of interactions between actors and the ecosystem formation to build an understanding of the early moments of the entrepreneurial ecosystem which can be categorized into three stages; these are creating community, developing legal infrastructure, and generating financial support (see Appendix C.3.3). Although the study provides useful insights into how the entrepreneurial ecosystem develops over time, particularly in the early stages of evolution, more longitudinal research is needed to investigate entrepreneurial ecosystems in different contexts and stages of evolution to capture a holistic view of the entrepreneurial ecosystem's evolution.

In conclusion, there is a lack of knowledge regarding the evolution of the entrepreneurial ecosystem, particularly research based on actual evidence. Because there is a lack of literature on the evolution of the entrepreneurial ecosystem, establishing more effective frameworks to capture all stages of evolution is challenging. As such, we urge more longitudinal studies of entrepreneurial ecosystems, as well as a challenge for future research to develop more effective frameworks on the evolution of an entrepreneurial ecosystem.

3.3.2.4 The strength of an entrepreneurial ecosystem

The literature on the evolution of an entrepreneurial ecosystem is mostly presented in the form of conceptual models. However, quantifying and qualifying the current phase of development of the entrepreneurial ecosystem remains challenging. The strength of an entrepreneurial ecosystem, as well as knowledge of what elements of the entrepreneurial ecosystem are essential for the entrepreneurial ecosystem evolution, are required for policymakers to examine and further develop the entrepreneurial ecosystem. Several entrepreneurial ecosystem assessment approaches have been developed by scholars using a combination of various indicators or proxies.

Spigel and Harrison (2018) develop a representative schematic of ecosystem types that uses *network strength* and *entrepreneurial resources* as an indicator matrix to illustrate four types of entrepreneurial ecosystems which are *strong, arid, irrigated, and weak* (see Appendix C.4.1). Although this framework is simple, only the network strength and entrepreneurial resources cannot represent all elements of the entrepreneurial ecosystem. Furthermore, this framework relies on the author's or the user's judgement to identify which entrepreneurial ecosystem is well-functioning or poorly functioning in terms of network strength, and which entrepreneurial ecosystem is munificent or sparse in terms of entrepreneurial resources. As such, different assessors may provide contradictory conclusions using this framework to evaluate the same entrepreneurial ecosystem.

Leendertse, Schrijvers and Stam (2022) develop the entrepreneurial ecosystem metrics and compose a data set from multiple sources, such as Regional Ecosystem Scoreboard, European Innovation Scoreboard, Regional Competitiveness Index, and Crunchbase, to assess entrepreneurial ecosystems in the context of the European Union (see Appendix C.4.3). The findings indicate a strong and positive relationship between the Entrepreneurial Ecosystem Index and entrepreneurial outputs. However, the drawback of this measuring technique is that it is significantly reliant on data availability. As a result, many of the indicators utilized in the index are proxy indicators that, due to the constraints of the available data set, may not be the best representation of the elements of the entrepreneurial ecosystem. In addition, the majority of the indicators included in this research are based on the European Union dataset. As a consequence,

finding equivalent variables to duplicate and validate the Entrepreneurial Ecosystem Index in other countries is predicted to be challenging in future research. Furthermore, all variables in the Entrepreneurial Ecosystem index are given equal weight, which might be improved in future research regarding the fact that each element is not equally important to the entrepreneurial ecosystem. Another drawback with the index is that it is a comparative static study that assesses the entrepreneurial ecosystem at a specified timeframe to the mean score of the population in the dataset, which in this instance is the European Union (Leendertse, Schrijvers and Stam, 2022). As a result, the Entrepreneurial Ecosystem Index cannot reflect the actual phase of the entrepreneurial ecosystem evolution. This would require longitudinal datasets to capture the activities within entrepreneurial ecosystems as well as identify the distinct formations in each phase of the entrepreneurial ecosystem evolution rather than using the population average score as a standard, which could lead to other issues. For example, the Entrepreneurial Ecosystem Index may not describe the actual strength of the particular entrepreneurial ecosystem when compared with other entrepreneurial ecosystems in different regions. In other words, the actual strength of the entrepreneurial ecosystem, with the same Entrepreneurial Ecosystem index score, in a region of the European Union may be vastly different from the entrepreneurial ecosystem in a region of Africa, due to the different average scores of the two regions. Finally, the Entrepreneurial Ecosystem Index does not capture the aggregate welfare consequences of entrepreneurship which the author mentioned in his previous work (Stam, 2015) as outcomes of the entrepreneurial ecosystem as well as the downward causation from both outputs and outcomes such as entrepreneurial recycling process where entrepreneurs who have exited from their businesses, whether through success or failure, become serial entrepreneurs, business angels, venture capitalists, mentors, or advisors (Mason and Brown, 2014).

Another entrepreneurial ecosystem assessment was developed by Autio *et al.* (2019), the Entrepreneurial Ecosystem Maturity Model (see Appendix C.4.2). The index aims to access the maturity of the entrepreneurial ecosystem using four major dimensions – these are general framework conditions, resource dynamic, knowledge dynamic, and community structure. The ratings on a 7-point Likert-type scale are derived from the interview survey of 16 ecosystem actors in 2 different regional entrepreneurial ecosystems in Thailand. Using a 7-point Likert-type scale, this entrepreneurial ecosystem assessment approach overcomes the challenge of standardization between diverse populations. However, the issue of equal weights for different variables persists and must be addressed. Furthermore, the entrepreneurial ecosystem assessment scores are based on interviews with entrepreneurial ecosystem participants, which may be problematic in terms of consistency and reliability when compared to the entrepreneurial ecosystem assessment that utilized statistical figures.

In conclusion, there is much space for future study to improve entrepreneurial ecosystem assessment approaches. It is unquestionably a major challenge since it demands us to visualize, in a holistic manner, the key predictors of entrepreneurial ecosystems that can be implemented or adjusted to meet any context while also minimizing the problem of standardization.

3.3.2.5 The roles of science and technology park in the entrepreneurial ecosystem

As mentioned earlier, the roles of science and technology parks in the entrepreneurial ecosystem have been underexplored. Science and technology parks have been usually described as entrepreneurial support organisations, that provide office space, support services, networking with mentors and investors to entrepreneurs, and promote the collaboration between government, universities, and the private sector, in entrepreneurial ecosystems (Cohen, 2006; Mason and Brown, 2014) which is similar to the definition of science and technology park provided by several organisations (see Table 3.1). However, the literature on the entrepreneurial ecosystem has not discussed the interrelationship between science and technology parks and the elements of entrepreneurial ecosystems. Isenberg (2011) includes science and technology parks as one support structure element in the entrepreneurial ecosystem; however, he posits that science and technology parks are certainly not necessary for entrepreneurial ecosystem evolution. In contrast, Chen *et al.* (2020) mention that Zhongguancun Science Park (Z-Park) was built by the Beijing local government to recreate the success of Silicon Valley in developing the entrepreneurial ecosystem and also highlight the role of the Chinese government plays a greater role than do the governments in the Western countries. However, this research did not go through details on how science and technology parks in China have an impact on entrepreneurial ecosystems. A more recent work by Germain et al. (2022) is the first to empirically examine the role of a science and technology park in developing the entrepreneurial ecosystem in Södertälje, Sweden, or acting as the role of an ecosystem manager. The contrasting ideas about the role and impact of science and technology parks in the entrepreneurial ecosystem have revealed that little knowledge has been made. Further studies should unpack the role and impact of science and technology parks in different contexts of the entrepreneurial ecosystem, and how the importance of science and technology parks has changed as entrepreneurial ecosystems have evolved.

3.4 Theory Development

The conceptual role and impact of science and technology parks in entrepreneurial ecosystems will be discussed in this section. Furthermore, since the role and impact of science and technology parks may vary as the ecosystem evolves, we will incorporate the entrepreneurial ecosystem dynamics into our propositions. As such, the definitions of a developing and a developed

entrepreneurial ecosystem will be provided first, followed by our propositions on how science and technology parks may influence entrepreneurial ecosystems.

3.4.1 Defining a developing and a developed entrepreneurial ecosystem

In the previous sections, there are two primary approaches in the literature on entrepreneurial ecosystems that may be applied as a typology of the entrepreneurial ecosystems including the evolution and the strength of an entrepreneurial ecosystem. The following statements discuss definitions of a developing, a developed, a weak, and a strong entrepreneurial ecosystem.

The first approach is the evolution of the entrepreneurial ecosystem; for example (see, e.g., Mack and Mayer, 2016; Spigel and Harrison, 2018). Both papers applied the business life cycle that goes through different phases from birth to either the resilience phase or the decline phase. However, both papers define phases of evolution differently. Mack and Mayer (2016) have four phases including *birth, growth, sustainment,* and *decline* (see Appendix C.3.1) while Spigel and Harrison (2018) have only three phases including *nascent, strengthening,* and either *resilient or weakened* ecosystem (see Appendix C.3.2).

In the *birth* or *nascent* phase, an ecosystem still has a lot of weaknesses due to several factors, such as the lack of entrepreneurial resources and also the leakage of existing resources, the underdeveloped entrepreneurial culture, and the institutional voids. As such, the entrepreneurial ecosystem in this phase has low firm birth rates, and also few to no successful firms exit through sale, merger, acquisition, or initial public offering. The flow of resources between entrepreneurs and other ecosystem actors is still low due to the low level of connections between them.

The *growth* phase or *strengthening* phase is usually a stronger entrepreneurial ecosystem than the one in the birth stage. In this phase, the definitions between the two papers are different. Mack and Mayer (2016) defined the *growth* phase as a fully-developed ecosystem and after this phase, everything will begin to decline while Spigel and Harrison (2018) have one more phase to become either a *resilient* ecosystem or a *weakened* ecosystem. In this phase, the ecosystem should already have the presence of fundamental elements of an entrepreneurial ecosystem. For example, a strong entrepreneurial culture that encourages the flow of knowledge and entrepreneurial resources among ecosystem actors and, also, a strong entrepreneurial policy and governance that encourages the growth of new entrepreneurship in the region. In terms of the entrepreneurship outputs, the entrepreneurial ecosystems should have growing firm birth rates, a growing number of successful firms, and a minimal number of firm death rates at this phase of evolution.

The *sustainment* and *decline* phases defined by Mack and Mayer (2016) are similar to the *weakening* phase defined by Spigel and Harrison (2018). Although entrepreneurial ecosystems at these stages are fully-developed, some may not be able to survive the shocks and begin to decline. However, there is a difference between Mack and Mayer (2016) model which the entrepreneurial ecosystem will always decline. Whereas the Spigel and Harrison (2018) model, the entrepreneurial ecosystem can either become a *resilient* ecosystem or a *weakened* ecosystem after experiencing the shocks. Resilient entrepreneurial ecosystems will be able to absorb shocks by reconfiguring the ecosystem resources, such as entrepreneurs, skilled workers, and venture capital who come out of collapsed firms, and recirculate this into a new generation of entrepreneurship rather than them leaving the entrepreneurial ecosystem. The entrepreneurial ecosystems that can reconfigure important resources are proven to be resilient or fully-developed entrepreneurial ecosystems.

To simplify the evolution perspective of an entrepreneurial ecosystem, we introduced a binary typology including the term “developing entrepreneurial ecosystems” to represent new or growing entrepreneurial ecosystems having limited or weak ecosystem elements and the term “developed entrepreneurial ecosystems” to represent well-developed and sustainable entrepreneurial ecosystem having all and strong elements of the entrepreneurial ecosystem. In addition, we focus only on the interrelationship between science and technology parks and the evolution of entrepreneurial ecosystems. Therefore, unsuccessful development and unprecedented shocks which leads to the decline of an entrepreneurial ecosystem are not in the scope of this study.

The second approach is the strength of entrepreneurial ecosystems using the assessments or metrics (see, e.g., Autio *et al.*, 2019; Leendertse, Schrijvers and Stam, 2022). This approach tends to differentiate between a weak and a strong entrepreneurial ecosystem rather than an evolution of the entrepreneurial ecosystem. This approach is different from the evolutionary perspective because it is a comparative analysis of the particular entrepreneurial ecosystems at a specific point in time. It assesses the relative strengths and weaknesses of entrepreneurial ecosystems by comparing these with the reference point such as the average score of the population within which the entrepreneurial ecosystems are assessed (Leendertse, Schrijvers and Stam, 2022), or by comparing them with the specific entrepreneurial ecosystem as a reference point such as Silicon Valley (Autio *et al.*, 2019). However, this approach still has many weaknesses; for instance, the proper weight distribution of each element is difficult to justify and may vary in different entrepreneurial ecosystems regarding their local contexts, and it is problematic to justify the appropriate reference points, particularly when comparing entrepreneurial ecosystems in totally different regions such as between Europe and Africa. This approach can tell us which

entrepreneurial ecosystems perform better than others in comparison. Nevertheless, it is still difficult to justify whether that particular entrepreneurial ecosystem is a well-developed one or not.

In this study, we focus on the development of entrepreneurial ecosystem elements. Therefore, the entrepreneurial ecosystem evolution perspective is more proper than the strength of an entrepreneurial ecosystem. As such, the terms a developing and a developed entrepreneurial ecosystem are more appropriate to portray the development of the elements than a weak and a strong entrepreneurial ecosystem in this regard.

3.4.2 Defining movable and immovable elements of an entrepreneurial ecosystem

Although several research papers propose the elements of the entrepreneurial ecosystem, there is still no agreement on which model is the best to represent the elements of the entrepreneurial ecosystem. Moreover, there is a possibility that the configurations of the elements can differ and some of the elements are not presented in the ecosystem regarding the specific context, such as the biotechnology ecosystem in Boston which lacks a strong local market or a history of successful entrepreneurs (Spigel, 2017). Therefore, we distinguish between two major groups of elements in the entrepreneurial ecosystem: *immovable* elements include, for example, supportive culture, histories of successful entrepreneurship, policy and governance, physical infrastructure, networks, and universities, and *movable* elements include investment capital, mentors, worker talent, support services, and target markets. Although the elements of the entrepreneurial ecosystem are interrelated and contribute to the entrepreneurial ecosystem evolution, the need for the elements to exist in an entrepreneurial ecosystem is not equal. Some elements are required to be present in an entrepreneurial ecosystem and cannot be easily acquired from elsewhere while others are more flexible because they can be acquired from outside the entrepreneurial ecosystem or even exist outside the entrepreneurial ecosystem boundary such as the open market.

Spigel (2017) lists there are eleven core entrepreneurial ecosystem elements. Six are classified as immovable elements in our definition including supportive culture, histories of successful entrepreneurship, networks, policy and governance, universities, and physical infrastructure. These elements are the institutions and organisations normally rooted in a particular place inside the ecosystem. Additionally, the elements contribute the most or only contribute when they are in the entrepreneurial ecosystem because it is difficult or even impossible for entrepreneurs to access or be exposed to the elements from other entrepreneurial ecosystems. For example, supportive culture and histories of entrepreneurship are the cultural elements that belong to a

specific region. In other words, it is a region's entrepreneurial culture that defines how entrepreneurs and other stakeholders should act and present themselves to others within the entrepreneurial ecosystem. Policy and governance also show regional differences. To address specific issues within the region, the government tends to deploy regional policies to boost economic activity.

The remaining five elements are worker talent, investment capital, mentors, support services, and target markets categorized as movable elements in our definition which means that the elements can be accessed or located anywhere inside or outside the ecosystem. Worker talent is quite difficult to classify in terms of mobility because it can be recognized as an immovable element as well. Remote and flexible jobs are increasing, and this major shift is caused by the COVID-19 pandemic. There will be some jobs that permanently shift to remote work after the end of the pandemic, such as programmers that may become digital nomads who usually work remotely in countries that have a low cost of living with proper digital infrastructure. However, some jobs cannot be done remotely, particularly blue-collar jobs. Therefore, companies in some specific industries such as manufacturing may not be able to shift to this trend. This type of worker is still required to be in the entrepreneurial ecosystem as their employers. However, we postulate that talented workers usually hold white-collar jobs most of which can be done locally or remotely. Thus, we categorize talented workers as a movable element. Investment capital and mentors are more footloose; it is quite clear that these can be available anywhere inside or outside the ecosystem boundary and can be acquired through social networks as well from firms and organisations that provide support services for new ventures, such as patent lawyers, accountancies, and virtual incubation services. Last, open markets are usually not limited to the entrepreneurial ecosystem boundary, particularly high-growth entrepreneurs that tend to expand their target markets to national or even international regions. These elements are usually rare in a developing entrepreneurial ecosystem because there are only a few entrepreneurial activities. Therefore, the entrepreneurial ecosystem still cannot attract entrepreneurial resources into the region. However, these elements can be acquired from other entrepreneurial ecosystems. Thus, strong social networks that extend beyond the boundary of the entrepreneurial ecosystem to create pathways are required to access those movable elements.

Figure 3.2 shows the eleven elements of the entrepreneurial ecosystem grouped into three sets of interrelated attributes comprising cultural, social, and material based on the framework by Spigel (2017). We distinguish the elements by each one's mobility: immovable and movable elements regarding our definition. The number attached to each element indicates the following associated propositions in the following section.

	Immovable elements	Movable elements
Material Attributes	Physical infrastructure[1] Universities[1,3] Policy and governance[6]	Support services[1,5] Target markets[5]
Social Attributes	Networks[4]	Mentors[1,5] Investment capital[2,5] Worker talent[3,5]
Cultural Attributes	Supportive culture[4] Histories of successful entrepreneurship[4]	-

Figure 3.2 Mobility and relationships among ecosystem attributes.

Building on these studies, we suggest the following definition of the entrepreneurial ecosystem dynamics. A developing entrepreneurial ecosystem is *an entrepreneurial ecosystem that produces a limited number of successful entrepreneurs and cannot productively reconfigure ecosystem resources*. A developed entrepreneurial ecosystem, in contrast, is *an entrepreneurial ecosystem that produces a substantial number of successful entrepreneurs and the ability to reconfigure ecosystem resources in a productive way which helps the ecosystem to be self-sustainable and resilient to shocks*. The characteristics that distinguish between a developing and a developed entrepreneurial ecosystem are presented in Table 3.3.

Roundy and Bayer (2019) discussed a similar concept in their research paper, however, they distinguish between nascent and mature entrepreneurial ecosystems by just two features the level of firm births and the development of entrepreneurial resources. Our concept elaborates further by focusing on successful entrepreneurs instead and adding the mobility of entrepreneurial ecosystem elements. Furthermore, this concept highlights the ability to reconfigure ecosystem resources which can be observed only in a resilient entrepreneurial ecosystem.

Table 3.3 The characteristics of a developing and a developed entrepreneurial ecosystem.

Characteristics	Developing entrepreneurial ecosystem	Developed entrepreneurial ecosystem
Successful entrepreneurs	Low	High
Immovable Elements	Lacking or underdeveloped	Sufficient and strong
Movable Elements	Underdeveloped or difficult to acquire from outside the boundary	Well-developed or easy to acquire from outside the boundary
Ability to reconfigure ecosystem resources in a productive way	No	Yes
Resource flow	Limited and may leak to other ecosystems	Flow freely and may attract from other ecosystems
Resilient to the shocks	Low	High

3.4.3 The conceptual roles of science and technology park in entrepreneurial ecosystems

The entrepreneurial ecosystem represents the appropriate environments that support high-growth entrepreneurship (Spigel and Harrison, 2018). In our definition, the ability of the entrepreneurial ecosystem to foster those new ventures also depends on the entrepreneurial ecosystem dynamics, which means that a developed entrepreneurial ecosystem should produce successful entrepreneurs more than a developing entrepreneurial ecosystem would. In addition, the ability of the entrepreneurial ecosystem to reconfigure its entrepreneurial resources productively in a developed entrepreneurial ecosystem will make the entrepreneurial ecosystem self-sustaining and also more resilient to shocks. To develop the entrepreneurial ecosystem, the elements of the entrepreneurial ecosystem should be sufficient and strong enough to encourage entrepreneurial activity. Particularly, immovable elements should be rooted within the ecosystem while movable elements are more flexible and can be anywhere inside or outside the entrepreneurial ecosystem. However, it still requires strong social networks acting as conduits and actors who play an intermediary role to bring those movable elements into the ecosystem.

In a developed entrepreneurial ecosystem where elements of the entrepreneurial ecosystem are rich, entrepreneurial organisations such as science and technology parks may not be necessary as per Isenberg (2011) who gave an example of Israel where high-tech parks were just real-estate

projects without support or mentoring services. However, we argue that the roles of the science and technology park and its importance may increase in a developing entrepreneurial ecosystem where entrepreneurial resources, support services, and support organisations are still underdeveloped or not available to support the rise of entrepreneurship. The science and technology park can play a role as a business incubator in fostering new ventures in the entrepreneurial ecosystem or play a role as an intermediary organisation to help entrepreneurs access and exchange resources with each other and with entrepreneurial support organisations both inside and outside the entrepreneurial ecosystem. The following propositions are developed based on the importance of the science and technology park in the context of a developing entrepreneurial ecosystem. Our key propositions are:

> **Proposition A** *The science and technology park plays a disproportionately important role in the entrepreneurial ecosystem evolution and/or transition stages.*
>
> **Proposition B** *The science and technology park's role diminishes as the entrepreneurial ecosystem evolves and/or is relatively stable.*

Science and technology parks normally provide a range of services to foster new ventures such as business mentoring, legal services, marketing services, office spaces, and incubation programs. Although support services for entrepreneurship can be offered by other firms or organisations within the entrepreneurial ecosystem, the availability of these service providers also depends on the entrepreneurial ecosystem dynamics. In a developed entrepreneurial ecosystem, many entrepreneurial activities take place which makes the entrepreneurial ecosystem more attractive to entrepreneurial service providers to set up their companies inside the entrepreneurial ecosystem as they are often limited in a developing entrepreneurial ecosystem. Therefore, science and technology parks are more likely to make a meaningful contribution to a developing entrepreneurial ecosystem by increasing the availability of support services in the entrepreneurial ecosystem. Science and technology parks can directly provide support services for new ventures to compensate for the lack in a developing entrepreneurial ecosystem, or science and technology parks may use their social networks to help local entrepreneurs to access services or facilities from the universities or other service providers outside the entrepreneurial ecosystem as support services are movable elements. The following proposition is developed.

> **Proposition 1** *Science and technology parks which provide support services and/or mentorship and/or physical infrastructure for new ventures and/or networking with the universities and/or networking with service providers outside the ecosystem are more likely to make a meaningful contribution to developing entrepreneurial ecosystems.*

In a developed entrepreneurial ecosystem, the availability of venture capital should be alone sufficient to support the growth of entrepreneurs in the entrepreneurial ecosystem (Spigel, 2017). Where had capital come from before the arrival of venture capitalists or angel investors in a developing entrepreneurial ecosystem? Commercial banks are not usually associated with start-ups because they tend to be conservative institutions (Adams, 2021). They often require collateral from borrowers to make loans which makes it difficult for new ventures to access the investment capital. Science and technology parks in some countries such as Israel (which are mostly private-owned) or Zhongguancun Science Park in China offer financial support for entrepreneurs ranging from start-ups to large scale with different formats such as loans, angel funds, matching funds, and joint ventures (Science Park Promotion Agency, 2014; Xiao and North, 2018). Therefore, science and technology parks that offer financial support for new ventures help increase the availability of venture capital in a developing entrepreneurial ecosystem before the advent of local venture capital. Furthermore, science and technology parks can use their networks to help match local entrepreneurs with venture capital investors from outside the entrepreneurial ecosystem since investment capital is a movable element. Hence, science and technology parks are more likely to make a meaningful contribution to a developing entrepreneurial ecosystem. The following proposition is developed.

> **Proposition 2** *Science and technology parks that provide venture capital or network with venture capital investors outside the entrepreneurial ecosystem are more likely to make a meaningful contribution to developing entrepreneurial ecosystems.*

Universities not only focus on their academic mission through teaching and research but also focus on the economic and social development in their region. The first academic revolution in the late nineteenth century transformed the classical teaching college into a research university, incorporating both teaching and research as its missions. Now, in this second academic revolution in the late twentieth century, the research university is transforming into an entrepreneurial university, including economic and social development as the third mission (Etzkowitz, 2003). As a result, all three academic missions have shifted from individual to group-oriented; a transition from teaching individuals to forming organisations regarding the emergence of incubators, research groups operating as quasi-firms, and the role of the university as a regional innovation organizer, such as the university-based science and technology park, in the drive towards economic and social development (Etzkowitz, 2003). Accordingly, modern universities are not only the producers of skilled human capital and technological knowledge; they also breed academic entrepreneurs or university spin-offs and transfer technology into the entrepreneurial ecosystem, which generates new income streams for the university.

Science and technology parks are designed to bridge the gap between academia and industry by commercializing academic research (Quintas, Wield and Massey, 1992) and by fostering new innovative firms through incubation programs and networking with entrepreneurial actors. Besides, the collaboration between industry and universities produces benefits for both sides (see, e.g., Mansfield and Lee, 1996; Cohen, Nelson and Walsh, 2002; Mueller, 2006; Kim, Kim and Yang, 2012; Perkmann *et al.*, 2013; Maietta, 2015; Scandura, 2016). Not only does the industry benefit from this relationship, but universities can also adapt their research and teaching programs toward market demand, which then increases their performance as educational and research institutions. Hence, science and technology parks enhance the collaboration between universities and industry so that universities carry out research and produce human capital more relevant to the ecosystem as a result. The proposition is developed as the following.

> **Proposition 3** *Science and technology parks that align the university teaching programs and the industry demand so that the university produces human capital more relevant to the industry are more likely to make a meaningful contribution to developing entrepreneurial ecosystems.*

By shaping the cultural outlook of the entrepreneurial ecosystem to support entrepreneurship, it will create a context that encourages a high level of connectivity or a dense network among entrepreneurs, workers, investors, and advisors (Spigel, 2017). Entrepreneurial support organisations – such as incubators, accelerators, and science and technology parks – can encourage entrepreneurial activity and strengthen entrepreneurial culture leading to strong social networks in the entrepreneurial ecosystem.

Science and technology parks foster tenant firms through their incubation programs which often provide a series of business training and mentoring to increase the entrepreneurial knowledge of their tenants. Science and technology parks also often provide start-up boot camps for university students or others in the region who are interested in pursuing entrepreneurship. These programs not only help entrepreneurs or potential entrepreneurs by providing entrepreneurial knowledge but also help build networks among entrepreneurs that might become co-founders or talented workers in the future. In addition, these programs can help shape the entrepreneurial mindset that will strengthen entrepreneurial culture. Moreover, other entrepreneurial events hosted by science and technology parks help entrepreneurs to connect with other entrepreneurial actors or organisations – for example, investors in pitch competitions; customers or suppliers in business matchings; and successful entrepreneurs in entrepreneurial forums. Therefore, science and technology parks can act as intermediary organisations that provide social networks to connect entrepreneurs with the elements of the entrepreneurial ecosystem, particularly movable

elements both inside and outside the entrepreneurial ecosystem. The contribution of science and technology parks in this aspect may help speed up the evolution of a developing entrepreneurial ecosystem by acquiring movable elements from outside the entrepreneurial ecosystem. The following propositions are developed.

> **Proposition 4** *Science and technology parks that actively promote social connections among entrepreneurs and other ecosystem actors through incubation programs and entrepreneurial events strengthen the cultural and social attributes, particularly in developing entrepreneurial ecosystems.*

> **Proposition 5** *Science and technology parks may help speed up the evolution of developing entrepreneurial ecosystems by acquiring movable elements from outside of entrepreneurial ecosystems.*

Large firms may have the political power to engage with local government agencies to create a more supportive environment for entrepreneurship in the region such as new programs, new policies, or new infrastructure (Spigel and Vinodrai, 2020). However, these large firms are usually found in developed entrepreneurial ecosystems. In developing entrepreneurial ecosystems, science and technology parks may play the role of 'ecosystem coordinators' instead of those large firms to lobby with policymakers and influence a more supportive policy for entrepreneurship in the entrepreneurial ecosystem. The following proposition is developed.

> **Proposition 6** *Science and technology parks may act as entrepreneurial organisations engaging with policymakers to lobby for new policies to support entrepreneurship, particularly in developing entrepreneurial ecosystems.*

3.5 Conclusions

This conceptual paper contributes several unique points to the entrepreneurial ecosystem literature. *First*, we introduce the definition of the entrepreneurial ecosystem dynamic at both ends of the continuum, a developing and developed entrepreneurial ecosystem. Unlike the recent works on the assessment of an entrepreneurial ecosystem using the scoring system to measure the strength or maturity of an entrepreneurial ecosystem, which is a relative point of view, our definitions approach the entrepreneurial ecosystem dynamics using the characteristics of the entrepreneurial ecosystem. Although there is still room to improve, the approach tells what should be featured in a developed entrepreneurial ecosystem. *Second*, we introduce a new dimension to categorize the elements of an entrepreneurial ecosystem by assessing its mobility characteristics. This new dimension helps identify what elements in the entrepreneurial

ecosystem have to be built and rooted within the entrepreneurial ecosystem – we called these *immovable* elements and the *movable* elements that can be accessed or located outside the entrepreneurial ecosystem. This dimension also highlights the important role of the intermediary organisations that help connect entrepreneurs in the entrepreneurial ecosystem with movable elements outside the entrepreneurial ecosystem. *Third*, we highlight the role of science and technology parks in the entrepreneurial ecosystem as intermediary organisations and how science and technology parks may influence the evolution of the entrepreneurial ecosystem, particularly a developing entrepreneurial ecosystem.

More empirical studies are needed to answer the questions of what factors make resilient entrepreneurial ecosystems; how different factors impact the evolution of entrepreneurial ecosystems; and under what circumstances. The contribution of this conceptual paper may help the leaders of entrepreneurial ecosystems and policymakers to develop the entrepreneurial ecosystem more efficiently by focusing on the key areas. Moreover, the mobility characteristics view of entrepreneurial ecosystem elements may help accelerate the evolution of the entrepreneurial ecosystem. As we suggest that movable elements can be accessed from outside the entrepreneurial ecosystem, the leaders of entrepreneurial ecosystems or the policymakers may make use of the intermediary organisations to connect entrepreneurs inside the entrepreneurial ecosystem and movable elements outside the entrepreneurial ecosystem.

This paper only highlights the role of science and technology parks in developing entrepreneurial ecosystems. However, there are ownership models of science and technology parks, for example, private- and public-owned science and technology parks, standalone and university-based science and technology parks, and we still do not know which type of science and technology park will perform well under what particular configuration of the entrepreneurial ecosystem. Moreover, there are other entrepreneurial support organisations such as business parks, business incubators, and accelerators. Different types of entrepreneurial support organisations may have different effects on the evolution of entrepreneurial ecosystems under certain circumstances. If we know what difference might it make, and under what circumstances, it may help policymakers and the leaders of entrepreneurial ecosystems to employ the right tools to grow the entrepreneurial ecosystems. Therefore, we still need future research to examine this perspective in greater depth.

There are opportunities for future scholars to empirically examine many aspects as proposed in this conceptual paper. The fruitfulness of qualitative methods may be suited to unpack the complex characteristics of entrepreneurial ecosystems. Another challenge to deal with is the variety of configurations and dynamics of entrepreneurial ecosystems. Thus, multiple exploratory

case studies may be suitable to tackle this challenge. Finally, many scholars attempt to distinguish the entrepreneurial ecosystem from other related concepts such as regional innovation systems, clusters, and industrial districts. The multi-faceted characteristics of entrepreneurship study may require multiple approaches to explore these issues. Hence, future entrepreneurship research may attempt to incorporate multiple concepts to explain the entrepreneurship phenomena.

Chapter 4 The Roles of Science and Technology Park in a Developing Entrepreneurial Ecosystem

4.1 Abstract

While scholars are focusing more on the entrepreneurial ecosystem, the causal relationship between elements is frequently overlooked in the literature, and evidence-based studies are also limited. In addition, previous studies have focused on developed entrepreneurial ecosystems in large cities. This paper seeks to fill gaps in the entrepreneurial ecosystem literature by investigating one of the entrepreneurial support organisations, a science and technology park, and determining how it influences the elements of the entrepreneurial ecosystem in a developing entrepreneurial ecosystem. Based on semi-structured interviews conducted in Chiang Mai, Thailand, with entrepreneurs and other relevant actors and entrepreneurial support organisations. The frameworks illustrate how the science and technology park and the elements of the entrepreneurial ecosystem are interconnected. The case study demonstrates that Northern Science Park has a significant impact on Chiang Mai's entrepreneurial ecosystem, particularly in terms of institutional and cultural changes that provide a context for social and material elements of the entrepreneurial ecosystem to emerge to support entrepreneurship.

4.2 Introduction

Although entrepreneurship or a new firm formation is important to economic development, it has never been a central subject of study until the recent attention to the entrepreneurial ecosystem (Stam, 2007; Alvedalen and Boschma, 2017; Malecki, 2018). Other related concepts such as industrial districts, clusters, and innovation system frameworks share common features with the entrepreneurial ecosystem except for the fact that entrepreneurs play a central role in the latter framework (Stam, 2015; Spigel and Harrison, 2018). However, the entrepreneurial ecosystem concept tends to overlook the interrelationship between the elements of a variety of entrepreneurial agents, social, and culture that promotes new venture formation and growth (Malecki, 2018; Spigel and Harrison, 2018). Developed entrepreneurial ecosystems, particularly in metropolitans or major cities, have been the subject of empirical investigations in entrepreneurial ecosystem literature (Roundy, 2017b). As a result, the understanding of how the entrepreneurial ecosystem evolves and how the elements of the entrepreneurial ecosystem interact with each other is still challenging (Mack and Mayer, 2016).

Previous studies have discussed the elements of the entrepreneurial ecosystem whereas the role of each actor or organisation and their impact on the entrepreneurial ecosystem have been under-explored. Science and technology park is often missing in the previous entrepreneurial ecosystem literature while it is discussed more in the regional innovation system literature as an intermediary organisation between university and industry. To address the issues, the objective of this study is to examine the role and impact of a science and technology park in a developing entrepreneurial ecosystem context. The findings from the study are concluded from 31 semi-structured interviews of different ecosystem actors in Chiang Mai's entrepreneurial ecosystem as primary data and general information from documents and websites as secondary data. This empirical study is valuable because it redefines a science and technology park as an influential actor in the entrepreneurial ecosystem evolution, particularly in the context of a developing entrepreneurial ecosystem.

4.3 Literature Review

4.3.1 Entrepreneurial Ecosystem

Entrepreneurship has been studied from many different theoretical perspectives and different units of analysis that transcend many disciplines, for instance, economics, psychology, sociology, strategic management, and regional development. The early studies of entrepreneurship emphasized personality characteristics, backgrounds, and motivations defining behaviours of individual entrepreneurs based on psychological theories. Over the years, research on entrepreneurship has been developed to become more contextual and process-oriented. The ecological approach is also included in this progression.

The term 'ecosystem' was first coined by British ecologist, Sir Arthur George Tanleys, in his paper in 1935 (Trudgill, 2007). The ecosystem studies the interactions between organisms and their environment as an integrated system (Chapin, Matson and Vitousek, 2002). From the natural ecosystem, the ecological metaphor is also adopted in business and management studies. Moore (1993) is the first person to use the term 'ecosystem' in business and management study to introduce the concept of 'business ecosystem' published in Harvard Business Review. Since then the 'ecosystem' concept has been applied in many different perspectives, for example, 'innovation ecosystems', 'modular ecosystems', 'platform ecosystems', 'entrepreneurial ecosystem', and 'knowledge ecosystem' (Thomas and Autio, 2020). There are different types of ecosystems as already noted and the 'entrepreneurial ecosystem' is the one discussed in this paper.

The entrepreneurial ecosystem was first introduced by Boyd Cohen in 2006 (Alvedalen and Boschma, 2017). Cohen (2006, p. 3) defines an entrepreneurial ecosystem as "an interconnected group of actors in a local geographical community committed to sustainable development through the support and facilitation of new sustainable ventures." This definition has emphasized two important features of the entrepreneurial ecosystem which are the ecosystem output as 'new ventures' or 'entrepreneurship' and the 'spatial' dimension of the entrepreneurial ecosystem. These two features help distinguish the entrepreneurial ecosystem from other ecosystem concepts as already mentioned. Thomas and Autio (2020) present a typology of ecosystem concepts in business and management, as well as definitions for each type of ecosystem, which contributes to conceptual and terminological ambiguity as shown in Table 4.1.

Table 4.1 Ecosystem Vocabulary.

Term	Definition
Ecosystem	A community of hierarchically independent, yet interdependent heterogeneous participants who collectively generate an ecosystem output.
Innovation Ecosystem	A community of hierarchically independent, yet interdependent heterogeneous participants who collectively generate an ecosystem output and related value offering targeted at a defined audience.
Entrepreneurial Ecosystem	A regional community of hierarchically independent, yet interdependent heterogeneous participants who facilitate the start-up and scale-up of entrepreneurial new ventures who compete with innovative business models.
Knowledge Ecosystem	A regional community of hierarchically independent, yet interdependent heterogeneous participants who advance the translation of advances in research knowledge into products and services.
Ecosystem Output	An system-level output that has been collectively generated by heterogeneous ecosystem participants.
Ecosystem Value Offering	An ecosystem output that is targeted at a defined audience whose needs it helps address.

Source: Thomas and Autio (2020, p. 38)

The discussions on entrepreneurial ecosystem literature largely focus on identifying elements, or ingredients, within the entrepreneurial ecosystems exhibited as a list or diagram (Malecki, 2018). For example, the entrepreneurial ecosystem components by Cohen (2006), the six domains of the entrepreneurial ecosystem by Isenberg (2011), the participants in a start-up community by Feld (2012), the elements of the entrepreneurial ecosystem by Stam (2015), and the attributes of entrepreneurial ecosystem by Spigel (2017). The concept of an entrepreneurial ecosystem is often presented as a complex system in which all elements have interdependencies and diverse connections (Motoyama and Knowlton, 2014; Alvedalen and Boschma, 2017; Stam and Spigel,

2017). However, the relationships between these elements have been largely ignored in the previous works, for instance, the causal paths that present what is cause and what is effect. Though some previous works (see, e.g., Stam, 2015; Spigel, 2017) attempted to propose relational frameworks in their works, they are holistic frameworks or very broad concepts which are insufficient to explain how different elements interact with each other and what kinds of connection they have between each other. Furthermore, determining which elements are vital to the ecosystem and must be rooted in the ecosystem against which elements may be brought from outside the ecosystem is challenging. Another limitation of previous works on entrepreneurial ecosystems is the lack of evolutionary frameworks or recipes for the entrepreneurial ecosystem. Most empirical studies have investigated successful entrepreneurial ecosystems such as Silicon Valley (Saxenian, 1996), Boulder (Feld, 2012), Waterloo and Calgary (Spigel, 2017) where they are all developed entrepreneurial ecosystems. The answers to queries such as how the entrepreneurial ecosystem began and grew into a successful one would be far more valuable from the standpoint of policymakers (Motoyama and Knowlton, 2014). There are just only a few works that add to the evolutionary perspective (see, e.g., Mack and Mayer, 2016; Spigel and Harrison, 2018; Thompson, Purdy and Ventresca, 2018).

The definitions of entrepreneurial ecosystems by different authors are mainly based on a set of ingredients of the well-developed entrepreneurial ecosystem. Still, there are many overlapping attributes in different models since the term was first coined until recent works as shown in Figure 4.1. The analytical framework in this paper is based on the framework by Spigel (2017) (see Appendix C.1.4). Spigel (2017) highlights that well-developed entrepreneurial ecosystems are not necessary to have all the attributes of the ecosystem presented in the framework. There are some examples of well-developed entrepreneurial ecosystems without one or more of these attributes and Spigel further suggests that entrepreneurial ecosystem structures might vary yet be successful, making them unique. Since the entrepreneurial ecosystem in our study is a developing one and may be expected to have different structures than the successful entrepreneurial ecosystem, the flexibility of the Spigel framework matches better with our research. The heterogeneity of the entrepreneurial ecosystems is another reason why more empirical studies in different regions and contexts are necessary to advance the research on the entrepreneurial ecosystem.

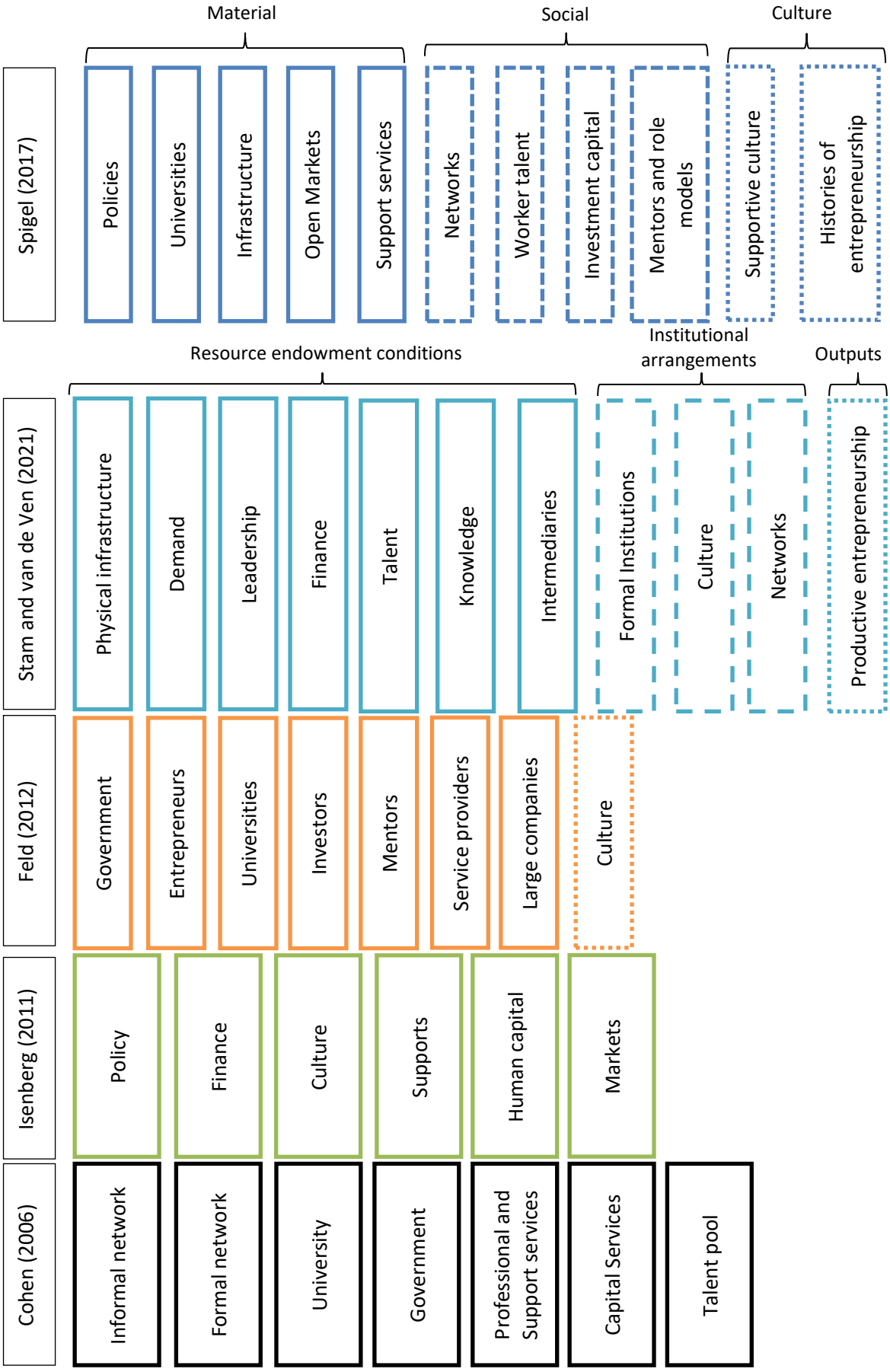


Figure 4.1 Entrepreneurial Ecosystem attributes by various authors.

Entrepreneurs are defined in the entrepreneurial ecosystem literature as high-growth, technology-led start-ups, as opposed to entrepreneurs in general, who are also associated with self-employment and small business ownership. The literature emphasizes high-growth firms because they have a greater influence on productivity growth, new employment, innovation diffusion, and business internationalization (Isenberg, 2011; Mason and Brown, 2014; Stam, 2015; Spigel, 2017).

The focus on high-growth firms is another key point that makes the entrepreneurial ecosystem distinct from the regional innovation system. The regional innovation system argues that local firms, no matter whether they are large firms or small start-ups, can enhance their productivity and innovativeness by accessing resources from nearby universities and anchor firms. While the entrepreneurial ecosystem addresses the common issues for new ventures since they may have low levels of absorptive capacity, limited social capital, or a lack of entrepreneurial skills. Therefore, several elements in the entrepreneurial ecosystem; such as networks, entrepreneurial culture, and mentors; are there to help new ventures to overcome the issues (Spigel and Harrison, 2018).

Entrepreneurs are not only the outputs of the entrepreneurial ecosystem but also play a central role in the entrepreneurial ecosystem. While the government in the regional innovation system concept plays a leadership role in the system and views entrepreneurship as an external factor (Motoyama and Knowlton, 2014), the government in the entrepreneurial ecosystem should play a supportive role in providing necessary entrepreneurial resources instead because they usually lack understanding about entrepreneurship (Isenberg, 2011; Feld, 2012). To provide public support for entrepreneurship effectively, the issues should be identified by entrepreneurs (Spigel and Harrison, 2018). In addition, successful entrepreneurs tend to generate more entrepreneurship by becoming advisors, angel investors, or venture capitalists giving their valuable experiences and success stories to inspire new generations to pursue the same path and also affecting the entrepreneurial culture in the entrepreneurial ecosystem. While the entrepreneurs strengthen the entrepreneurial ecosystem, the ecosystem generates more entrepreneurs which strengthens the ecosystem. Accordingly, the phenomena may lead to a self-generating or self-sustaining state if there is enough entrepreneurship to hit a tipping point (Isenberg, 2011).

If one adopts the entrepreneurial ecosystem perspective and strategy, the following questions may arise. For example, how much entrepreneurship is enough to achieve a self-sustaining ecosystem, who should be responsible for developing the entrepreneurial ecosystem to reach the tipping point, where is the geography concentrated in entrepreneurship to implement the

strategy, and what is an appropriate scale for the strategy; city, regional, or national. Isenberg (2011) suggests that 'entrepreneurship enablers' should be established by leaders and accountable for reaching the tipping point by creating an impact on all elements in the entrepreneurial ecosystem. In addition, they should be hybrid independent organisations that consist of representatives from the government, universities, and entrepreneurial support organisations. From this perspective, science and technology parks may have the potential to be organisations as they have been recognized in the regional innovation system literature as hybrid independent organisations in the triple-helix of university-industry-government relations (Champenois and Etzkowitz, 2018). Although not all kinds of science and technology parks are independent of any organisation regarding the ownership model as the ideal 'entrepreneurship enablers' suggested by Isenberg, it is still worth exploring how science and technology parks create an impact on the entrepreneurial ecosystem. If science and technology parks can easily be 'white elephants' in the entrepreneurial ecosystem perspective as Isenberg (2011) concerned, then the question is how to reorganize them to be support organisations in the entrepreneurial ecosystem or at least not be detrimental to entrepreneurship.

Even though lots of important insights presenting in well-established theories such as clusters and regional innovation systems contribute to economic development strategies, the development of a new theory is still required to fill the gaps that existing theories cannot, for instance, the sustained ability to regenerate entrepreneurship (Spigel and Harrison, 2018). As such, the entrepreneurial ecosystem concept can either replaces or at least complements the existing theories (Isenberg, 2011).

4.3.2 Science and Technology Park

Regarding Schumpeterian economics, 'creative destruction' is a key driving force for economic development and important mechanisms behind the creative destruction are innovation and entrepreneurship. Innovation itself would not be implemented without the entrepreneurs and only innovative entrepreneurs can replace the incumbents and generate a higher degree of economic growth. Entrepreneurs in the Schumpeterian viewpoint refer to high-growth, innovative-led firms which seem to influence entrepreneurs' concepts in the entrepreneurial ecosystem literature as well. The role of public policy reflecting Schumpeterian economics, or knowledge-based economies, therefore, emphasizes innovation and entrepreneurship which is to facilitate the creation of knowledge through research and education investment and to encourage innovative entrepreneurs to start their businesses. Accordingly, policy instruments targeted at universities, research institutions, and high-growth entrepreneurs, for example, funding for

research and science, funding for start-ups, technology transfer programs at universities, incubators, and science and technology parks (Audretsch and Link, 2012).

By definition, a science and technology park is a property-based organisation that promotes technology commercialization from knowledge-based institutions to the industry sector by providing incubation programs together with other professional services, and infrastructures for technology-based startups or academic spin-offs (AURP, 2022; IASP, 2022; UKSPA, 2019). From a broader perspective, science and technology parks are widely recognized as important policy instruments in developing regional economies and innovation (Audretsch and Link, 2012; Lamine *et al.*, 2018). Science and technology parks usually help connect university, industry, and government entities to foster innovation and entrepreneurship in knowledge-based economies and regional innovation systems (Champenois and Etzkowitz, 2018). There are more than 400 science and technology parks around the world currently and they have been recognized by many different terms, such as technology business incubators, science parks, technology parks, research parks, and technopolis (UNESCO, 2017). The incubation process of a science and technology park can be categorized into main three phases which are pre-incubation, incubation and acceleration, and post-incubation, however, some science and technology parks offer all phases of the incubation process while most of them do not (Mian, Lamine and Fayolle, 2016).

Stanford Research Park, Silicon Valley, founded in the 1950s, has been known as the first science and technology park in the world. Many other nations across the globe are trying to replicate it due to the success of Silicon Valley in terms of regional economic development (Diez-Vial and Montoro-Sanchez, 2017). However, the most substantial movement of science and technology parks was triggered by the 1980 Bayh-Dole Act in the United States where many universities established their science and technology parks, business incubators, and technology transfer offices to encourage the creation of innovative start-ups based on university-own technologies during the 1980s and 1990s (Grimaldi *et al.*, 2011; Lamine *et al.*, 2018). The ability to transfer technology from universities to industry, either through new ventures or large firms, often determines the success of university-based science and technology parks, business incubators, and technology transfer offices (Markman *et al.*, 2005). The number of science and technology parks has risen worldwide (Phan, Siegel and Wright, 2005) as well as the shifts of basic research toward applied research in universities regarding the effects of the Bayh-Dole Act (Markman *et al.*, 2005).

Since the advent of science and technology parks, they have evolved substantially and offer more and more value-added services to support high-growth start-ups. The first generation focused on providing start-ups with basic physical infrastructures such as affordable office space and meeting

rooms. Additionally, equipment and laboratories are also provided by university-based science and technology parks. Most of these high-growth entrepreneurs generally have excellent technical skills while are less competent in terms of entrepreneurial skills (McAdam *et al.*, 2006). The lack of entrepreneurship knowledge led science and technology parks to offer more value-adding services such as professional consultancy services, and entrepreneurial skills training in the second generation of science and technology parks in the early 1990s. Furthermore, some of them began to provide financial capital, especially in the early stage. In the late 1990s, entrepreneurial networks and external resources became the focus of the third generation of science and technology parks. Science and technology parks in this generation act as a node point for start-ups to develop their entrepreneurial networks more rapidly with other start-ups or important external actors. When start-ups connect to entrepreneurial networks and develop fruitful relationships, they can access entrepreneurship knowledge and external resources that flow within networks easier (McAdam *et al.*, 2006). In addition, entrepreneurial networks help strengthen cultural norms and values, that support entrepreneurship such as innovation, collaboration, openness and information exchange, and tolerance to risks and failure (Feld, 2012), which can be transmitted from experienced entrepreneurs, mentors, or role models to new entrepreneurs.

Individual entrepreneurs may not have enough power and legitimacy to negotiate favourable regulations. In this situation, science and technology parks may act as institutional entrepreneurs which represent a collective group of entrepreneurs in a region and increase the bargaining power and protect them from unfavourable regulations (van Weele *et al.*, 2018).

The field of education is also adapted to the shift towards entrepreneurship and innovation as there are more technology entrepreneurship programs and courses offered at the university level, especially in business schools, and engineering schools (Fayolle, 2013). In this sense, science and technology parks can help researchers and educators in the field of entrepreneurship education to design and experiment with teaching models to better reflect the real-life of entrepreneurs such as experiential learning by integrating technology entrepreneurship into entrepreneurship education during study periods and after graduation (Lamine *et al.*, 2018). As a result, universities can produce competent entrepreneurs in the ecosystem.

As science and technology parks encourage the creation of innovation and entrepreneurship, especially in the region they operate, they are considered to play roles in contributing to the performance of the regional innovation system (Gkypali *et al.*, 2016). Besides, several entrepreneurial ecosystem research (see, e.g., Mason and Brown, 2014; Stam, 2015; Spigel and Harrison, 2018) refer to regional innovation systems as a related concept.

The idea that innovation is a systemic process where the interaction between the two subsystems, knowledge generation, and exploitation, facilitates the innovation process (Autio, 1998), and the geographic stickiness of knowledge spillover affects the innovation process (Tödtling and Trippl, 2005) are the ideas behind the regional innovation system (Cooke, Gomez Uranga and Etxebarria, 1997). The role of science and technology parks in the regional innovation system is to mediate the flow of technological knowledge between the two subsystems.

One of the weaknesses of regional innovation system literature is the fact that it emphasizes only the condition conducive to innovation in the region and there is no clear explanation of how local innovation is correlated with regional economic growth (Doloreux and Porto Gomez, 2017). As mentioned in the beginning, creative destruction is the key driving for economic development. It is the entrepreneur's role that brings innovation to life or creates value. However, the role of entrepreneurs, especially new ventures, is downplayed in the regional innovation system literature.

Therefore, the entrepreneurial ecosystem may either complement or replace the regional innovation system as it approaches many weaknesses including the lack of entrepreneurship orientation. While science and technology parks have developed their roles over the period as they offered more value-added services through generations, the role of science and technology parks in the literature on the entrepreneurial ecosystem has received less attention. This paper aims to examine the roles of science and technology parks in a developing entrepreneurial ecosystem.

4.4 Research Methodology

4.4.1 Research questions

Most studies suggested the key elements of the entrepreneurial ecosystem which are the ideal understanding of how a self-sustained ecosystem should be. In addition, we have already known from the empirical study that the configuration of elements in self-sustained ecosystems can be differed (Spigel, 2017). However, we still do not have much knowledge about the key characteristics of the elements of the entrepreneurial ecosystems in developing entrepreneurial ecosystems which can be differed as well as in developed entrepreneurial ecosystems. Although there are some studies address the dynamic of the entrepreneurial ecosystem such as the lifecycle perspective of the entrepreneurial ecosystem (Mack and Mayer, 2016) and the transformation process of the entrepreneurial ecosystem (Spigel and Harrison, 2018), they failed to identify which elements are more important and what are the roles of those elements.

This study approaches the role of the science and technology park in the entrepreneurial ecosystem. Although there is no universal definition of the entrepreneurial ecosystem, we know that the entrepreneurial ecosystem is a community of interrelated entrepreneurial actors and organisations including the science and technology park. However, most of the studies do not address the interrelationship among different actors and organisations including the role of science and technology parks in the entrepreneurial ecosystem. Although Isenberg (2011) mentioned that science and technology parks are certainly not necessary structures in the entrepreneurial ecosystem, we argue that the role of science and technology parks should be highlighted especially in the context of developing entrepreneurial ecosystems.

The study aims to examine how the science and technology park plays different roles in a developing entrepreneurial ecosystem by exploring the relationships between the science and technology park and the entrepreneurial ecosystem elements based on the attributes of the framework of the entrepreneurial ecosystem by Spigel (2017). Therefore, the research question is proposed as follows:

RQ: What are the relationships between the science and technology park and the entrepreneurial ecosystem elements in a developing ecosystem context?

To approach the research question properly, the research design with strategy and method is described in the next section.

4.4.2 Research design

To explore the role of a science and technology park in developing the entrepreneurial ecosystem, a case study was conducted. Case study research provides real-world data that allows the researcher to get a deeper understanding of complex and dynamic social phenomena (Eisenhardt, 1989). This study is exploratory research that aims to make an understanding of how the social actors perceive the roles of a science and technology park in a developing entrepreneurial ecosystem.

To theorize from a case study, an inductive, deductive, or abductive may be taken (Yin, 2018). The abductive approach was applied in this study. The elements of the entrepreneurial ecosystem in the extant literature were used as a coding template and to help guide the interview questions (see Appendix C.1.4). Then the questions were developed to explore the roles of the science and technology park in the entrepreneurial ecosystem as perceived by different actors in the ecosystem. In addition, theory-building from case study research is most appropriate when is little

known about the phenomena, or there is a need for empirical studies to support new perspectives on an already researched topic (Eisenhardt, 1989).

A potential case for the study must be the entrepreneurial ecosystem that has a science and technology park. Most of the existing literature on the entrepreneurial ecosystem is often grounded on developed entrepreneurial ecosystems located in large metropolitan cities (Roundy, 2017b). Examples are Silicon Valley, CA; Victoria, British Columbia (Cohen, 2006); Seattle, Washington (Thompson, Purdy and Ventresca, 2018); Phoenix, Arizona (Mack and Mayer, 2016); Calgary, Alberta (Spigel, 2017). Unlike large cities, entrepreneurial ecosystems in small cities are more likely to be developing entrepreneurial ecosystems, that lack entrepreneurial resources, infrastructure, and supportive culture and produce a limited number of successful entrepreneurs. However, there is some exception that well-developed entrepreneurial ecosystems are in small cities, such as Waterloo, Ontario (Spigel, 2017); and Chattanooga, Tennessee (Motoyama *et al.*, 2016). In conclusion, the entrepreneurial ecosystem literature has understated the entrepreneurial ecosystems in small- to medium-sized cities, particularly developing entrepreneurial ecosystems.

Chiang Mai's entrepreneurial ecosystem serves as an excellent example of a developing entrepreneurial ecosystem that has been driven by a science and technology park. Consequently, this case study is built on the interactions between the entrepreneurial ecosystem of Chiang Mai, Thailand, and Northern Science Park, which is also the project's sponsor.

4.4.3 Sampling

To investigate the roles of the science and technology park in the entrepreneurial ecosystem, which is the main research aim of this study, the entrepreneurial ecosystem elements discussed in the literature have been used. Theoretical sampling is, therefore, a suitable technique for this case. Although the conceptual boundary can be defined, collecting data from every ecosystem actor in the entrepreneurial ecosystem is still not viable. Non-probability sampling is therefore a more realistic option for the project.

Participants are chosen to represent various ecosystem actors as subunits of the analysis of the entrepreneurial ecosystem. In addition, participants must have some sort of connection to Northern Science Park because the case study's main focus is on the linkages between the science and technology park and the entrepreneurial ecosystem. As such, the samplings may not represent other ecosystem actors who are not related to Northern Science Park.

Following the initial meeting with the contact person at Northern Science Park, during which the goals of this study and the attributes of entrepreneurial ecosystems (see Appendix C.1.4) were discussed, the list of the ecosystem's actors was compiled. The participants' list was then identified by the author. Participants' groups were mapped into relevant elements in the entrepreneurial ecosystem theory, as shown in Figure 4.2, to confirm that the diversity in the samples is sufficient to describe all elements in the entrepreneurial ecosystem theory. Each element should be able to link to as least one group of participants. The Northern Science Park, entrepreneurs, successful entrepreneurs, public and private entrepreneurial support organisations, and universities in Chiang Mai, Thailand were among the participant groups in this study.

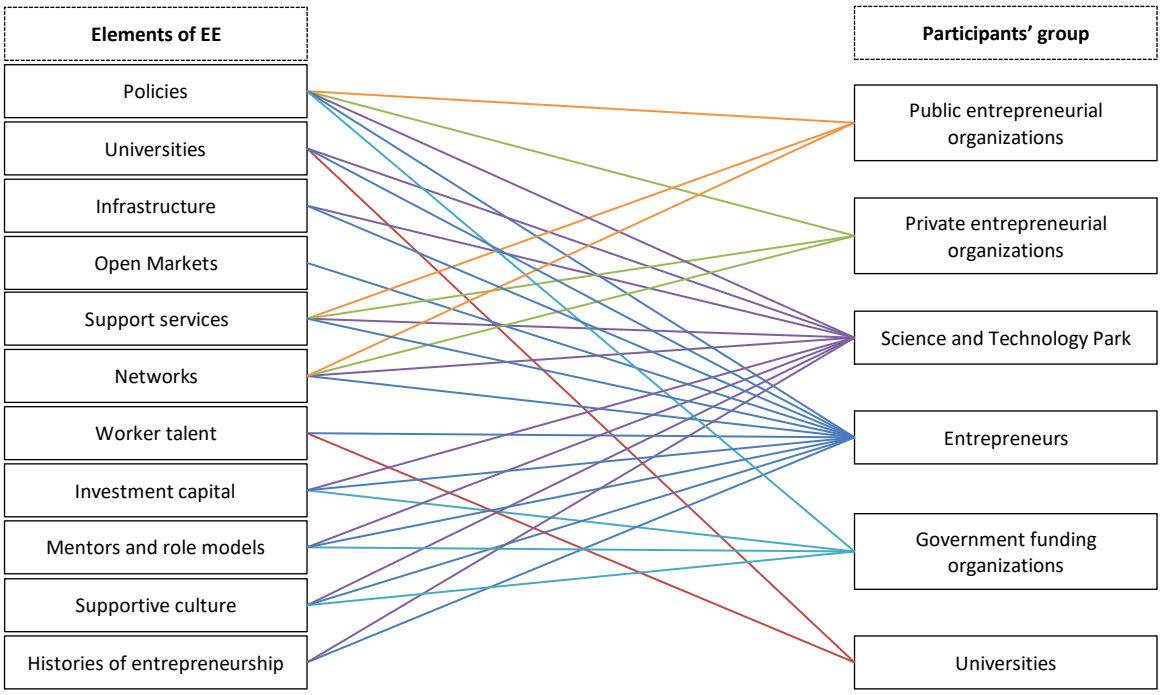


Figure 4.2 The mapping between the ecosystem's actors and related elements of the entrepreneurial.

4.4.4 Data collection

Data collections in a case study are usually a combination of multiple data collection methods such as archives, and interviews (Eisenhardt, 1989). Besides, multiple data collection methods provide a more complete account than using only a single data collection method by improving the internal validity of the study.

Data collection in this study was carried out between 2020 – 2021. Both primary and secondary data were collected in the study including 31 semi-structured interviews (including the pilot

interview) with different ecosystem participants in the entrepreneurial ecosystem and general information on documents and websites.

The participants were chosen by the judgement of the author together with the Northern Science Park management team to ensure that participants represent different ecosystem actors in Chiang Mai, Thailand and can be related to each element in the entrepreneurial ecosystem theory. After that, Northern Science Park assigned two of their staff to be a contact point and they were very helpful in reaching out to all participants in this study.

Table 4.2 provides descriptive information about interviewees in the study from different affiliations including 15 entrepreneurs in Chiang Mai, 8 from Northern Science Park, and 10 from other institutions and organisations in Chiang Mai such as universities, and public- and private-entrepreneurial support organisations.

Table 4.2 Interview subjects.

Participants	**No. of persons**	**No. of interviews**
Startups	6	6
SMEs	3	3
Social entrepreneurs	2	2
Successful entrepreneurs	4	4
Northern Science Park	8	7
University	1	1
Financial support organisation	2	1
Public entrepreneurial support organisations	4	4
Private entrepreneurial support organisations	3	3
Total	**33**	**31**

The 31 interviews with 33 participants ranged from 58 to 173 minutes with an average of 105 minutes per interview and 3,264 minutes in total. The interview began with a brief overview of the research. Then interviewees were asked to describe the background of their previous and current job positions or their businesses before moving on to the core of the interview. The semi-structured interviews were conducted with broad sets of questions that guided the interviews while additional questions might arise during the discussion. Broad sets of questions were prepared for different affiliations including entrepreneurs, science and technology park, university, government, financial support organisations, and public-, and private-entrepreneurial support organisations. In this part of the interview, questions about specific components in the ecosystem were based on the Spigel (2017) elements of the entrepreneurial ecosystem. The interview queried about the outlook of specific elements of the entrepreneurial ecosystem and

how Northern Science Park has made changes to those elements in their perspectives. (Eg. How did Northern Science Park influence the entrepreneurial culture in Chiang Mai? Did Northern Science Park influence the entrepreneurial policy in Chiang Mai?). The list of key questions was initially prepared in English and then translated into Thai. Then the guideline questions were pretested during the pilot interview to ensure the clarity and validity of the translation.

4.4.5 Data analysis

First, the literature review of the entrepreneurial ecosystem provides information regarding the elements of the entrepreneurial ecosystem in which the framework by Spigel (2017) was selected to understand how a science and technology park influences which element. Eleven elements have been used as 'Provisional coding' in this study.

Second, data were collected using 31 semi-structured interviews which then were recorded and transcribed. To ensure that the data was relevant to the research objectives, discussions that were not related to our research concern were removed from the data screening process.

Third, data were analysed using the qualitative data analysis software 'Nvivo'. 'Initial Coding' was the first step of our coding processes. This coding method is appropriate for all qualitative studies (Saldaña, 2013) as it is an open-ended approach and the goal of this coding method is "to remain open to all possible theoretical directions indicated by your readings of the data" (Charmaz, 2006, p. 46). The initial coding helps break down raw data into discrete parts in the first cycle (Saldaña, 2013). 'Action coding' was used in the following to describe on what Northern Science Park interacts with the entrepreneurial ecosystem elements and to combine separated data into broader categories

Fourth, the codes were then mapped to the 'Provisional coding' that was derived from the literature, which also represents the abductive approach of this study. This coding process aimed to verify which elements of the entrepreneurial ecosystem was influenced by the science and technology park and identify uncategorized codes that will be new emerging elements besides the existing framework. The coding structure is illustrated in Table 4.3

Finally, 'Axial Coding' was applied to represent the contributions of Northern Science Park to the entrepreneurial ecosystem under the following themes; contributions through the incubation program, and contributions through the university-industry linkage as shown in Figure 4.4, Figure 4.5, and Figure 4.6. After that, the codes were illustrated in diagrams that systematically link together to reflect the interactions, and consequences of a process between Northern Science

Park and the ecosystem's elements from the author's points of view in section 4.5.2. The overview of data collection and coding processes was illustrated in Figure 4.3.

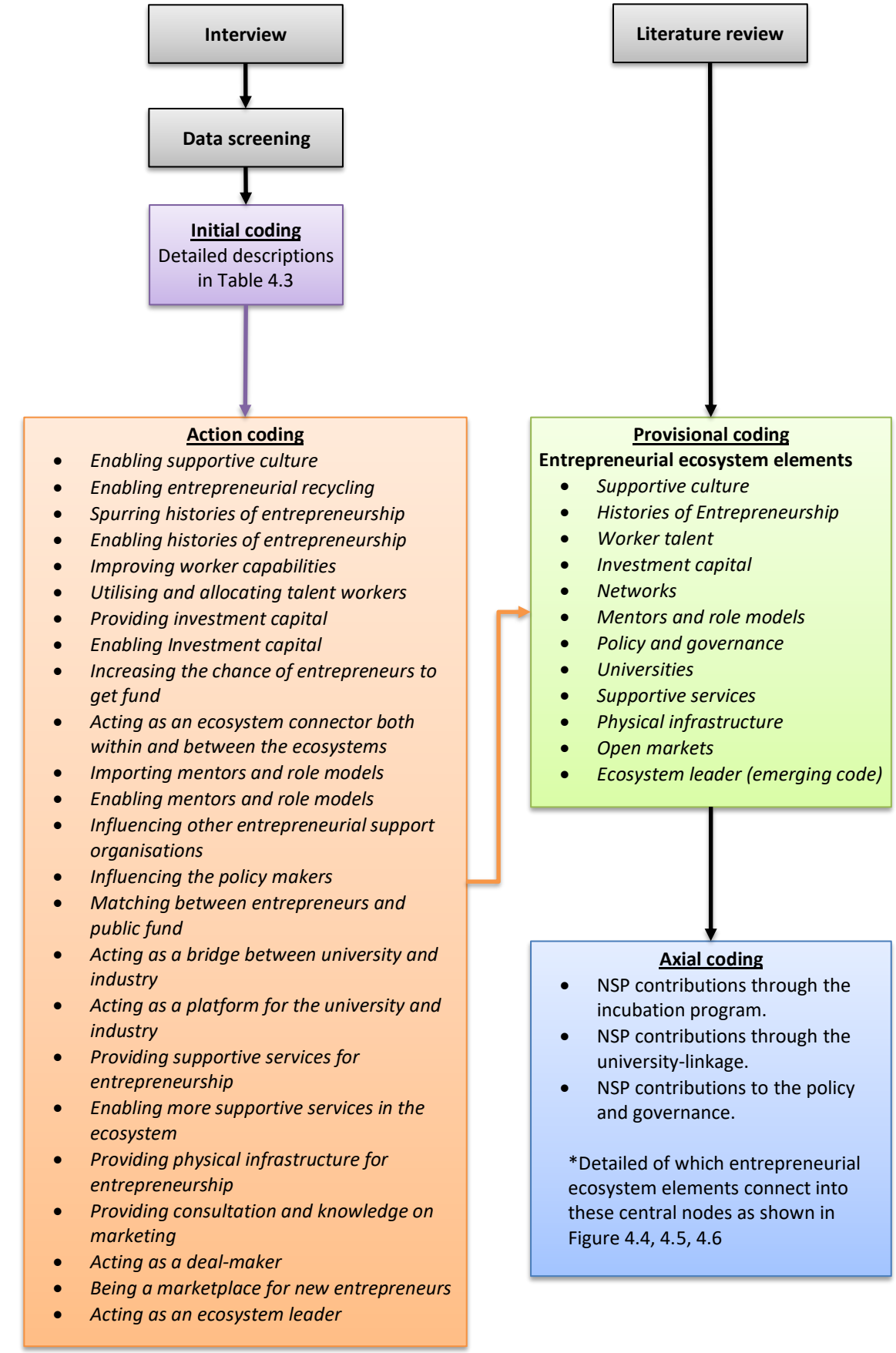


Figure 4.3 Data collection and coding processes.

Table 4.3 Coding structure.

Initial coding	Action coding	Provisional coding
NSP staffs are very supportive and contribute to helping entrepreneurs. Entrepreneurs in NSP are more likely to share knowledge and experience with others. NSP increased the level of collaboration between universities, and other entrepreneurial support organisations to support entrepreneurship in Chiang Mai. NSP is the symbol of innovation and entrepreneurship in Chiang Mai.	Enabling supportive culture	Supportive culture
Entrepreneurs who are NSP alumni tend to come back and pay it forward whenever they can, for instance, they attend social events as speakers, mentors, or investors.	Enabling entrepreneurial recycling	
NSP often hold social events where successful entrepreneurs, alumni of the NSP, can share their stories. Successful entrepreneurs, alumni of the NSP, share their stories with new entrepreneurs both inside and outside the ecosystem. Successful entrepreneurs, alumni of the NSP, share their stories with university students. NSP produces filming documentaries and shares the stories of successful alumni through YouTube.	Spurring histories of entrepreneurship	Histories of entrepreneurship
NSP alumni became successful entrepreneurs in the ecosystem. Success cases attract new entrepreneurs into the ecosystem.	Enabling histories of entrepreneurship	
NSP has a project called ‘up-skill, re-skill,’ which is a series of training programmes designed to improve the capabilities of new graduates and workers in sectors with a shortage of talent.	Improving worker capabilities	Worker talent
NSP has a project called ‘talent mobility’ that allows university researchers to work with the private sector for a while to gain insights. Moreover, the project also provides a database of researchers across the country so that the private sector can approach the right person.	Utilising and allocating talented workers	

Initial coding	Action coding	Provisional coding
NSP directly provides financial support for new entrepreneurs. Ang Kaew Holding (AKH) was founded by NSP and Chiang Mai University planning to invest in startups soon.	Providing investment capital	Investment capital
Success cases attract investors into the ecosystem. NSP alumni became investors or venture builders in the ecosystem. NSP collaborated with NIA to educate local investors about startups. Because of NSP's outstanding performance and their success cases, central and local governments, and public and private organizations would like to collaborate on projects, which means NSP can draw more financial resources to spend on entrepreneurial projects.	Enabling investment capital	
NSP increases the chance of entrepreneurs to get funds by preparing documents for pitching. Being a startup in NSP help them in term of creditability when getting a loan from banks.	Increasing the chance of entrepreneurs to get fund	
NSP acts as a central node providing a range of entrepreneurial networks for entrepreneurs both within and between entrepreneurial ecosystems such as mentors, entrepreneurs, experts, investors, public and private entrepreneurial support organisations, support services providers, universities, and other regional science parks.	Acting as an ecosystem connector both within the ecosystem and between ecosystems	Networks
Due to a lack of mentors in Chiang Mai, NSP brings mentors from Bangkok as well as international mentors.	Importing mentors and role models	Mentors and role models
NSP alumni became mentors for new entrepreneurs in the ecosystem. Successful alumni became role models and give inspirational talks to new entrepreneurs or university students.	Enabling mentors and role models	
Because NSP values its relationships with both public and private organisations, the number of policies to support entrepreneurship is growing.	Influencing other entrepreneurial support organisations.	Policy and governance

Initial coding	Action coding	Provisional coding
NSP facilitates entrepreneurs in communicating their needs to policymakers. NSP has an impact on policy and governance due to its level of credibility.	Influencing the policymakers.	
NSP compiles all information on public funds and projects before communicating with eligible entrepreneurs. NSP assists entrepreneurs in avoiding issues and limitations in current policy and governance.	Matching between entrepreneurs and public funds.	
NSP facilitates collaborative research projects between the university and the private sector.	Acting as a bridge between university and industry	Universities
NSP is a platform for Chiang Mai University to train university students and researchers to become entrepreneurs in the ecosystem. NSP encourages Chiang Mai University to become a more entrepreneurial university (Initiatives to focus more on industry needs such as patent landscape, co-research, the foundation of AKH and AKIP)	Acting as a platform for the university to create entrepreneurs	
NSP provides supportive services including technology business incubation, IP management and licensing, and collaborative research.	Providing supportive services for entrepreneurship	Supportive services
NSP collaborates with other entrepreneurial support organisations to create more entrepreneurship projects such as developing training programmes for young entrepreneurs, inviting successful entrepreneurs to be guest speakers, or managing entrepreneurial projects.	Enabling more supportive services in the ecosystem	
NSP provides office spaces, co-working spaces, maker spaces, meeting rooms, laboratories, and a food pilot plant for entrepreneurs.	Providing physical infrastructure for entrepreneurship	Physical infrastructure
NSP provides consultation for entrepreneurs to identify their beachhead market. By providing financial support and networking opportunities, NSP encourages entrepreneurs to attend relevant tradeshows or social events in Thailand, as well as international tradeshows. NSP offers digital marketing courses for entrepreneurs as well as financial support for advertising.	Providing consultation and knowledge on marketing	Open markets

Initial coding	Action coding	Provisional coding
NSP assists entrepreneurs in business matching. Entrepreneurs gain more credibility as startups at NSP.	Acting as a dealmaker	
The "NSP Inno Store" is an outlet store for entrepreneurs to test the market.	Being a marketplace for new entrepreneurs	
NSP is the main driver for entrepreneurship in Chiang Mai. NSP has the vision and power to play the role of leader to promote entrepreneurship in Chiang Mai.	Acting as an ecosystem leader	Ecosystem leader (emerging code)

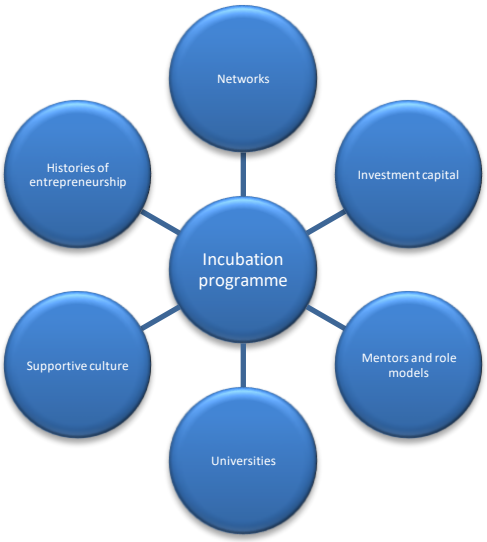


Figure 4.4 Contribution through the incubation programme.

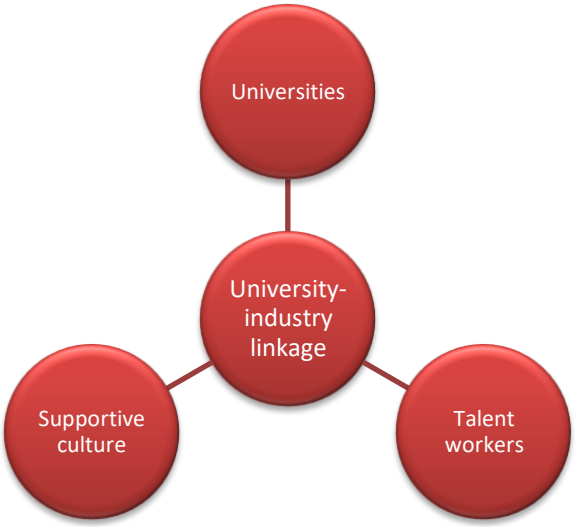


Figure 4.5 Contribution through the university-industry linkage.

Figure 4.6 Contribution to the policy and governance.

4.5 Findings and discussions

This section discusses the findings on how Northern Science Park contributes to Chiang Mai's entrepreneurial ecosystem regarding the ecosystem elements by Spigel (2017). At the end of the section, frameworks of how the Northern Science Park and the elements of the entrepreneurial ecosystem are interconnected were proposed.

4.5.1 The impact of the Northern Science Park on the Chiang Mai entrepreneurial ecosystem

4.5.1.1 Cultural Attributes

4.5.1.1.1 Supportive culture and histories of entrepreneurship

The importance of entrepreneurial culture is well documented in the previous literature (Feld, 2012; Isenberg, 2011; Spigel, 2017; Stam, 2015; Feldman, 2001; Aoyama, 2009). Culture is recognized as the foundation of the entrepreneurial ecosystem which helps create a condition or context in that entrepreneurship and other support elements can emerge (Stam, 2015; Spigel, 2017). Cultural attributes, unlike material and social attributes, are unique to the entrepreneurial ecosystem and cannot be easily created or imported from other ecosystems. Although the literature on the entrepreneurial ecosystem has suggested who may play the role in shaping entrepreneurial culture in the entrepreneurial ecosystem, the knowledge of how they shape the culture is limited. Especially in developing entrepreneurial ecosystems where entrepreneurial culture and success stories of entrepreneurship are lacking.

The findings show that the Northern Science Park promotes entrepreneurial culture among entrepreneurs by exposing them to success stories and engaging them in networking activities with other entrepreneurs, mentors, investors, and entrepreneurial support organisations throughout the incubation process. Northern Science Park has a good relationship with other public and private entrepreneurial support organisations in the entrepreneurial ecosystem, and they frequently collaborate on projects, which encourages a supportive culture among these entrepreneurial support organisations as well. This is supported by the comment of STP-p1 (see Table 2.5 Interview Participants.) who mentioned that *"…Startups and SMEs are not quite the same thought, and they rarely collaborate. Northern Science Park is attempting to bring them together."* STP-p2 added that *"In Chiang Mai, startups and SMEs usually stay in separate groups, such as digital nomads in the Digital Hub, SMEs under the Industrial Promotion Centre, and*

Northern Science Park alumni. We are attempting to bring them together for them to share their ideas and business experiences."

In addition, Northern Science Park alumni can contribute to the ecosystem as role models or guest speakers when the Northern Science Park or other partner organisations, such as universities or entrepreneurial support organisations, hold entrepreneurial events. Alumni can share their stories or experiences which will help inspire others to pursue entrepreneurship. SuccessENT01 said that *"…without Northern Science Park, I won't have much chance to share my stories with others".* Therefore, the Northern Science Park not only fosters an entrepreneurial culture for entrepreneurs in their incubation program, but it also has an impact on science and technology park outsiders in the entrepreneurial ecosystem, such as university staff and students, and established firms that are members of private entrepreneurial support organisations, or other individual entrepreneurs who attend seminars or training programs held by public entrepreneurial support organisations in Chiang Mai. Consequently, there is an increase in a positive attitude towards entrepreneurship in Chiang Mai as the number of people who are interested to become entrepreneurs has increased over time. For example, the number of applications of students who would like to join the Bootcamp project provided by the Northern Science Park is increasing as told by STP-p2, or Startup04 who told that he was inspired to become a startup after he went back from the Startup Thailand event several years ago.

The findings show that the Northern Science Park's contributions to Chiang Mai's entrepreneurial ecosystem by shaping the entrepreneurial culture and increasing the opportunity to spur the success stories of entrepreneurship. To have an influence, Chiang Mai's supportive culture for entrepreneurship must be the result of many years of commitment, and the Northern Science Park is the one that plays an active role in our case study.

4.5.1.2 Social Attributes

4.5.1.2.1 Networks

Northern Science Park supports local entrepreneurship together with other ecosystem actors in Chiang Mai's entrepreneurial ecosystem during the incubation processes. Incubator organisations, such as science and technology parks, can help new entrepreneurs connect with their broader networks such as business, technical, financial, and others (Etzkowitz, 2002). In the entrepreneurial ecosystem literature, networks that link entrepreneurs, advisors, investors, and workers are recognized as one of the elements of the entrepreneurial ecosystem (Spigel, 2017). The results reveal that the Northern Science Park has strong entrepreneurial networks both inside and outside Chiang Mai's entrepreneurial ecosystem and acts as an ecosystem connector

between distinct regional entrepreneurial ecosystems complementing the availability of mentors, and investment capital and connecting local entrepreneurs to broader entrepreneurial networks during the incubation program. This is backed up by the comment of STP-p2 who said that *"…we are building networks of mentors and VCs to help our entrepreneurs and most of them are from Bangkok, not Chiang Mai…"* The influence of these contributions is quite large in a developing entrepreneurial ecosystem like Chiang Mai. Northern Science Park's impact is expected to diminish once the entrepreneurial ecosystem becomes fully developed and produces many successful entrepreneurs who can serve as mentors, as well as attracts investors and skilled workers to the region.

4.5.1.2.2 Mentors

Northern Science Park provides business mentorships to their entrepreneurs by bringing mentors in their networks, mostly from Bangkok, into the incubation programs because mentors particularly for startups in Chiang Mai's entrepreneurial ecosystem are insufficient. Mentors from Bangkok also act as ecosystem connectors that help startups in Chiang Mai to connect with the networks in Bangkok where the entrepreneurial resources are richer than in Chiang Mai. Moreover, some mentors are Northern Science Park alumni who graduated and come back to help. This is backed up by the comment of STP-p2 who mentioned: *"There are some of our alumni who are successful entrepreneurs who came back…usually as mentors for new generation entrepreneurs, or as guest speakers to give inspiring talks in entrepreneurial events that we hosted…".* The results reveal that three out of four successful entrepreneurs have provided mentorship including SuccessENT02, SuccessENT03, and SuccessENT04.

4.5.1.2.3 Investment capital

Northern Science Park helps startups to access financial support ranging from developing their prototype to doing market validation, until scaling up in the later stage of the incubation program. STP-p2 said that *"…we know very well where we can find the right financial support for startups in each stage of the startup development. For example, there are Startup Thailand League, Youth Startup Fund, and Hedge Fund to provide financial support for developing a prototype and doing market validation."* STP-1 added that *"…we help startups match the right funds and also help them in the preparation such as checking conditions of funding, reviewing a business plan, and coaching in a presentation to increase the chance of getting funds."*

The findings also reveal that some Northern Science Park alumni invested in new startups which made them become angel investors or venture builders in Chiang Mai's entrepreneurial ecosystem such as SME03, Start-up02, and SuccessENT03. In addition, other alumni have an

interest to become investors such as SuccessENT01, Start-up05, and Start-up06. This phenomenon, which is called entrepreneurial recycling (see Appendix C.5.1), is aligned with the literature on the entrepreneurial ecosystem (Mason and Brown, 2014; Spigel and Harrison, 2018; Spigel and Vinodrai, 2020). This makes the Northern Science Park important in triggering a process of entrepreneurial recycling or attracting successful entrepreneurs who may subsequently return to Chiang Mai's entrepreneurial ecosystem to engage in other entrepreneurial activities including mentors and investors as discussed earlier.

However, the availability of financial support for entrepreneurship in Chiang Mai is still considered to be limited. This is supported by participants from every group including Northern Science Park (STP-2, STP-3, STP-4, STP-5, STP-6), entrepreneurs (Startup01, Startup02, Startup03, Startup05, Startup06), entrepreneurial support organisations (PrivateOrg01, PrivateOrg02, PublicOrg02, PublicOrg04), university (Uni01), and financial support organisation (Fin01). The majority of financial support comes from government-funded organisations that foster entrepreneurship in its early stages. Also, such supports are hard to get and are only available in limited quantities. Moreover, it is challenging for new companies to scale up their firms in Chiang Mai since VCs, CVCs, and angel investors that typically assist entrepreneurship at the growth stage are scarce.

4.5.1.2.4 Skilled workers and talents

Despite the university's potential to produce new entrepreneurs, skilled workers, and talents for the entrepreneurial ecosystem, the outcomes have just been unsatisfactory. This is evidenced by the fact that despite the proportion of university students' desire to become entrepreneurs has increased, the proportion of new startups founded by graduates remains low, as well as the fact that graduated students still prefer to work for large corporations rather than risky startups. The findings reveal that Northern Science Park also has initiatives to approach this issue such as a pool of talents or skills development training programs. Nonetheless, participants from the Northern Science Park, university, and entrepreneurs all agreed that Chiang Mai is still suffering from a brain drain. As a result of low average income or a lack of financial support for later-stage startups, particularly VCs, these young generations, particularly talents, may be drawn to other well-developed entrepreneurial ecosystems, such as Bangkok.

4.5.1.3 Material Attributes

4.5.1.3.1 Support services and physical infrastructure

Northern Science Park provides an incubation program and office spaces for new startups. STP-1 told that "…we provide the incubation program for startups…". STP-p2 added, *"…we have three co-working spaces and office spaces at Northern Science Park to support our entrepreneurs who*

are under the incubation program…". Northern Science Park is the largest business incubator, particularly for startups, and the sole provider that helps entrepreneurs to access resources from universities in Chiang Mai's entrepreneurial ecosystem. Therefore, the impact of Northern Science Park on Chiang Mai's entrepreneurial ecosystem is considerable. STP-1 said that *"…there are lots of co-working space providers here in Chiang Mai, but we also have an incubation program and the linkage to universities which make us unique…".* Business incubation services and office spaces can be provided by other entrepreneurial support organisations and entrepreneurial service providers such as co-working spaces, business incubators, or accelerators. Therefore, the impact of Northern Science Park will be diminished when the entrepreneurial ecosystem develops with plenty of entrepreneurial support organisations and entrepreneurial service providers in the region. Nevertheless, the contribution of Northern Science Park still complements support services and physical infrastructure elements in Chiang Mai's entrepreneurial ecosystem. In addition, the role of a science and technology park as an intermediary organisation between entrepreneurs and universities is still valid and hard to replace by any other entrepreneurial support organisation even in well-developed entrepreneurial ecosystems which are common in studies of regional innovation systems (Zhu and Tann, 2005; Fernández-Esquinas, Merchán-Hernández and Valmaseda-Andía, 2016).

4.5.1.3.2 Markets

Local markets or demand for innovative products or services are said to be limited in Chiang Mai's entrepreneurial ecosystem, limiting startup growth. The majority of startups in Chiang Mai, therefore, aim for larger markets such as Bangkok, nationwide, or even international markets. Mentorships during the incubation program guide startups to choose more relevant target markets. Northern Science Park can help entrepreneurs to connect with partner entrepreneurial support organisations in this regard such as the Office of Provincial Commercial Affairs Chiang Mai which helps the entrepreneur connect with both domestic and international markets (PublicOrg03). Moreover, Northern Science Park has a budget for startups to do digital marketing and exhibit at a trade show (STP-2). Although Northern Science Park can help entrepreneurs to penetrate markets by connecting them to responsible entrepreneurial support organisations or exposing them to potential customers in trade shows, some entrepreneurs can access the market without the help of Northern Science Park. For example, tech entrepreneurs who develop a platform as a service can only do digital marketing to reach potential customers by themselves. Northern Science Park has no or little impact on the development of a local market in Chiang Mai; however, according to our findings, Northern Science Park helps entrepreneurs connect to potential markets outside the ecosystem.

4.5.1.3.3 University

Collaborative research is intended to assist both SMEs and large enterprises in conducting research and development by leveraging university expertise, whereas intellectual property management and licensing make use of technological knowledge from existing research. Northern Science Park acts as an intermediary organisation between entrepreneurs and universities. Universities and other higher education institutions are the elements often discussed in the entrepreneurial ecosystem literature (Spigel, 2017; WEF, 2013). The most important contributions that universities and other higher education institutions can make to the entrepreneurial ecosystem are producing new knowledge and training both new entrepreneurs and skilled workers. However, the effectiveness of these roles of universities in the entrepreneurial ecosystem is sceptical because university technology transfer offices' practices are occasionally viewed as barriers to research commercialization and the number of university spin-offs is relatively small (Mason and Brown, 2014; Feld, 2012). University in Chiang Mai has suffered from these two aspects as well. This is backed up by the comment of Uni01 who said that *"…the technology transfer office is not effective in research commercialization as we expected…"* and comments from entrepreneurs (Startup01, Startup03, Startup06, SocialENT01, SuccessENT02, SuccessENT03, SuccessENT06), Northern Science Park (STP-2), and public organisation (PublicOrg01) who agree that the university still has failed to produce new entrepreneurs into the entrepreneurial ecosystem considering the number of graduate students who become entrepreneurs. Although the university still produces skilled workers, they still prefer to work in large companies rather than startups and often move to Bangkok as Chiang Mai is still a weak entrepreneurial ecosystem where there is a limited number of large firms. As a result of this situation, Chiang Mai is in desperate need of skilled workers willing to work with startups.

In the literature on regional innovation systems, a university is viewed as a producer of technological knowledge and technical skills, whereas a science and technology park is seen as an intermediary organisation that disseminates technological knowledge between the university and the industry (Autio, 1998). The findings show that Northern Science Park has influenced Chiang Mai University's ability to support entrepreneurship in the ecosystem. Northern Science Park's collaborative research approach has increased the level of knowledge spillovers between the university and the private sector, which helps to strengthen the university's contributions to producing new knowledge in the ecosystem. This is backed up by comment STP-2 who told that *"…Northern Science Park has collected the number of university professors who have collaborative projects with the private sector and the number is rising over time…".* Several entrepreneurs in the incubation program, including SME01, SME02, and SocialENT01, benefit from collaborative research, for which Northern Science Park provides financial support of up to 70% of the research

budget. Furthermore, the projects benefit established firms in Chiang Mai's entrepreneurial ecosystem. Both private entrepreneurial support organisations in our study, PrivateOrg01, and PrivateOrg02 agreed that Northern Science Park assisted them in connecting with universities. PrivateOrg01 told that *"…Universities, in my opinion, are extremely beneficial. They offer us advice, research, or conduct collaborative research with us to find solutions. I'm not sure where to begin without Northern Science Park. They are extremely helpful in connecting us with universities… Consequently, over the last 4-5 years, our organisations in each province have formed alliances with universities in their respective regions to work on collaborative projects…. Northern Science Park can assist in connecting to universities in their networks including Chiang Mai and other northern cities."* Therefore, Northern Science Park not only strengthens the contributions of universities in terms of technological knowledge producers in Chiang Mai but also other universities in other northern cities.

Other driving forces behind the university's decision to focus more on entrepreneurship are the younger generation being more interested in becoming entrepreneurs and the decrease in the number of university students. The shift in the university's goals placed Northern Science Park in a critical position to drive the transition toward an entrepreneurial university. This is supported by the comment of Uni01 who stated that *"...we must admit that the university has never focused on entrepreneurship until recently, and we have discovered that our students are more interested in becoming entrepreneurs. However, we don't have a platform or a school of entrepreneurship to support them. Northern Science Park has an excellent track record in this regard, so we see it as a platform to support our students or university staff in entrepreneurship. In addition, I've noticed that several faculties have begun to incorporate entrepreneurial coursework into their programs in the last year.*" STP-4 added that the Northern Science Park also plays a role in assisting the university's transition to entrepreneurship-focused teaching programs such as providing entrepreneurial workshops to complement the current courses or providing internship programs at the Northern Science Park or incubated startups in the Northern Science Park. In addition, several entrepreneurs both incubated startups and the Northern Science Park alumni were invited to be guest speakers in several programs such as SuccessENT03, SuccessENT04, Startup03, SocialENT01, and SME02. Furthermore, STP-4 told that Chiang Mai University has recently established Ang Kaew Holding (AKH) to invest in future research commercialization and Northern Science Park also participates in the project. There are currently two subsidiaries: Ang Kaew IP Venture (AKIP), which does patent landscape and trend analysis for university researchers, and Ang Kaew Startup (AKS), which is a storefront for startups to test the market before scaling up.

4.5.1.3.4 Policy and governance

As we interviewed various participants in the entrepreneurial ecosystem, such as entrepreneurs, universities, and public and private entrepreneurial support organisations in Chiang Mai. They're all linked to the Northern Science Park. The Northern Science Park's director has a strategy to maintain a good relationship with all actors in the ecosystem. The entrepreneurial support organisations must create projects to support entrepreneurs in Chiang Mai and defend the proposed projects for the budget with the central government regularly. There are two local private entrepreneurial support organisations, five local public entrepreneurial support organisations, and one university in the study, and the Northern Science Park gets involved with the organisations as a consultant or even helps them create projects to defend the public fund. This reduces the redundancy of entrepreneurial projects or policies in Chiang Mai while also increasing the impact on the entrepreneurial ecosystem because they are all interconnected. The attempt to engage with entrepreneurial support organisations in the entrepreneurial ecosystem to create a synergy impact is unique to the Northern Science Park and is not typical of regional science and technology parks' missions to the best of the author's knowledge. As previously stated, financial support for startups is limited in Chiang Mai, with the majority coming from public funds. Northern Science Park serves as an ecosystem leader by attracting public funds from other entrepreneurial support organisations through collaborative projects. Although Northern Science Park is Chiang Mai's largest startup incubation platform, the amount of public funding available to support its projects is not the greatest. Other public entrepreneurial support organisations, such as the NIA (National Innovation Agency) or DEPA (Digital Economy Promotion Agency), have more funding to support startups than the Northern Science Park, but they lack the manpower, infrastructure, and startups that the Northern Science Park has. While other public and private entrepreneurial support organisations in Chiang Mai typically support traditional businesses such as the service and manufacturing industries, they are now shifting their support to tech entrepreneurs or startups, encouraging traditional entrepreneurs to adopt innovation and technology from the academic sector to improve productivity or create more value-added services. As a result, doing collaborative projects with Northern Science Park and other partner entrepreneurial support organisations benefits both parties.

Although Chiang Mai is still a developing entrepreneurial ecosystem, the institutional structure has changed considerably and allowed innovative startups to become successful progressively. Northern Science Park is a part of this growth and a key player in this entrepreneurial ecosystem that encourages the changes in entrepreneurial support organisations, and universities in the region to synchronize in supporting high-growth entrepreneurs. Furthermore, Northern Science Park helps access entrepreneurial resources outside the ecosystem to compensate for its

deficiencies in Chiang Mai. The changes in the institutional structure of the ecosystem enabled local high-growth entrepreneurs or startups to thrive and remain in the entrepreneurial ecosystem of Chiang Mai rather than migrating out and settling down in a more developed entrepreneurial ecosystem such as Bangkok.

The governance nature of Chiang Mai's entrepreneurial ecosystem differs from the assumptions made in the literature about the ecosystem leader. Our data reveal that Northern Science Park is acting as a necessary leader of Chiang Mai's entrepreneurial ecosystem instead of entrepreneurs themselves. Throughout the incubation programs, Northern Science Park provides entrepreneurs with entrepreneurial knowledge, technical knowledge, and linkage to university networks, mentorships, government grants and linkage to investor networks, support services, and physical infrastructure. Northern Science Park also plays a role in building supportive culture. We found that the supportive culture brings alumni back into the entrepreneurial ecosystem to help new rounds of entrepreneurship as mentors, role models, guest speakers, or angel investors and also allowed their success stories of entrepreneurship to become more widespread and help inspire new potential entrepreneurs in the ecosystem. Because Northern Science Park typically collaborates on projects with other entrepreneurial support organisations and universities in the ecosystem, this effect extends beyond Northern Science Park's boundaries. As a result, according to our data, there has been an increase in the number of people interested in pursuing entrepreneurship, particularly in startup businesses.

Northern Science Park has done beyond the mission of the organisation or the definition of a science and technology park that is commonly discussed in the literature. The findings reveal that the high level of engagement of Northern Science Park with many public and private entrepreneurial support organisations creates more projects, and public funds, to support entrepreneurs in the entrepreneurial ecosystem. Northern Science Park has built a very good reputation as an intermediary organisation and response to the needs of entrepreneurs in the entrepreneurial ecosystem which helps them gain more trust and substantial support from other entrepreneurial support organisations and the government. The high level of trust in entrepreneurial support organisations and the government in Northern Science Park helps create more impact on the entrepreneurial ecosystem in terms of entrepreneurial policy and governance.

4.5.2 The interrelationship between Northern Science Park and Chiang Mai entrepreneurial ecosystem elements

Although the mission of Northern Science Park is usually fostering startups to create entrepreneurial activity as outputs, the outcomes or the total value created by Northern Science Park is more than that. The existence of Northern Science Park strengthens the networks of entrepreneurs, mentors, investors, and entrepreneurial support organisations both within Chiang Mai's entrepreneurial ecosystem and between Chiang Mai and other entrepreneurial ecosystems, while also facilitating the development of the underlying entrepreneurial culture of Chiang Mai's entrepreneurial ecosystem which is a fundamental element that contributes to the creation of a context in which entrepreneurship and other elements can emerge. According to the findings, this is the most significant impact of Northern Science Park in the developing entrepreneurial ecosystem of Chiang Mai in the author's perspective as it creates not only a positive attitude towards entrepreneurship but also increases the coherence among entrepreneurial support organisations in the ecosystem to better support entrepreneurship.

In this section, we will look at another shortcoming in the entrepreneurial ecosystem: the interdependence of the entrepreneurial ecosystem's elements. For this investigation, we will use Northern Science Park as a focal point and examine how the elements are interconnected. The interrelationship of Northern Science Park and Chiang Mai entrepreneurial ecosystem elements is illustrated using the diagrams as follows.

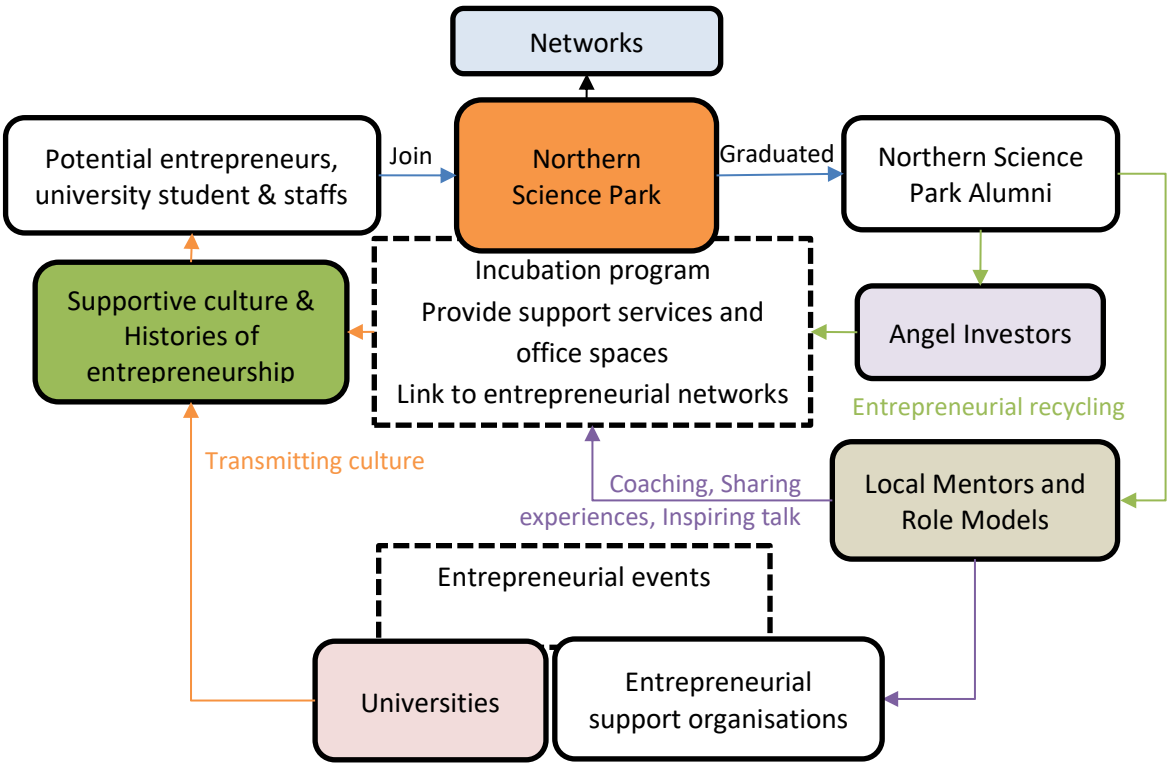


Figure 4.7 Northern Science Park contributions through the incubation program.

Figure 4.7 shows the role of Northern Science Park as a business incubator and the interrelationship between Northern Science Park and Chiang Mai entrepreneurial ecosystem elements during the incubation process. Northern Science Park usually provides support services, and office spaces as well as the link to entrepreneurial networks. Entrepreneurs in the incubation program will have the opportunity to learn about other entrepreneurship through a variety of case studies including both success and failure cases, as well as directly from their mentors or successful entrepreneurs who will share their experiences and inspiring talks. Therefore, Northern Science Park contributes to enabling supportive culture and spurring success stories of entrepreneurship among incubated entrepreneurs in the program. Furthermore, the findings show that Northern Science Park alumni have gone on to become mentors, role models, or angel investors in the ecosystem. The phenomenon is referred to as recycling in the entrepreneurial ecosystem where resources such as people, skills, knowledge, and capital move between firms within an ecosystem (Spigel and Vinodrai, 2020; Mason and Harrison, 2006; Spigel and Harrison, 2018). Because Northern Science Park has contributed to their success, these alumni tend to attract new potential entrepreneurs when they have the opportunity to share their stories in events hosted by Northern Science Park, entrepreneurial support organisations, or universities.

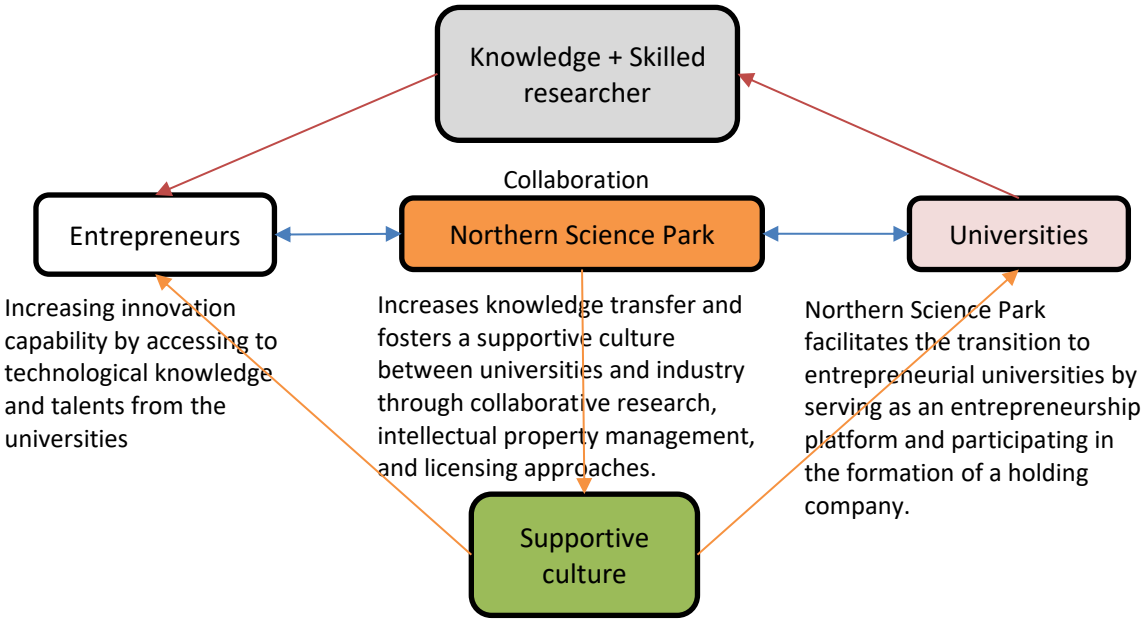


Figure 4.8 Northern Science Park contributions through university-industry linkage.

Figure 4.8 depicts the role of Northern Science Park as an intermediary organisation between universities and industries. The most important contributions of universities in the entrepreneurial ecosystem are producing new knowledge and training both new entrepreneurs and skilled workers. The findings reveal that Northern Science Park does increase knowledge transfer between university and industry through collaborative research, IP management & licensing approaches, however, the number of new entrepreneurs or skilled workers from

graduates is still low. As a result, the main effects of Northern Science Park are to strengthen universities' contributions as knowledge producers and to support the transition to entrepreneurial universities, which also encourages an entrepreneurial culture, such as innovation, collaboration, and a positive attitude towards entrepreneurship, between entrepreneurs and universities.

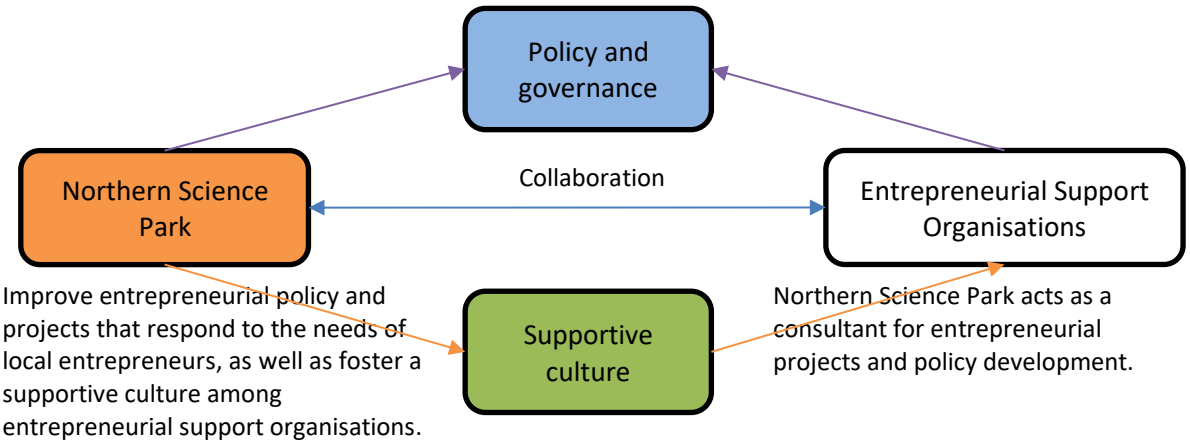


Figure 4.9 Northern Science Park contributions to policy and governance.

Figure 4.9 presents the role of Northern Science Park as an ecosystem's leader, as Northern Science Park engages all local entrepreneurial support organisations in the ecosystem while also acting as a consultant for entrepreneurial projects and policy development. Northern Science Park's influence on these entrepreneurial support organisations helps to improve the ecosystem's overall entrepreneurial policy and governance by better responding to the needs of local entrepreneurs and reducing the redundancy of entrepreneurial projects among entrepreneurial support organisations in the Chiang Mai entrepreneurial ecosystem. Furthermore, a partnership among these entrepreneurial support organisations may foster cultural values between them, for instance, collaboration, and commitment to the region.

4.6 Conclusion

This paper provides empirical evidence that Northern Science Park can play an important role as an ecosystem leader in Chiang Mai's entrepreneurial ecosystem. The findings indicate that Northern Science Park's contributions have resulted in a rise in the number of institutions and corporations engaging in the Chiang Mai entrepreneurial ecosystem, thereby strengthening Chiang Mai's entrepreneurial culture. The evolution of an entrepreneurial ecosystem is linked to the instit'tional and cultural structures of a region, the entrepreneurial ecosystem grows stronger as it evol'es.

Nonetheless, entrepreneurs in Chiang Mai still face several challenges which have hindered their growth such as difficulty in hiring talented workers regarding the brain drain in Chiang Mai and inaccessibility to funds for scaling up due to the unfamiliarity of VCs with investment opportunities in Chiang Mai.

4.6.1 Research contribution

First, it adds to the literature on the entrepreneurial ecosystem that a science and technology park can play an important role as an ecosystem leader in a developing entrepreneurial ecosystem influencing the development of the entrepreneurial ecosystem elements. The case study also indicates that, in contrast to what has been claimed in the literature, leaders of the entrepreneurial ecosystem do not always need to be entrepreneurs or government, as is typically argued in the entrepreneurial ecosystem literature. Furthermore, it is the second single-case study to support the notion come up by Germain *et al.* (2022) that a science and technology park can act as a key actor and manager of the entrepreneurial ecosystem.

Second, a science and technology park contributes to the development of the elements of the entrepreneurial ecosystem, particularly entrepreneurial culture, which is a foundation element of a developing entrepreneurial ecosystem. This case study also contributes to the area of entrepreneurial culture development which is still limited in the entrepreneurial ecosystem literature (Roundy, 2017a).

Third, this paper demonstrates the evidence of entrepreneurial recycling, in which successful entrepreneurs become mentors, investors, or venture builders, to support new rounds of entrepreneurship in the entrepreneurial ecosystem (Mason and Brown, 2014), as well as the importance of entrepreneurial culture and the role of science and technology parks that enable this process.

Finally, this study adds empirical evidence from developing entrepreneurial ecosystems to case studies that are typically based on well-developed entrepreneurial ecosystems (Roundy, 2017b).

4.6.2 Practical implications

The results from the case study imply that policymakers may establish a science and technology park as a key player in accelerating a developing entrepreneurial ecosystem evolution. Moreover, the case provides examples of how a science and technology park influences different entrepreneurial ecosystem elements.

Second, the case study emphasises the significance of developing an entrepreneurial culture, particularly among entrepreneurial support organisations. As a result, policymakers may include this as one of the missions for science and technology parks, and possibly as one of the missions for ecosystem leaders in ecosystems without science and technology parks.

Third, the case study also shows that a single entrepreneurial ecosystem may not be able to address all of the issues that a particular ecosystem encounters. Policymakers should encourage connectivity between different entrepreneurial ecosystems to generate the flow of entrepreneurial resources between them. In this case, a science and technology park acts as a connector between distinct entrepreneurial ecosystems. In other different settings, policymakers may have to assign this role to others in the ecosystems without science and technology parks.

4.6.3 Limitations

Nonetheless, based on this case study, there are some limitations that we should be aware of. First, because the study is based on entrepreneurs affiliated with Northern Science Park, it cannot represent the entire population of entrepreneurs in every industry existing in the Chiang Mai entrepreneurial ecosystem. Second, the scope of this study was limited to one science and technology park within a single entrepreneurial ecosystem in an Asian country. More research is needed to fill the gaps before this conclusion can be generalised.

4.6.4 Future perspectives

The lesson learned from the case study is that a science and technology park can play an important role in a developing entrepreneurial ecosystem and can be used as a working hypothesis in future research. In addition, a multiple-case study design in different entrepreneurial ecosystems that have other different settings may elaborate our hypothesis further.

The results also emphasise the significance of entrepreneurial culture, particularly in a developing entrepreneurial ecosystem, although the processes by which a science and technology park affects the growth of entrepreneurial culture are yet unknown. Future research may elaborate on this evolution further. Moreover, we still cannot generalise that entrepreneurial culture development is the key to developing entrepreneurial ecosystems in other different settings. Future research may also address these evolutions in other different entrepreneurial ecosystem settings including the one without a science and technology park.

Chapter 5 Science and Technology Park in Developing Entrepreneurial Culture

5.1 Abstract

Policymakers commonly attempt to shape an entrepreneurial ecosystem through entrepreneurial policy and instruments, especially in a developing entrepreneurial ecosystem, to promote entrepreneurship and economic growth in the regions. Therefore, the understanding of how entrepreneurial ecosystems emerge and what are the fundamental elements that create a condition for the entrepreneurial ecosystem to grow further is important to policymakers. While the entrepreneurial ecosystem literature has discussed *entrepreneurial culture* to be part of the fundamental elements and also describes the dimensions of entrepreneurial culture, the understanding of how to develop an entrepreneurial culture within entrepreneurial ecosystems or who might play the role to shape entrepreneurial culture is poorly understood. Science and technology parks are designed to nurture high-growth startups through incubation programs, shared infrastructure, support services, and networking connections, particularly the links to universities, therefore, they are often recognized to be part of support infrastructure and services elements in the entrepreneurial ecosystem literature. However, there is a lack of knowledge of how science and technology parks may affect cultural elements in the entrepreneurial ecosystem. This paper illustrates, through a case study of the Northern Science Park in Chiang Mai, Thailand, how a science and technology park may impact the entrepreneurial culture in a developing entrepreneurial ecosystem context. The four-dimensional framework of entrepreneurial culture development is introduced to demonstrate how a science and technology park helps to develop the entrepreneurial culture in an entrepreneurial ecosystem, including *(1) inspiring new entrepreneurs; (2) encouraging an entrepreneurial mindset; (3) embedding supportive culture; and (4) synergizing entrepreneurial support organisations*. Furthermore, the findings highlight that the science and technology park plays two important roles as *an ecosystem leader* and as *an ecosystem connector* to address the challenges of the entrepreneurial ecosystem evolution such as a weak network of entrepreneurial support organisations and a lack of entrepreneurial resources.

5.2 Introduction

The literature focuses primarily on the entrepreneurial ecosystem's elements and largely misses the causal linkages of the elements, as well as a lack of evidence-based investigations (Malecki,

2018). It is required to look beyond the list of attributes to comprehend how the entrepreneurial ecosystem emerges (Auerswald, 2015). A distinction between fundamental and optional elements is necessary, as well as a clear explanation of the role of the government and other entrepreneurial support organisations in policy development (Stam, 2015). Besides, many previous studies have focused on well-developed entrepreneurial ecosystems, ignoring the evolution of developing entrepreneurial ecosystems with limited entrepreneurial resources (Alvedalen and Boschma, 2017). It is unclear how a region lacking in entrepreneurial resources can gather momentum and emerge as an entrepreneurial ecosystem; nevertheless, this does not imply that only a region with rich entrepreneurial resources can nurture a vibrant entrepreneurial ecosystem (Harima, Harima and Freiling, 2021). A region without such resources at the inception may obtain them through resource injections, such as a financial injection on a specific type of technology, funding for the development of business incubators, or the attraction of transnational entrepreneurs (Harima, Harima and Freiling, 2021; Roundy, Bradshaw and Brockman, 2018). However, the understanding of which resources can be injected and how they influence the institutional ecosystem conditions to generate momentum for entrepreneurial ecosystem evolution is limited (Harima, Harima and Freiling, 2021).

Even though entrepreneurship is viewed as a highly autonomous and independent behaviour, people's actions are influenced by society and cultural organisations (Aoyama, 2009). A culture that encourages entrepreneurship or entrepreneurial culture has always been regarded as a part of the entrepreneurial ecosystem's elements (Feld, 2012; Stam, 2015; Spigel, 2017; Isenberg, 2011; WEF, 2013) and it has been recognized as one of the fundamental elements that help create a context for other elements to emerge within the ecosystem (Stam, 2015; Spigel, 2017), particularly in the beginning of the entrepreneurial ecosystem evolution (Mack and Mayer, 2016).

Although science and technology parks can be considered to play an important role in fostering entrepreneurial ecosystems in some cases (Cohen, 2006; Chen *et al.*, 2020; Germain *et al.*, 2022), it is frequently overlooked in the research on the entrepreneurial ecosystem. In our project, the Northern Science Park in Chiang Mai, Thailand has a considerable influence, notably on the entrepreneurial ecosystem evolution particularly in cultivating entrepreneurial culture. Although it is difficult to transform a firmly rooted culture, the Northern Science Park demonstrates that it is possible to influence social norms surrounding entrepreneurship in less than a decade. The supportive culture is applied not just to entrepreneurs, but also to entrepreneurial support organisations in the entrepreneurial ecosystem, which induce the collaboration between entrepreneurs and organisational actors. The coherence in collaboration across diverse entrepreneurial support organisations enables the Northern Science Park to have a greater impact while reducing redundancy among the ecosystem's actors. In addition, the literature on the

entrepreneurial ecosystem has highlighted the role of the government as a feeder or a supporter while entrepreneurs should play a leadership role in the ecosystem (Isenberg, 2011; Feld, 2012). According to the findings of this study, when entrepreneurs fail to lead the entrepreneurial ecosystem, particularly in a developing entrepreneurial ecosystem, there is still a case for government intervention, with a science and technology park functioning as a necessary leader of the ecosystem in this respect.

Although the literature on the entrepreneurial ecosystem has acknowledged the importance of entrepreneurial culture (Cohen, 2006; Isenberg, 2011; Feld, 2012; WEF, 2013; Spigel, 2017), which is difficult to change and takes time (van Rijnsoever, 2020), it has not yet provided understanding on how entrepreneurial culture emerges, who may play a role in shaping the culture, and how they do so (Roundy, 2017a). Furthermore, the literature on incubation has mostly focused on how incubator organisations enhance the business performance of startups (Eveleens, van Rijnsoever and Niesten, 2017). These two gaps prevent us from fully understanding how entrepreneurial support organisations, such as science and technology parks, may effectively overcome a lack of entrepreneurial culture in entrepreneurial ecosystems. This article fills gaps by studying the links between science and technology parks and entrepreneurial ecosystems, as well as investigating how science and technology parks can develop an entrepreneurial culture to create conditions for developing entrepreneurial ecosystems to grow.

To answer the question, a case study was conducted in Chiang Mai, Thailand. The entrepreneurial ecosystem in Chiang Mai is unique, as the Northern Science Park has taken a proactive role to foster the entrepreneurial ecosystem regarding prior findings in the project. The paper is structured as follows. First, it presents discussions on entrepreneurial culture in entrepreneurial ecosystem literature, followed by the impact of science and technology parks in entrepreneurial ecosystem literature. It then introduces the case study of Chiang Mai's entrepreneurial ecosystem in Thailand and discusses how the Northern Science Park fosters an entrepreneurial culture based on a qualitative study including 32 interviews with a range of ecosystem actors. Lastly, research contributions, implications, limitations, and future perspectives are discussed.

5.3 Literature Review

Entrepreneurship has been studied in various dimensions including the regional dimension, such as industrial districts, innovative milieu, clusters, regional innovation systems, and entrepreneurial ecosystems, all of which address the importance of non-economic factors. Cultural factors are often mentioned in this regard, and the arguments that culture can magnify or mitigate regional economic performance upon entrepreneurial activity have been discussed for several decades

(eg. Baumol, 1968; Leff, 1979), particularly in the literature on regional science and economic geography.

In the context of entrepreneurship, literature frequently discusses Hofstede's dimensions of culture (Hofstede, 1980), including individualism-collectivism, uncertainty avoidance, power distance, and masculinity-femininity which are associated with rates of entrepreneurship (Hayton, George and Zahra, 2002). However, the relationship between culture and rates of entrepreneurship cannot be concluded as there is some evidence showing that the relationships can be altered over time (eg. Shane, 1993; Wennekers *et al.*, 2007). Furthermore, a culture that promotes entrepreneurship can be different, particularly between individualist and collectivist countries (Stephan and Uhlaner, 2010). Even though the literature on culture and entrepreneurship has been described as messy (Hayton and Cacciotti, 2013), a specific type of culture of entrepreneurs that differs from non-entrepreneurs or national culture does exist.

Similarly, the existence and importance of entrepreneurial culture have been recognized in the entrepreneurial ecosystem literature. Nevertheless, the understanding of the impact of entrepreneurial culture and how it might be influenced by which factors are limited. In addition, it is critical for conceptualizing and particularly for policymakers and ecosystem leaders to encourage entrepreneurial activity.

5.3.1 Entrepreneurial Culture

Cohen (2006, p. 3) defines the entrepreneurial ecosystem as *"an interconnected group of actors in a local geographical community committed to sustainable development through the support and facilitation of new sustainable ventures."* The literature focuses on identifying the components of ecosystems (Malecki, 2018) one of which is the culture that is prevalent in the field of entrepreneurial ecosystem literature. Neck *et al.* (2004, p. 204) reveal "culture" as a critical element of the entrepreneurial ecosystem as all of the founders in his study cited culture as an important element and suggest that *"Culture may be the single most important element for a system to develop and also may be the most difficult to replicate and to manage."* Motoyama and Knowlton (2014) have similar comments on a culture that is difficult to change, however, it can be shaped through specific mechanisms through which people interact. The importance of culture has been discussed as fundamental for the evolution of an entrepreneurial ecosystem (Cohen, 2006), particularly in the early phases of ecosystem evolution (Mack and Mayer, 2016). Entrepreneurial culture is also considered to be one of the framework conditions of the ecosystem (Stam, 2015), a context that support the formation of a dense entrepreneurial network (Spigel, 2017), and one of the key success of the entrepreneurial ecosystem (Feld, 2012).

Culture in the entrepreneurial ecosystem literature has a broader meaning than culture as values, beliefs, and expected behaviours shared among a group of people that support entrepreneurship which has been frequently discussed in the entrepreneurship literature, and much research refers to Hofstede's cultural dimensions (Hayton and Cacciotti, 2013). Cultural elements that are often discussed in the literature on the entrepreneurial ecosystem include cultural values that encourage innovation, collaboration, openness and information exchange, tolerance of risk and failure, positive attitude towards entrepreneurship, commitment to the region, and the success stories of entrepreneurship (Isenberg, 2011; Feld, 2012; WEF, 2013; Spigel, 2017). In addition, some authors refer to the geographical landscape and climate that attract entrepreneurs to relocate to the region, and the collective interests and knowledge of the region (Neck *et al.*, 2004; Cohen, 2006). The dimensions of entrepreneurial culture in the entrepreneurial ecosystem literature are concluded in Table 5.1.

Table 5.1 The dimensions of entrepreneurial culture.

Cultural dimensions	Description	Examples
Openness and information exchange	Openness creates trust and transparency within the ecosystem.	Feld (2012)
Collaboration	Social values and culture that promote collaboration among the ecosystem's actors.	Isenberg (2011); Feld (2012)
Commitment to the region	The commitment of the ecosystem's actors, particularly leaders, to develop the entrepreneurial ecosystem.	Feld (2012)
Innovation	Social values and culture that promote innovation, creativity, and experimentation.	Isenberg (2011); WEF (2013); Feld (2012); Spigel (2017)
Tolerance of risk and failure	Social values and culture that normalize risk and failure.	Isenberg (2011); WEF (2013); Motoyama and Knowlton (2014); Spigel (2017)
Positive attitude towards entrepreneurship	Social values and culture that embrace entrepreneurship in the region.	Isenberg (2011); WEF (2013)
Success stories of entrepreneurship	Visible success stories of entrepreneurship in the region.	Isenberg (2011); WEF (2013); Feld (2012)
Geography and climate of the region	The natural landscape and climate of the region that attracts entrepreneurs into the region.	Neck *et al.* (2004); Cohen (2006)

Cultural dimensions	Description	Examples
Collective interests and knowledge of the region	The collective interests and knowledge of the region.	Neck *et al.* (2004); Cohen (2006)

Although several studies have highlighted the importance and dimensions of cultural elements in the entrepreneurial ecosystem, the contribution to how entrepreneurial culture develops and is affected by individuals, organisational actors, and ecosystem-level institutions is still limited (Roundy, 2017a). The literature on the entrepreneurial ecosystem suggests who may play the role in shaping entrepreneurial culture in the entrepreneurial ecosystem as follows. Roundy (2016) and van Rijnsoever (2020) suggest that incubators and accelerators could influence entrepreneurial culture by being places where cultural values and success stories of entrepreneurship can be shaped and communicated through entrepreneurial events. It could be the role of major universities in the ecosystem to promote a culture of respect for entrepreneurship (WEF, 2013). Spigel and Vinodrai (2020) suggest that anchor firms may help promote entrepreneurial culture as they normalize risk-taking and entrepreneurial behaviour as well as inspire potential entrepreneurs. Several authors suggest that it is the role of the government to promote an entrepreneurial culture that can be influenced by policy, campaigns, and regulation (Brown and Mawson, 2019; Spigel and Harrison, 2018; Malecki, 2018; Chen *et al.*, 2020). Roundy (2020) proposes that it is the role of a leader of the ecosystem. Roundy goes on to suggest that the ecosystem leaders are not limited to a single type of entrepreneurial ecosystem participant; rather, it could be entrepreneurs, investors, entrepreneurial support organisations, universities, and others. Spigel (2016) and Harper-Anderson (2018) found that entrepreneurial support organisations are the leaders of the entrepreneurial ecosystem in a case study in Edinburgh, Scotland and a case study in Chicago, Pittsburgh, and Richmond, USA. While Miles and Morrison (2020) discovered that a group of entrepreneurs, government officials, and university members acting as leaders in the Research Triangle ecosystem in North Carolina, USA.

Despite multiple studies suggesting who may affect entrepreneurial culture in the entrepreneurial ecosystem, it is unclear how various individuals or institutional actors may contribute to entrepreneurial culture in which setting of the entrepreneurial ecosystem.

5.3.2 Science and technology parks

Science and technology parks are the organisations that provide incubation programs, services, and infrastructures for tech startups or academic spin-offs by commercialization technology from the academic sector to the industry sector (AURP, 2022; IASP, 2022; UKSPA, 2019). The role and impact of science and technology parks have been largely overlooked in the entrepreneurial

ecosystem literature. Germain *et al.* (2022) may be the only work to date that empirically and explicitly discussed a science and technology park as a key player in shaping and developing the entrepreneurial ecosystem or playing the role of a manager for the entrepreneurial ecosystem in Södertälje, Sweden. Still, incubators, which are also featured by science and technology parks, are mentioned more often in the entrepreneurial ecosystem literature (eg. Isenberg, 2011; Mason and Brown, 2014; WEF, 2013; Acs *et al.*, 2017; Roundy, 2017c; Spigel, 2017; Spigel and Vinodrai, 2020; van Rijnsoever, 2020). Incubators are often recognized as part of important elements in the entrepreneurial ecosystem literature such as support services or intermediaries (Cohen, 2006; Spigel, 2017; Stam, 2015), and support infrastructure (Isenberg, 2011; WEF, 2013). In addition, incubators also provide financial support, mentoring, and networking for entrepreneurs (Roundy and Bayer, 2019) which are also important elements in the entrepreneurial ecosystem. Science and technology parks are expected to have similar but broader effects on the entrepreneurial ecosystem than incubators due to the wider scope of support mechanisms as well as the connection with universities.

Although incubators are recognized to be part of the entrepreneurial ecosystem, the literature has not widely discussed how incubators might affect the entrepreneurial ecosystem (Brown and Mawson, 2019; Kansheba and Wald, 2020). However, the relationship between incubators and entrepreneurial culture has been discussed tacitly in the entrepreneurial ecosystem literature. Mason and Brown (2014) mentioned that incubators may motivate individuals to pursue entrepreneurship and they also promote networking and collaboration between the ecosystem's actors. Motoyama *et al.* (2016) find in the study of the Chattanooga ecosystem that a venture incubator, Lamp Post Group, has the vision to create an environment of possibility to encourage entrepreneurship in the ecosystem. Roundy (2016) has a theory that narratives may be used to transmit the ecosystem's culture and gain attention for the ecosystem through the success stories of entrepreneurship. Roundy goes on to suggest that incubators that host entrepreneurial events are vital to the health of an ecosystem because they serve as a meeting place for ecosystem actors to interact through narratives. Roundy, Brockman and Bradshaw (2017) suggest that incubators improve the coherence of the entrepreneurial ecosystem by exposing ecosystem actors to two logics: an entrepreneurial-market logic (a linked set of behaviour on innovation, entrepreneurial mindset, tolerance for uncertainty, and failure) and a community logic (an emphasis on community trust and collaboration). In a case study of the Waterloo entrepreneurial ecosystem, Spigel (2017) finds that Communitech, a non-profit entrepreneurial support organisation, benefits from the Waterloo ecosystem's entrepreneurial culture while also reproducing it. Limited studies have been discussed on the relationship between science and technology parks and entrepreneurial ecosystems, particularly the influence on entrepreneurial

culture. In our project, the Northern Science Park increases the level of cooperation among entrepreneurs and entrepreneurial support organisations and reproduces the entrepreneurial culture. Therefore, this study aims to investigate how a science and technology park might help in overcoming a lack of entrepreneurial culture. Support mechanisms of science and technology parks were classified to study the relationship between entrepreneurial culture and science and technology parks.

van Rijnsoever (2020) identified the support mechanisms of the incubators from the literature including community-building, field-building, peer-coupling, infrastructure support, VC-networking, deal-making, and business-learning. Science and technology parks have a broader area of operation than just incubators, hence the support mechanisms are more diverse. Therefore, the incubator support mechanisms as described by van Rijnsoever (2020) are unsuitable for this study without adjustments.

In the first adjustment, additional support mechanisms were included to cover the science and technology park's broader operational area regarding the observations in the literature as follows. First, science and technology parks are designed to encourage the flow of knowledge and technology among universities and private firms by acting as intermediary organisations. The interactions between entrepreneurs and university researchers, while the science and technology park acts as an intermediary, are part of the support mechanisms of the science and technology parks. Furthermore, science and technology parks often encourage university spinoffs, which might be founded by university students or researchers. Therefore, the interactions through which science and technology park establishes university-industry links or promotes university spinoffs should be included as science and technology park support mechanisms that we referred to in our study as 'university-networking'. Second, the ownership structure of science and technology parks can be public, private, university, public-private, university-public, university-private, or university-public-private (Ng *et al.*, 2019). In this project, a public-owned science and technology park often works closely with entrepreneurs, and they do understand the requirements of local entrepreneurs better than the central government. Science and technology park has influenced government policy and funding for entrepreneurship in the ecosystem since it is part of the government body. The connection between a science and technology park and a government should be, therefore, included in the support mechanisms of a science and technology park which we called 'government-networking' in this study. Science and technology parks also act as an intermediary between entrepreneurs and entrepreneurial support organisations. In our project, the science and technology park exchanges information about entrepreneurial projects with entrepreneurial support organisations. Entrepreneurs will be informed about the incoming projects so they can get support if they are qualified. This support

mechanism improves the collaboration between entrepreneurs and entrepreneurial support organisations. Another important finding from this project is that a science and technology park may operate as an ecosystem leader, coordinating with other entrepreneurial support organisations in the entrepreneurial ecosystem which help utilize overall resources to support entrepreneurs more effectively. For example, entrepreneurial projects from various organisations are less redundant and more focused since they shared projects information or even planning projects with the science and technology park. Therefore, we include this connection in the support mechanisms of science and technology parks and called 'entrepreneurial support organisations-networking'.

The second adjustment, missing ecosystem actors that are correlated with each support mechanism was included. The original framework by van Rijnsoever (2020) focuses solely on the financial support network, whereas our study focuses on the entrepreneurial culture that is associated with wider actors in the ecosystem. For example, incubated entrepreneurs, in the business-learning support mechanism, also have a chance to meet with successful entrepreneurs who join their class to share their business knowledge and experience, some experienced entrepreneurs are mentors for incubated entrepreneurs, and some successful entrepreneurs may become role models for these incubated entrepreneurs. In infrastructure support, the interaction between VCs and entrepreneurs is excluded and the result of research by van Rijnsoever (2020) also confirms that the correlation is not significant. Although the deal-making mechanism does not have a significant correlation with the ties among entrepreneurs or the ties between entrepreneurs and VCs (van Rijnsoever, 2020), we expect that it might help build trust between entrepreneurs and science and technology park as well as VCs and science and technology park who help facilitate the negotiation.

In the final adjustment, support mechanisms were combined if related ecosystem actors are identical, or if the purposes of support mechanisms are related. The peer-coupling mechanism was merged into the business-learning mechanism as both are related to the formal interaction among incubated entrepreneurs and both of which aim to develop the business further. While infrastructure support was merged into community-building because these mechanisms allow incubated entrepreneurs to develop informal relationships. Deal-making was combined with VCs-networking which shares similar interaction between entrepreneurs and VCs. As a result, seven support mechanisms of science and technology parks and related ecosystem actors are summarized in Table 5.2.

Table 5.2 Science and technology park support mechanisms.

Support mechanisms	Description	Related ecosystem actors
Business-learning	Providing business-related knowledge for incubated entrepreneurs (coaching, mentoring, consulting, training)	Incubated entrepreneurs – Successful entrepreneurs, Mentors, Role models
Community-building	Building community within the science and technology park (co-working, social events)	Among incubated entrepreneurs
Field-building	Building relationships between incubated entrepreneurs and firms in the same field/industry outside the science park (networking and social events)	Incubated entrepreneurs – Non-incubated entrepreneurs
VC-networking	Bridging between incubated entrepreneurs and VCs (referrals, encouragement, introductions, providing advice, assisting in negotiation)	Incubated entrepreneurs – VCs
University-networking	Bridging between entrepreneurs and universities (co-research, licensing, spinoffs)	Entrepreneurs – University
Government-networking	Influencing entrepreneurial policy	Science and technology park – Government
Entrepreneurial support organisation-networking	Coordinating among entrepreneurial support organisations as a leader Bridging between entrepreneurs and entrepreneurial support organisations	Science and technology park – Entrepreneurial support organisations, Entrepreneurs – Entrepreneurial support organisations

Source: Adapted from van Rijnsoever (2020)

5.4 Research Methodology

5.4.1 Research questions

The literature on the entrepreneurial ecosystem has failed to describe the role of science and technology parks in the entrepreneurial ecosystem. Our project reveals that science and technology parks might play a leading role in the developing entrepreneurial ecosystem and shaping the entrepreneurial culture. Culture is considered one of the important elements, particularly in the beginning phase of ecosystem evolution (Mack and Mayer, 2016). While the ecosystem in Chiang Mai has the potential to become one of the vibrant entrepreneurial ecosystems, it is still developing and not yet self-sustaining. StartupBlink (2021) reveals the best

startup ecosystems by countries and cities in the Global Startup Ecosystem Index 2021, Thailand is placed 50th in the top 100 countries. While in the top 1,000 cities, Thailand has 4 cities in the ranking including Bangkok, which is ranked 71st, Chiang Mai, which is ranked 397th, Phuket, which is ranked 442nd, and Pattaya, which has recently joined the rankings for the first time, which is ranked 833rd. Although Chiang Mai is ranked 2nd in Thailand, a significant difference in global rankings suggests that Bangkok's ecosystem is still substantially stronger than Chiang Mai's. The gap difference is also supported by a case study of Chiang Mai and Chiang Rai, Thailand in the Entrepreneurship in Regional Innovation Clusters report by OECD (2021) which found that the Thai government is primarily concerned with the national level, leaving the issue of regional bottlenecks influencing entrepreneurship development unresolved. Moreover, they suggest that there is a need for the necessary regional entrepreneurial ecosystem leadership that brings local stakeholders together to assess and respond to local issues. While OECD (2021) suggested that the Office of Small and Medium Enterprises Promotion might take the lead in Chiang Mai's ecosystem, it was the Northern Science Park that actively performed the role of an ecosystem leader in our project. Therefore, this study aims to investigate how the science and technology park was able to influence entrepreneurial culture in a developing entrepreneurial ecosystem context, research question is proposed as follows:

RQ: How can a science and technology park develop an entrepreneurial culture in a developing entrepreneurial ecosystem?

5.4.2 Research design

This study applied an exploratory case study to investigate how Northern Science Park can influence entrepreneurial culture in the entrepreneurial ecosystem in Chiang Mai, Thailand. Case study research gives real-world data that enables researchers to comprehend social phenomena (Eisenhardt, 1989). Because the entrepreneurial ecosystem is frequently viewed as a complex system, inductive qualitative approaches are appropriate for several reasons (Roundy, Bradshaw and Brockman, 2018). First, members in the ecosystem interact to exchange knowledge, values, and culture through narrative and discourse communication where the qualitative methods are effective in capturing such discourse. Second, the flexibility of qualitative methodologies, such as semi-structured interviews and ethnographic observation, and the richness of qualitative data enable researchers to reveal the complexities, such as non-linear dynamics, feedback loops, and multi-level interaction, of the entrepreneurial ecosystem's causal relationship. Finally, existing research has mostly focused on case studies of well-developed entrepreneurial ecosystems, but case studies of developing entrepreneurial ecosystems, which this study intended to explore, are limited.

The entrepreneurial ecosystem in Chiang Mai, Thailand was selected because the Northern Science Park has been active in developing and implementing several initiatives to foster the ecosystem. Therefore, the single-case study represents the critical test of our theoretical proposition (Yin, 2018). Although the main unit of the analysis is the ecosystem level of the city of Chiang Mai, Thailand, the study involved units of analysis of more than one level including organisations and individuals as subunits of analysis. As such, it is an embedded case study design (Yin, 2018). The ecosystem's participants include the Northern Science Park, entrepreneurs, universities, and public and private entrepreneurial support organisations that are related to entrepreneurship in Chiang Mai.

5.4.3 Sampling

The data set from the previous study was used in this project. In the previous project, the roles of the science and technology park in the entrepreneurial ecosystem were explored and all elements in the entrepreneurial ecosystem were examined. However, the entrepreneurial culture is the only element of the entrepreneurial ecosystem that this project focuses on in depth. To understand how the science and technology park influences the entrepreneurial culture, participants were selected to represent a range of entrepreneurial ecosystem actors that have direct relationships with the science and technology park. A sampling technique was not required in this study because all samples in the previous study were re-examined in this project focusing on a single element called the entrepreneurial culture.

5.4.4 Data collection

Since the data set was used from the previous study, there is no need to collect data in this project. In the previous study, the group of participants was chosen to represent different types of ecosystem participants in the entrepreneurial ecosystem in Chiang Mai, Thailand following previous studies (Spigel and Vinodrai, 2020; Spigel and Harrison, 2018; Spigel, 2017). After the initial meeting with our main contact at the Northern Science Park, individuals and entrepreneurial support organisations in Chiang Mai were identified according to the entrepreneurial ecosystem framework. Thereafter, the Northern Science Park kindly helped coordinate and organize the interview with all participants which also increased the response rate significantly.

Online interviews are the majority of the data collection in the previous study. In total, we interviewed 33 participants as shown in Table 5.3. The interview was carried out between 2020 and 2021, and most interviews were conducted with a single participant except only one

interview that was conducted in a group of two from the same organisation. In total, 3,264 minutes of interviews were conducted, each interview lasted between 58 and 173 minutes, with an average of 105 minutes.

Table 5.3 Interview participants.

Participants	**No. of persons**
Startups	6
SMEs	3
Social entrepreneurs	2
Successful entrepreneurs	4
Northern Science Park	8
University	1
Financial support organisation	2
Public entrepreneurial support organisations	4
Private entrepreneurial support organisations	3
Total	**33**

5.4.5 Data analysis

Simultaneous coding (Saldaña, 2013) was engaged to analyse the data including provisional coding followed by causation coding, as shown in Figure 5.1. Nvivo was used to help in the coding process.

First, data collection was initially designed to capture all elements in the entrepreneurial ecosystem in our prior project, therefore, discussions were removed if they were not directly related to the entrepreneurial culture which is our research concern in this study. The data screening in the first phase ensured that the case study maintained clear boundaries and was relevant to the research concern.

Second, provisional coding (Saldaña, 2013) was conducted using two predetermined sets of codes that were derived from the literature on the entrepreneurial ecosystem to classify the dimensions of entrepreneurial culture as illustrated in Table 5.1 and modified from the previous research (van Rijnsoever, 2020) to outline the science and technology park support mechanisms as shown in Table 5.2.

These two sets of codes were simultaneously coded using causation coding (Saldaña, 2013) to examine the interrelationship and causality between the science and technology park support mechanisms and entrepreneurial culture. This method is appropriate for this study since the entrepreneurial ecosystem is complicated, with various causes and multiple outcomes. Thereby, science and technology park support mechanisms were recognized as the causes while the dimensions of entrepreneurial culture were the outcomes regarding the research question.

The codes were then grouped into coherent categories or themes using thematic analysis which constructed a theory of how the Northern Science Park influences the entrepreneurial culture in the developing entrepreneurial ecosystem of Chiang Mai, Thailand as a result.

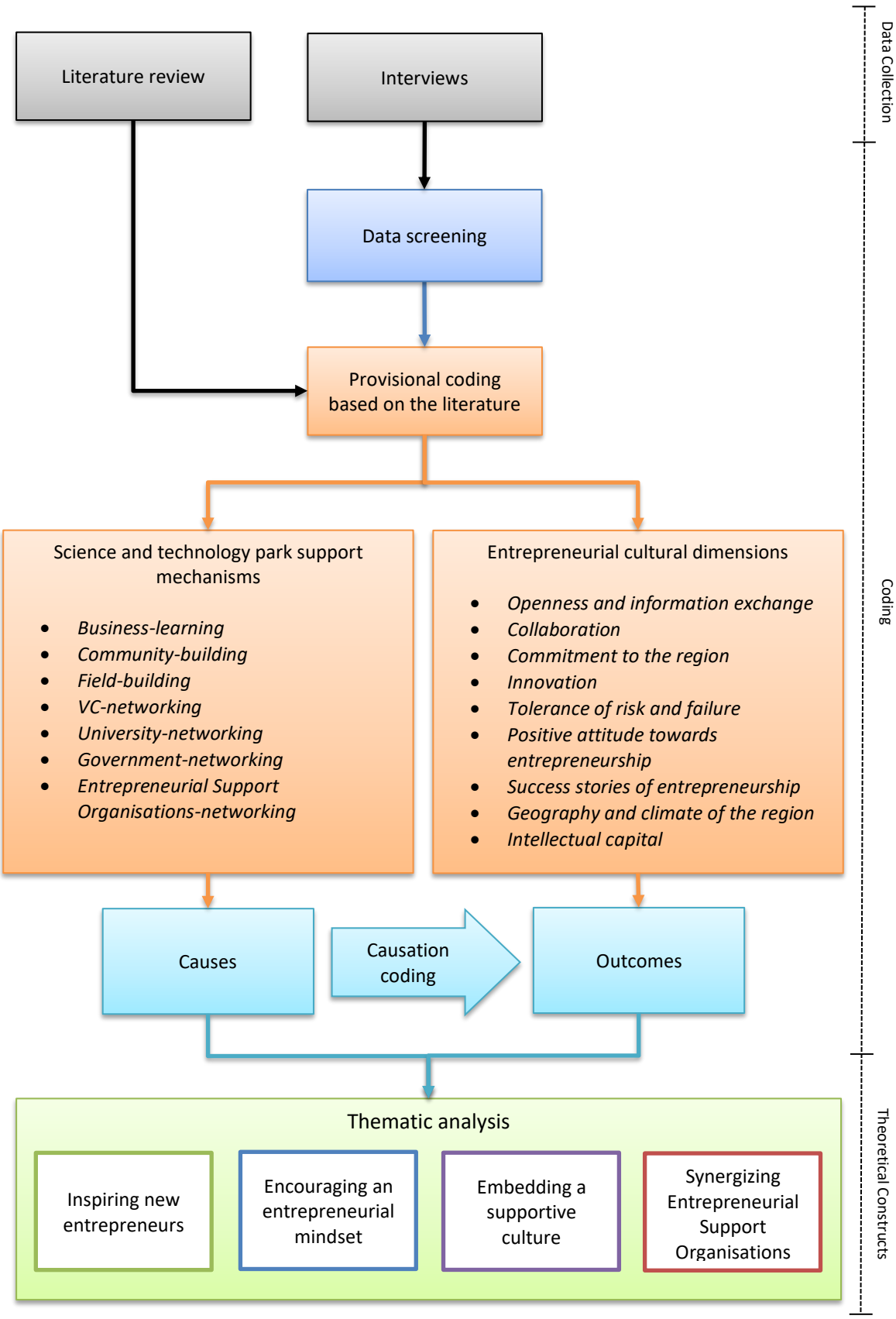


Figure 5.1 Data collection, coding, and analytical processes.

5.5 Findings

This section discusses the findings on how the Northern Science Park influences entrepreneurial culture in Chiang Mai's entrepreneurial ecosystem. The four emerging themes constructed by the thematic analysis include: *(1) inspiring new entrepreneurs; (2) embedding an entrepreneurial mindset; (3) encouraging a supportive culture; and (4) synergizing entrepreneurial support organisations*. A summary of our findings is provided in Table 5.4.

Based on the provisional codes that were derived from the literature, we were able to identify the interrelationship between the support mechanisms of science and technology parks and the dimensions of entrepreneurial culture. However, there are two cultural dimensions including 'geography and climate of the region', and 'collective interests and knowledge of the region' (see Table 5.1) that cannot be fitted into the theoretical construct due to no relevant text to support this study. Moreover, 'public relations' emerged during the coding process as a support mechanism for the science and technology park under the *'inspiring new entrepreneurs'* theme. It is a new project from the science and technology park to spread the success stories of their entrepreneurs through online media. We found that public relations cannot be fitted into our initial provisional codes, and we believe it will be another important mechanism to inspire new entrepreneurs both inside and outside the ecosystem. Although we did not have evidence yet to support that it increases the number of new entrepreneurs in the ecosystem.

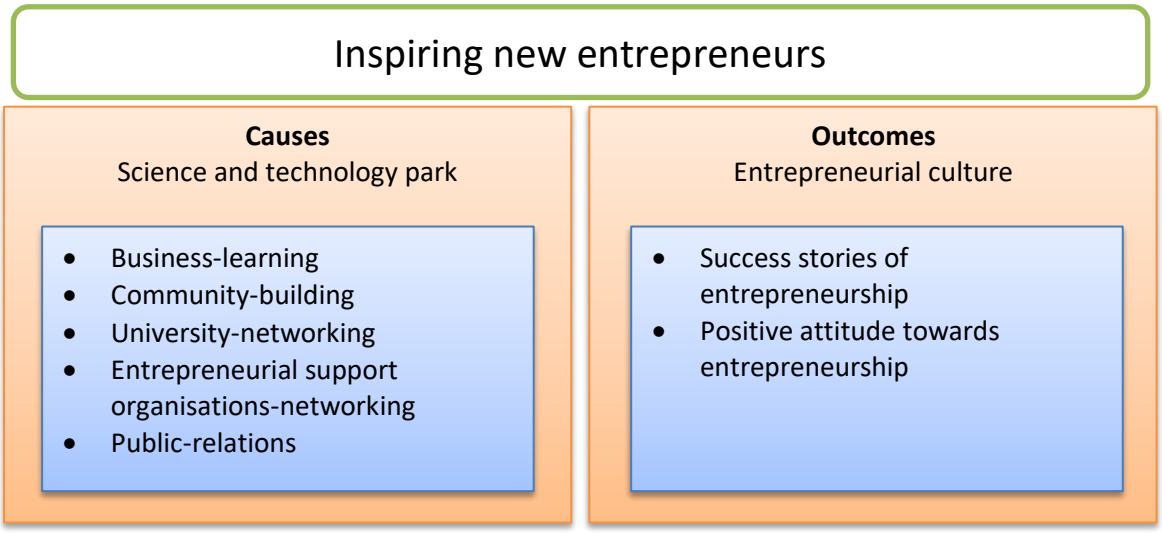


Figure 5.2 Inspiring new entrepreneurs.

Success stories of entrepreneurship are the one of key factors that affect positive attitudes toward entrepreneurship in the ecosystem. Regarding the entrepreneurial ecosystem literature, these two cultural dimensions, success stories and positive attitudes towards entrepreneurship are required to inspire or attract new entrepreneurs into the ecosystem. A positive attitude

towards entrepreneurship occurs when success stories are shared within the entrepreneurial ecosystem. The Northern Science Park is one of the places where success stories are shared in our findings. It occurs when the Northern Science Park alumni shared their stories with incubated entrepreneurs during the incubation program (business-learning). In addition, it also happens when incubated entrepreneurs (community-building) have informal events such as knowledge sharing. It can happen during the Bootcamp programs for university students (university-networking), and sometimes these successful entrepreneurs were invited to give a talk to non-incubated entrepreneurs in different organisations (entrepreneurial support organisations networking). Furthermore, the Northern Science Park also produces a series of documentaries on YouTube to share the success stories of its alumni with a wider audience (Public relations). In other words, the Northern Science Park targets all kinds of potential and new entrepreneurs through different mechanisms as illustrated in Figure 5.2 utilizing success stories to build a positive attitude towards entrepreneurship and attract new entrepreneurs into Chiang Mai's entrepreneurial ecosystem. STP-p2 told that some successful entrepreneurs (SuccessENT03 and SuccessENT04), who are alumni of the Northern Science Park, gave inspirational talks from their own stories to incubated entrepreneurs during the incubation program or social events within the Northern Science Park and to university students in 3-day Bootcamp projects, and in the MBA program as a special guest. Startup01 is one of the cases of a university student who joined the Bootcamp project and was inspired by the success stories to pursue entrepreneurship. STP-3 also confirms that there are applicants who want to join the Northern Science Park because they have heard success stories from the Northern Science Park alumni every year. Some other success stories, such as the story of SME01, may be told by the Northern Science Park as case studies for entrepreneurs during the process of incubation.

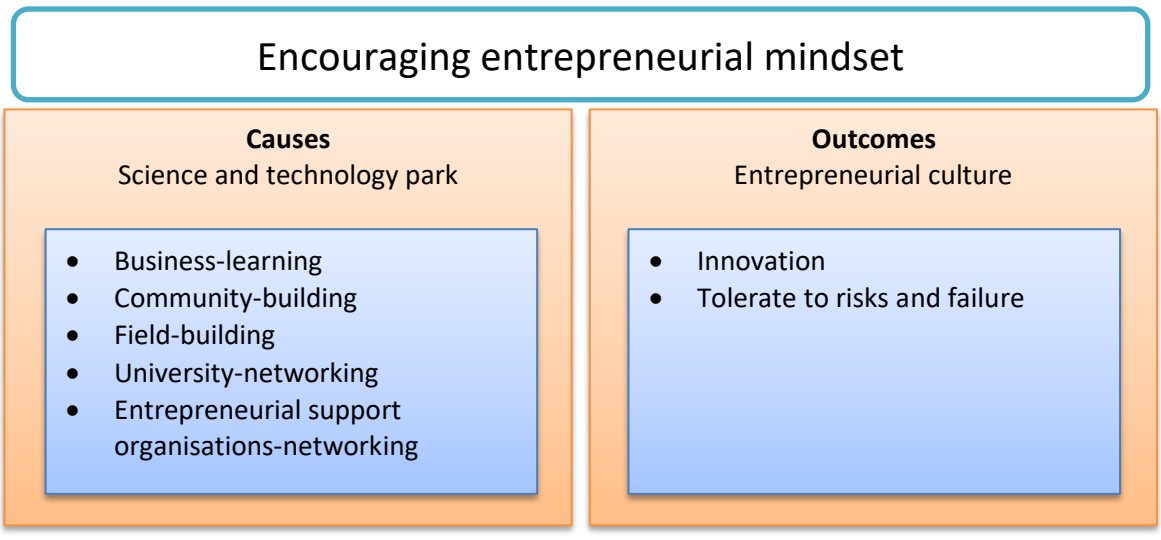


Figure 5.3 Encouraging entrepreneurial mindset.

The next phase after attracting new entrepreneurs into the ecosystem, particularly the Northern Science Park, is to encourage an entrepreneurial mindset. Innovation and tolerance to risks and failure are two cultural values that are involved in this theme. The Northern Science Park is designed to promote collaboration between universities and industry to commercialize innovation and technology. Therefore, the main support mechanism that promotes an innovation culture is the university-networking. "…the Northern Science Park is the symbol of innovation in Chiang Mai…" as told by PublicOrg02. The Northern Science Park promotes an innovation culture among entrepreneurs, university students, and researchers. "Inno night" is a social event held by the Northern Science Park to recognize and award university researchers who have done collaboration projects with the private sector. "Boot camp project" is a platform for university students who have an interest to create startups. Most of them are still in the idea stage that is needed to be improved during the program (business-learning). Therefore, a friendly environment that encourages creativity is the key. "Innovation meets up" is a monthly networking event that the Northern Science Park that will set the topic related to innovation and invite a guest speaker who is an expert to give a talk. Entrepreneurs or anyone outside the Northern Science Park are welcome to join the event (community-building, and field-building).

According to STP-2, the number of university researchers who have partnered with the private sector is growing. The Northern Science Park also has a collaborative research program that helps match entrepreneurs who need to do research and development with the universities (eg. SocialENT02). In some cases (eg. SME01, SME02), the Northern Science Park provides financial support for up to 70% of the research expenditure, reducing risk for entrepreneurs and supporting an innovative culture. Moreover, Northern Science Park also has a talent mobility project that allows university researchers to leave the university and work with private firms for a period. This initiative encourages cooperation while also providing researchers with information that may contribute to improving university education toward market demand or industrial needs.

The findings also show that the Northern Science Park has strong relationships with many entrepreneurial support organisations in the region from both private and public entities which refers to entrepreneurial support organisation-networking. The collaborations between the Northern Science Park and entrepreneurial support organisations occur in many forms. First, the Northern Science Park helps these non-incubated entrepreneurs who are a member of entrepreneurial support organisations (PrivateOrg01 and PrivateOrg02) to connect with universities to do collaborative research or improve the manufacturing processes which also encourages a culture of innovation. Second, entrepreneurial support organisation-networking also strengthens the field-building mechanism as both the Northern Science Park and these

entrepreneurial support organisations are acting as institutions of entrepreneurship. Both the Northern Science Park and entrepreneurial support organisations can help introduce incubated and non-incubated entrepreneurs, therefore, increasing the meeting chances between the two. In conclusion, the Northern Science Park encourages an innovation culture and tolerance to risks and failure for both incubated and non-incubated entrepreneurs with various support mechanisms as shown in Figure 5.3.

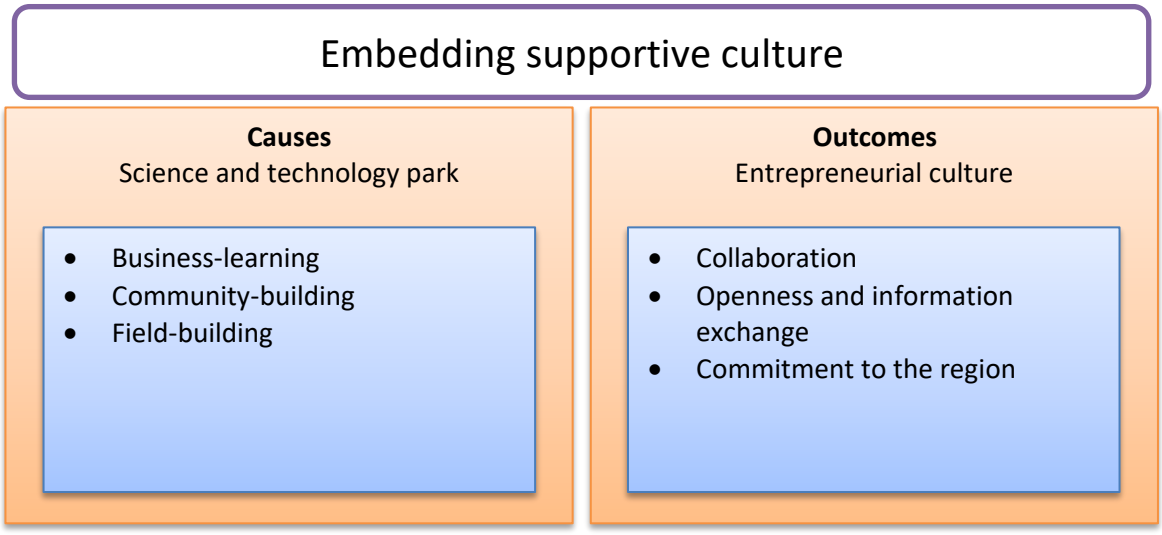


Figure 5.4 Embedding supportive culture.

The first two themes are directly involved with the cultural dimensions for individuals to become entrepreneurs. The third theme is still focused on entrepreneurs, but it represents the process that enables a supportive environment for entrepreneurship and the ultimate goal of the theme is to enable the 'regenerative feedback' that will help the entrepreneurial ecosystem to become self-sustain. Successful entrepreneurs will remain in the ecosystem to help out a new round of entrepreneurship as mentors, and angel investors. Their knowledge, experience, and resources will be passed on down the generations. This theme involved cultural dimensions including collaboration, openness and information exchange, and commitment to the region. The results show that the Northern Science Park increases the collaboration among incubated entrepreneurs through business-learning and community-building; between incubated and non-incubated entrepreneurs through field-building.

Through business-learning, incubated entrepreneurs will be trained with business knowledge during the incubation program where they have a chance to know each other in the classes. Multiple groups of entrepreneurs will be assigned to coaches and mentors in the later stages. This mechanism increases the chances of collaboration among incubated entrepreneurs, particularly ones that are in the same group. In many cases, mentors may recommend entrepreneurs to collaborate if it is beneficial to all parties.

The community-building mechanism includes office spaces and shared facilities for incubated entrepreneurs which help increase the chance of meetings among entrepreneurs, entrepreneurial activities, and social events within the Northern Science Park that encourage them to interact with each other such knowledge sharing sessions, a new year party that entrepreneurs who are the alumni will be invited to join the party. The community of the Northern Science Park encourages entrepreneurs to exchange ideas has been confirmed by several incubated entrepreneurs such as Startup05, and SME01. Startup01 further supports the culture of collaboration between incubated entrepreneurs. He said that he used to hold a knowledge-sharing session and he asked other startups to help organize and use the facilities at the Northern Science Park. In return, he invited startups who helped him to join the sessions. The community-building mechanism helps them to develop an informal relationship.

The field-building mechanism increases the collaborations between incubated and non-incubated entrepreneurs. STP-p1 and STP-p2 told that startups and SMEs are different in the way they do their businesses and normally do not collaborate across the groups, for example, a group of incubated startups in the Northern Science Park and a group of non-incubated SMEs who are a member of the industrial promotion centre. The Northern Science Park encourages collaboration between these groups because they believe that both can learn from each other. For example, SMEs can learn how to use technology to improve their businesses from startups while startups can get market insights and case studies from SMEs. This also encourages openness and information exchange across all types of entrepreneurs, as well as the development of trust, which will lead to greater collaboration or partnership in the future.

Finally, the commitment to the region is important for successful entrepreneurs who might return to the ecosystem as role models to inspire others to pursue entrepreneurship through their success stories or help new entrepreneurs as mentors, or angel investors. As STP-p2 shared that “There is a return of successful entrepreneurs who graduated from our incubation program but not all of them. It depends on their mindset that they would like to share and help the community of entrepreneurs or not.” The results show that all successful entrepreneurs, who are Northern Science Park alumni, have a chance to contribute to the ecosystem, however, the level of contributions is varied. To develop the ecosystem, SuccessENT03 collaborates closely with the Northern Science Park management team. She helps the Northern Science Park in refining the incubation program and is also one of the Northern Science Park’s mentors. While SuccessENT04 contributes to the ecosystem by giving an inspirational talk and coaching university students in a 3-days Bootcamp project. SuccessENT01, who is still based in the Brick, co-working space area of the Northern Science Park, stated that he does not have as many opportunities to participate in entrepreneurial activities as others, but he always opens his office for new entrepreneurs or

students who want to speak with him at the co-working space and sometimes giving an inspiring talk. These successful entrepreneurs are willing to help the Northern Science Park because they have all been supported by the Northern Science Park. As a result, the Northern Science Park has embedded supportive culture for entrepreneurs in the ecosystem through different support mechanisms as depicted in Figure 5.4.

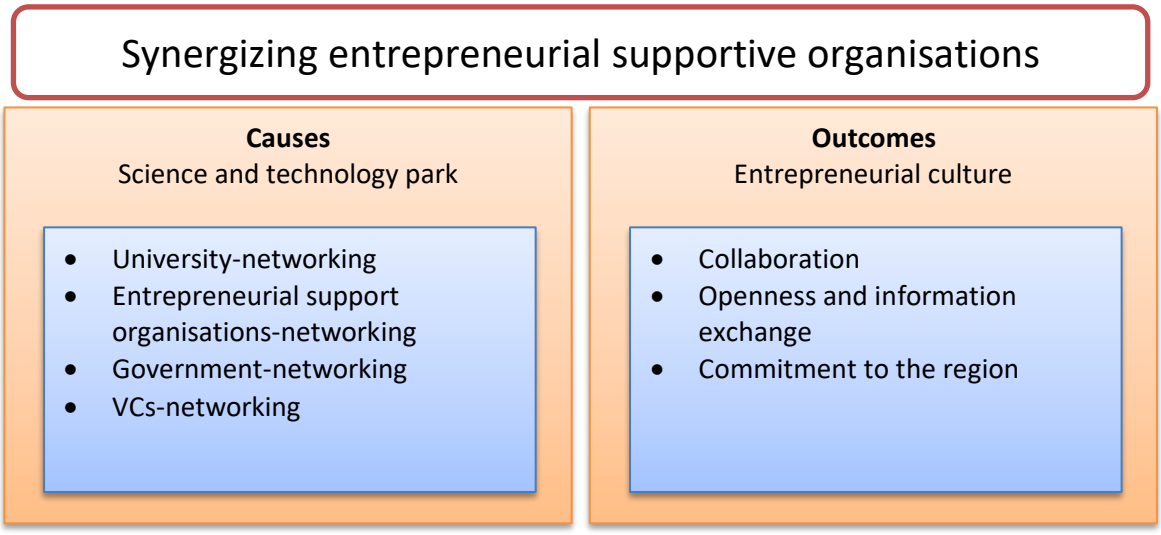


Figure 5.5 Synergizing entrepreneurial support organisations.

While the prior three themes involved entrepreneurs from the start to success and return to the ecosystem, the final theme that has emerged in this study is involved entrepreneurial support organisations. Entrepreneurial support organisations in this theme also include universities, VCs, and the government. To create a significant impact on the entrepreneurial ecosystem, the Northern Science Park alone is insufficient due to limited resources. In our prior study, the Northern Science Park acts as an ecosystem leader that united various support organisations together. The high level of commitment to the region of the Northern Science Parks to develop the entrepreneurial ecosystem has been recognized by; entrepreneurial support organisations, and universities through collaborations among these organisations (entrepreneurial support organisation-networking, and university-networking). Our findings show that the Northern Science Park acts as a consultant for these entrepreneurial support organisations and involve in the planning processes and helps create entrepreneurial projects which reflect the level of trust between the Northern Science Park and these entrepreneurial support organisations. Several public organisations similar said that the Northern Science Park influences the way they provide support to entrepreneurs (eg. PublicOrg01, PublicOrg02, PublicOrg03, and PublicOrg04). This also means that the Northern Science Park influences entrepreneurial policy indirectly through entrepreneurial support organisations as they must defend the projects, that the Northern Science Park helps them develop, to get public funds for the projects from the government.

Moreover, the Northern Science Park also offers a course for innovation managers to train staff within these support organisations. The initiative not only builds a relationship between the Northern Science Park and entrepreneurial support organisations but also among entrepreneurial support organisations during the training. The Northern Science Park increases the coherence among entrepreneurial support organisations, reduces the redundancy in entrepreneurial projects among organisations, and creates more impact on the ecosystem as a result. The high level of collaboration among these support organisations also shows the level of commitment to supporting entrepreneurship in the region.

The government also recognized the outstanding performance of the Northern Science Park (government-networking). For example, STP-1 reveals that the Northern Science Park will invite successful entrepreneurs who are their alumni when the government agency visits the Northern Science Park to present their success stories and speak for the Northern Science Park on how they generate an impact on Chiang Mai's ecosystem. Success stories of entrepreneurship in the Chiang Mai ecosystem and the commitment to the region of the Northern Science Park also build trust for the government. STP-3 adds that the success stories also help increase the success rate of the Northern Science Park in bidding on entrepreneurial projects with entrepreneurial support organisations because they have trust in the Northern Science Park. As a result, the amount of public funds for entrepreneurship in Chiang Mai's ecosystem has increased over the years. The fact that the Northern Science Park has many success cases also help attracts VCs as STP-1 told that VCs are now scouting for new potential startups and the Northern Science Park is one of the places where they want to collaborate or sign an MoU. In conclusion, the Northern Science Park acts as an ecosystem leader and synergizes entrepreneurial support organisations through various networking mechanisms as illustrated in Figure 5.5.

Table 5.4 A summary of the findings: mechanisms of cultural change in entrepreneurial ecosystems.

Related actors (within and between the ecosystems)	Science and technology park support mechanisms	Entrepreneurial cultural dimensions	Themes
• Incubated entrepreneurs – Successful entrepreneurs, Mentors, Role models	• Business-learning	• Success stories of entrepreneurship • Positive attitude towards entrepreneurship	• **Inspiring new entrepreneurs**
• Among incubated entrepreneurs	• Community-building		
• Entrepreneurs – University	• University-networking		

Related actors (within and between the ecosystems)	Science and technology park support mechanisms	Entrepreneurial cultural dimensions	Themes
• Entrepreneurs – Entrepreneurial support organisations	• Entrepreneurial support organisations-networking		
• Science and technology park – Potential entrepreneurs	• Public-relations		
• Incubated entrepreneurs – Successful entrepreneurs, Mentors, Role models	• Business-learning	• Innovation • Tolerate risk and failure	• **Encouraging entrepreneurial mindset**
• Among incubated entrepreneurs	• Community-building		
• Incubated entrepreneurs – Non-incubated entrepreneurs	• Field-building		
• Entrepreneurs – University	• University-networking		
• Entrepreneurs – Entrepreneurial support organisations	• Entrepreneurial support organisations-networking		
• Incubated entrepreneurs – Successful entrepreneurs, Mentors, Role models	• Business-learning	• Collaboration • Openness and information exchange • Commitment to the region	• **Embedding supportive culture**
• Among incubated entrepreneurs	• Community-building		
• Incubated entrepreneurs – Non-incubated entrepreneurs	• Field-building		
• Science and technology park – University	• University-networking	• Collaboration • Openness and information exchange • Commitment to the region	• **Synergizing Entrepreneurial support organisations**
• Science and technology park – Entrepreneurial support organisations	• Entrepreneurial support organisations-networking		
• Science and technology park – Government	• Government-networking		
• Science and technology park – VCs	• VCs-networking		

5.6 Discussion

Our empirical findings confirm that the science and technology park can have an impact on the entrepreneurial culture, particularly in a developing entrepreneurial ecosystem. To develop a

theoretical construct describing how the science and technology park has an impact on entrepreneurial culture, we conducted 31 interviews with a range of actors in the ecosystem, and the initial data analysis applied existing entrepreneurial cultural dimensions derived from the literature. All science and technology park support mechanisms in this study are related to entrepreneurial cultural dimensions and intertwined with each other which means that most support mechanisms associate with more than one cultural dimension. Besides, public relations was the support mechanism that emerged during the coding process which can help facilitate spurring success stories of entrepreneurship to a broader audience which is similar to what Cohen (2006) discussed about the role of media that helped raise success in tackling environmental issues in Victoria, British Columbia. Nevertheless, two entrepreneurial cultural dimensions were not affected by the science and technology park in our study including the *geography and climate of the region*, and *the collective interests and knowledge of the region* (see Table 5.1). Figure 5.6 shows a conceptual framework for the science and technology park to develop the entrepreneurial culture in four dimensions including *(1) inspiring new entrepreneurs; (2) encouraging an entrepreneurial mindset; (3) embedding supportive culture*; and *(4) synergizing entrepreneurial support organisations*.

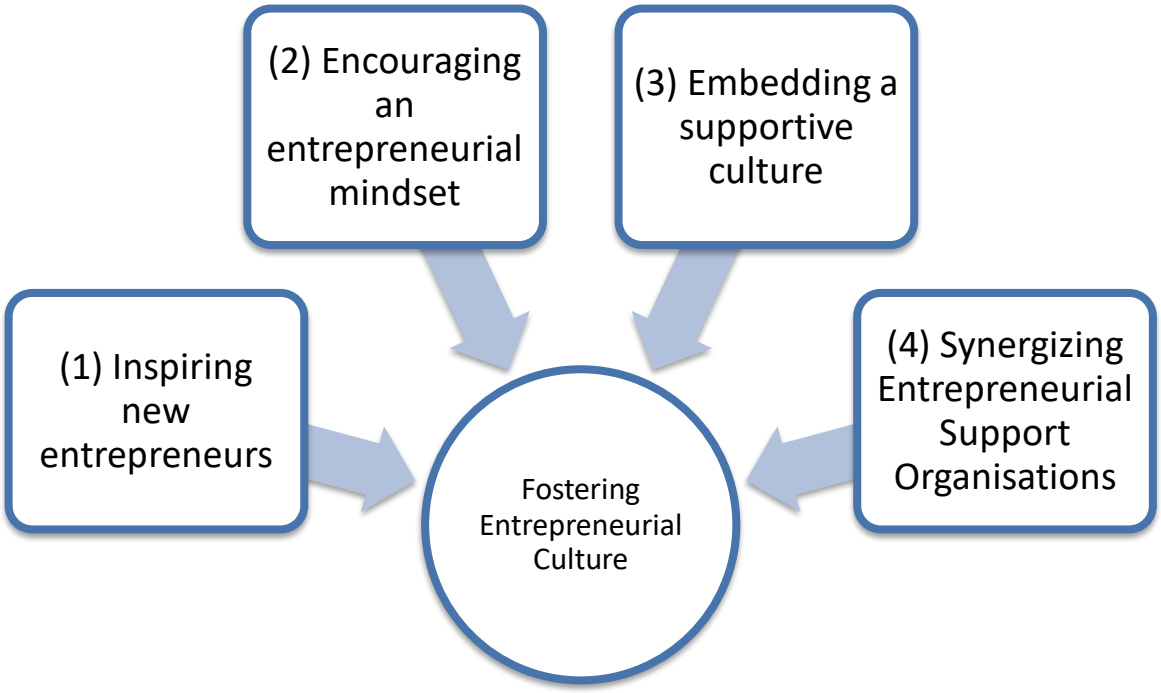


Figure 5.6 The entrepreneurial culture development model for science and technology parks.

As suggested by Roundy (2016) and van Rijnsoever (2020), incubators and accelerators do shape entrepreneurial culture through entrepreneurial events where cultural values and success stories can be communicated. In our case study, a similar phenomenon can be observed in the Northern

Science Park, and we classified them into two dimensions: (1) *inspiring new entrepreneurs*, and (2) *encouraging an entrepreneurial mindset*.

The first dimension of the entrepreneurial culture development model is to increase the number of new entrepreneurs in the entrepreneurial ecosystem by influencing entrepreneurial culture to create a *positive attitude towards entrepreneurship* by introducing *success stories of entrepreneurship* to inspire new entrepreneurs. Based on our case study, incubated entrepreneurs, university students, and university researchers were exposed to success stories of entrepreneurship through business-learning, community building, and university networking support mechanisms where the Northern Science Park was the host of the entrepreneurial events. In addition, the Northern Science Park also produced a series of a documentary about their success cases on YouTube which help attract potential entrepreneurs even if they are not inside the ecosystem's boundary.

The second dimension of the entrepreneurial culture development model is to increase the survival rate of new entrepreneurs by influencing entrepreneurial culture to encourage an entrepreneurial mindset including *innovation, tolerance of risk, and failure* as related cultural dimensions. Entrepreneurs were exposed to various actors and organisations through business-learning, community-building, field-building, university-networking, and entrepreneurial support organisations-networking support mechanisms including incubated and non-incubated entrepreneurs, successful entrepreneurs, mentors, role models, universities, and entrepreneurial support organisations where the environment in which the tolerance for failure in entrepreneurship is high encouraging entrepreneurs to take more risk, particularly in collaborative research with universities to create innovation.

The third dimension of the entrepreneurial culture development model is to increase the chance that successful entrepreneurs will remain in or return to the entrepreneurial ecosystem to support new entrepreneurs is to embed supportive culture including cultural dimensions such as following, *collaboration, openness, and information exchange, and commitment to the region*. Their expertise and experience are valuable to new entrepreneurs who follow the same path, and their success stories also help inspire others. The phenomena which can be observed in a strong and self-sustaining ecosystem and have been discussed in the entrepreneurial ecosystem literature as the *recycling of entrepreneurial resources* where successful entrepreneurs tend to remain or return and contribute to the region as angel investors, serial entrepreneurs, dealmakers, or advisors (Spigel and Harrison, 2018). Their valuable experience, entrepreneurial knowledge, and financial resources flow back into the ecosystem. Based on our case study, entrepreneurs who are alumni of the Northern Science Park, SME03, Start-up02, and

SuccessENT03 became angel investors or venture builders. SuccessENT02, SuccessENT03, and SuccessENT04 were three of four successful entrepreneurs who had already given mentorship to new entrepreneurs in the ecosystem. Even incubated entrepreneurs who are still in the incubation program said that they are willing to help new entrepreneurs when they have a chance, for example, Start-up05, and Start-up06. Although a similar phenomenon, the recycling of entrepreneurial resources, which describes key ecosystem resources, such as mentors, skilled workers, entrepreneurial knowledge, and financial capital, that were once used by successful entrepreneurs and were released to others when they exited the ecosystem (Spigel and Harrison, 2018), we would like to focus on the phenomenon that successful entrepreneurs remain or return to the ecosystem to help new entrepreneurs and create positive feedback loops. As a result, we named this phenomenon *regenerative feedback*, and science and technology parks may stimulate it by embedding a supportive culture for entrepreneurs in the ecosystem.

While the first three dimensions focus on how science and technology parks influence the entrepreneurial culture around entrepreneurs from the start to success, the fourth dimension addresses the culture among entrepreneurial support organisations in entrepreneurial ecosystems. In our case study, the Northern Science Park actively collaborates with other entrepreneurial support organisations in developing Chiang Mai's entrepreneurial ecosystem which is similar to the case of the science and technology park in Södertälje, Sweden which collaborates with other ecosystem stakeholders such as technology firms, academic institutions, and governmental organisations (Germain *et al.*, 2022). We do agree with Germain *et al.* (2022) who suggested that the success of the science and technology park in developing the entrepreneurial ecosystem depends on the level of cooperation among the key stakeholders or entrepreneurial support organisations in this study. We believe that one of the key success factors for the Northern Science Park to cooperate with entrepreneurial support organisations is to share the same culture; values and beliefs shared among groups of organisations that support entrepreneurship in the entrepreneurial ecosystem and the cultural elements included in the fourth dimension are *collaboration, openness and information exchange, and commitment to the region*.

In addition, our findings highlight the important role of the Northern Science Park as *an ecosystem leader and connector* which is aligned with Germain *et al.* (2022) who concluded that the science and technology park in Södertälje, Sweden has a manager role for the entrepreneurial ecosystem and a driver to expand the external networks. In our view, the Northern Science Park in our case study went a step beyond a manager role as they were not only managing cooperation among entrepreneurial support organisations in Chiang Mai's entrepreneurial ecosystem, but they also have an influence on future directions of entrepreneurial support organisations by involving them

in planning the entrepreneurial projects in the beginning. This *ecosystem leader and connector* phenomenon depend on the level of cooperation between the science and technology park and entrepreneurial support organisations in which we believe that they all shared the same culture in supporting entrepreneurship and this did not happen before the Northern Science Park was founded as our data revealed that entrepreneurial support organisations previously stayed in a separate group, and it was the Northern Science Park who brought them together.

Previous literature has attributed incubators, accelerators, and sometimes science and technology parks as part of the support systems or intermediaries that provide physical space and support services to new ventures (WEF, 2013; Isenberg, 2011; Stam, 2015; Spigel, 2017). While the lead role that provides direction and role models is often debated between top-down, government leadership and bottom-up, entrepreneurial leadership (Roundy, 2020; Feld, 2012; Stam, 2015). In terms of balancing the two continuums, the science and technology park as an intermediate leadership might provide the best viable solution found in this study as they do understand the requirements of entrepreneurs in the ecosystem and also understand how the government works in this regard. With the science and technology park as an ecosystem's leader, entrepreneurial support organisations in the ecosystem that used to work separately become more united and shape an ecosystem as an interconnected system. Limited resources from several entrepreneurial support organisations are now more effectively utilized to support entrepreneurial activities in the ecosystem.

A science and technology park may act as *an ecosystem connector* that can draw entrepreneurial resources from outside the entrepreneurial ecosystem to overcome a lack of resources in a developing entrepreneurial ecosystem. In their work, Spigel and Harrison (2018) explained how entrepreneurial resources might flow into or out of ecosystems, with a resilient entrepreneurial ecosystem attracting resources into the ecosystem while a nascent entrepreneurial ecosystem leaks resources out. However, it is unclear how a nascent entrepreneurial ecosystem without rich entrepreneurial resources gains momentum and transforms into a resilient one as literature tends to focus on well-developed and successful entrepreneurial ecosystems (Harima, Harima and Freiling, 2021). One method of overcoming resource shortages is to inject resources into the ecosystem, which appears to be a more effective approach than nurturing them on their own. (Roundy, Bradshaw and Brockman, 2018; Harima, Harima and Freiling, 2021). Resource injection can be viewed as an approach for policymakers to develop a specific entrepreneurial ecosystem, however, little is known about how to inject resources effectively and sufficiently to drive the momentum of entrepreneurial ecosystems to develop further. Against this background, science and technology park as *an ecosystem connector* that can draw on resources that are lacking in the ecosystem such as financial resources (eg. Public funding, business angels, and VCs), human

resources (eg. Successful entrepreneurs, mentors, and advisors), and knowledge resources (universities, research institutions, and professional in marketing, legal, or developer) from other entrepreneurial ecosystems might be a more viable approach for policymakers. As an ecosystem leader, the science and technology park, which understands the needs of entrepreneurs better than outsiders such as policymakers, is also expected to guide the selection of resources by proposing entrepreneurial initiatives to the government.

The roles of the science and technology park as *an ecosystem's leader and connector* also confirm the importance of culture as a foundation of the entrepreneurial ecosystem evolution, particularly in the early phases (Mack and Mayer, 2016; Cohen, 2006; Stam, 2015; Spigel, 2017) as it supports other ecosystem's element to emerge including leadership of the ecosystem, and networks for entrepreneurs to access resources (Stam and Spigel, 2017; Stam, 2015; Spigel, 2017) within and beyond the physical area of the ecosystem.

In this study, we argue that the science and technology park can influence the entrepreneurial culture of both entrepreneurs and entrepreneurial support organisations in the entrepreneurial ecosystem as depicted in the four-dimensional model in Figure 5.6. Moreover, the high level of entrepreneurial culture will stimulate regenerative feedback in the entrepreneurial ecosystem. Second, the science and technology park can act as *an ecosystem leader* to promote collaborations across entrepreneurial support organisations and increase the level of commitment to the region, allowing the ecosystem to better manage limited entrepreneurial resources. Finally, the science and technology park can serve as *an ecosystem connector*, allowing it to draw required entrepreneurial resources from outside the ecosystem to tackle weak ecosystem challenges and drive the ecosystem towards self-sustaining.

5.7 Conclusion

5.7.1 Research contributions

The findings of this case study contribute to the literature and bring attention to the discussions on the role and impact of the science and technology park in the entrepreneurial ecosystem, particularly in entrepreneurial culture development which is still limited (Roundy, 2017a). A theoretical construct was introduced the four-dimensional model for entrepreneurial culture development.

Furthermore, this study revealed the science and technology park's crucial role as *an ecosystem's leader* and *connector* in overcoming weak ecosystem issues such as a weak network of entrepreneurial support organisations and a lack of entrepreneurial resources. It is the second

single-case study to confirm that a science and technology park can serve as a key player, a manager of the entrepreneurial ecosystem, as suggested by Germain *et al.* (2022).

5.7.2 Practical implications

This case study implies that science and technology parks can positively influence the entrepreneurial culture in the entrepreneurial ecosystem. Our four-dimensional model for entrepreneurial culture development is intended to provide insights for science and technology park managers and policymakers to develop the entrepreneurial ecosystem further by enhancing entrepreneurial culture. The model should not be restricted to science and technology parks. The model may be altered to foster an entrepreneurial culture in other contexts with other ecosystem actors acting as leaders, or even in entrepreneurial ecosystems without science and technology parks.

5.7.3 Limitations

A single-case study design can be informative in terms of the mechanisms behind the phenomena, but it has limitations in terms of external validity compared to a multiple-cases study design (Yin, 2018). Each ecosystem has unique characteristics which require different kinds of support to overcome individual challenges, therefore, it is difficult to generalise the case. However, the lesson learned from the case study or theoretical constructs, as a working hypothesis, can be transferable to other cases with similar settings. It is also possible to apply it in other cases with different settings. Future research should investigate more cases in different contexts or conduct a multiple-cases study to offer a comparative perspective and elaborate the theoretical construct further.

This study employed a theoretical sampling to represent diverse viewpoints from different ecosystem actors/organisations based on the attributes of entrepreneurial ecosystems by Spigel (2017) including; entrepreneurs' viewpoints (local startups, SMEs, and successful entrepreneurs); mentors, role models, angel investors viewpoint (successful entrepreneurs); financial support organisation viewpoint, university viewpoint, support services, and physical infrastructure providers viewpoint (science and technology park, public-, and private-entrepreneurial support organisations), policymakers viewpoint (public entrepreneurial support organisations). However, participants in this study were chosen and contacted by the Northern Science Park and the author only gave the Northern Science Park a guideline to ensure that all important groups were included in this research. Therefore, it may have caused bias in the selection of participants.

The research has not investigated the negative influences. Science and technology parks can be seen as a positive intervention in the entrepreneurial ecosystem, but they may have unexpected consequences, even though the goal is to accelerate entrepreneurial activities in the region. Intervention may be useful to some but may be harmful to others, and due to limited knowledge about the negative effects, future research might look at this perspective. This contribution may offer valuable insights for science and technology park managers as well as policymakers to evaluate negative impacts more thoroughly to limit or avoid unintended consequences.

This study uses Northern Science Park as a focal point of the investigation. Northern Science Park has been considered the largest incubator platform in the ecosystem and could be one of the most influential mechanisms to support entrepreneurship in Chiang Mai. Regarding the complex nature of the entrepreneurial ecosystem, distinguishing other influential mechanisms is almost impossible, therefore, this study should not be viewed as conclusive in terms of all elements influencing the entrepreneurial culture in the ecosystem.

5.7.4 Future perspectives

Finally, to have a better understanding of the science and technology park's influence on entrepreneurial culture in the entrepreneurial ecosystem. We recommend that future investigations should be based on what we learned, rather than just recreating this study, and elaborating the theoretical construct further. For example, similar case sampling can be applied to investigate how the theoretical construct in this study works in a similar context but is not identical to this case. On the other hand, extreme case sampling may be used to explore how the theoretical construct operates in a completely different situation, such as a well-developed entrepreneurial ecosystem in a developed country. How does the role and impact of the science and technology park change as the entrepreneurial ecosystem grow stronger? Other entrepreneurial ecosystems may not have science and technology parks in their entrepreneurial ecosystem. Can future research specify the ones who have influential mechanisms on entrepreneurial culture? The four-dimensional model introduced in this paper might be a useful theoretical construct for future entrepreneurial ecosystem research.

Chapter 6 Conclusions

6.1 Project Overview

This PhD thesis aims to explore the relationship between science and technology parks and entrepreneurial ecosystems. The research is based on the premise that while science and technology parks are important in the literature on the regional innovation system, they have been disregarded in the literature on the entrepreneurial ecosystem, which is a related concept to the regional innovation system. Furthermore, the fact that there are hundreds of science and technology parks throughout the world, all of which are meant to nurture high-growth businesses, has led to the presumption that science and technology parks must be related to entrepreneurial ecosystems, which aim to create a supportive environment in which high-growth businesses can thrive. Knowledge of how science and technology parks can contribute to the evolution of the entrepreneurial ecosystem is therefore critical, as it may be replicated in existing science and technology parks across the world.

Three research papers thesis had been designed as a multi-layered study of the relationship between the science and technology parks and the entrepreneurial ecosystem beginning from the broadest perspective and narrowing down to the most critical contribution science and technology parks made to the entrepreneurial ecosystem to understand what role and impact science and technology parks have on the entrepreneurial ecosystem, particularly in a developing one.

The first research paper of this project addressed the lack of a study of science and technology parks in the literature on the entrepreneurial ecosystem (Chapter 3). The purpose of this paper was to lay a theoretical framework for further studies by investigating both science and technology park and entrepreneurial ecosystem literature and developing theories on the conceptual roles of science and technology parks in the entrepreneurial ecosystem. Furthermore, we construct a novel approach to the dynamic of entrepreneurial ecosystems by defining developing and developed entrepreneurial ecosystems and distinguishing them through their unique characteristics.

The second research paper of this project is an empirical study that explored the role and impact of the science and technology park in the developing entrepreneurial ecosystem of Chiang Mai, Thailand (Chapter 4). This paper examined the relationship between the science and technology park and the entrepreneurial ecosystem based on the propositions made in the first research paper. We also developed multiple frameworks in this paper to illustrate the causal relationship

between the elements of the entrepreneurial ecosystem and the science and technology park. Among the contributions that the science and technology park has made to a developing entrepreneurial ecosystem, the entrepreneurial culture is the most important contribution to our case study.

The third research paper aimed to reveal the most significant contribution of the science and technology park to the entrepreneurial ecosystem, as identified in the second research paper which is fostering the entrepreneurial culture (Chapter 5). We reanalysed the same dataset in the second research paper utilizing the dimensions of entrepreneurial culture discovered in the existing literature on the entrepreneurial ecosystem and the support mechanisms of science and technology parks based on the prior study. As a consequence, we created the entrepreneurial culture development model that describes the strategies of science and technology parks to foster the entrepreneurial culture in a developing entrepreneurial ecosystem from a single case study.

As the entrepreneurial ecosystem is a social phenomenon, the three research papers' thesis followed interpretivism in terms of research philosophy. The studies involving various social actors in the ecosystem, as well as the role and impact of the science and technology park identified in this project, were presented in the form of narratives that required the researcher's interpretations to understand the subjective meanings provided by participants. A list of participants was purposefully selected to represent all stakeholders in the ecosystem, including participants from Northern Science Park, startups, SMEs, successful entrepreneurs, social entrepreneurs, public- and private-entrepreneurial support organisations, government agencies, and universities, to describe the current state of the entrepreneurial ecosystem and the role and impact of the science and technology park on each element of the ecosystem. The primary source of data for this project was 31 semi-structured interviews with 33 participants. The average interview session lasts 105 minutes, ranging from 58 to 173 minutes, with a total interview length of 3,264 minutes for the project. To understand the context of the developing entrepreneurial ecosystem of Chiang Mai, Thailand, we also gathered secondary data from documents, websites, and government surveys. In this research project, an abductive method was used. Rather than generating a new theory, the conceptual frameworks produced in this study focus on refining existing theories in the entrepreneurial ecosystem literature. As a result, we employed template code based on existing frameworks in the entrepreneurial ecosystem literature. We also used thematic analysis to arrange the associated codes to construct conceptual frameworks. The project outcomes are presented in the following section.

6.2 Project Outcomes

In the first research paper, we have made several theoretical propositions on the role of science and technology parks in entrepreneurial ecosystems. To accomplish this, we have established two new approaches to viewing the elements of the entrepreneurial ecosystem, the mobility of entrepreneurial ecosystem elements, and the dynamics of the entrepreneurial ecosystem, the characteristics of a developing and developed entrepreneurial ecosystem.

	Immovable elements	Movable elements
Material Attributes	Physical infrastructure[1] Universities[1,3] Policy and governance[6]	Support services[1,5] Target markets[5]
Social Attributes	Networks[4]	Mentors[1,5] Investment capital[2,5] Worker talent[3,5]
Cultural Attributes	Supportive culture[4] Histories of successful entrepreneurship[4]	-

Figure 6.1 The mobility of entrepreneurial ecosystem elements.

Note: Numbers in the figure are the number of propositions related to each element.

The mobility of entrepreneurial ecosystem elements that we introduced in this research paper is based on the assumption that the entrepreneurial ecosystem configurations can vary, and the importance of each element is not equal (Spigel, 2017). We conceptualize that the elements of the entrepreneurial ecosystem can be categorized into two distinct groups according to their mobility which is *movable* and *immovable* (see Figure 6.1). Movable elements are *entrepreneurial ecosystem elements that may be imported or accessed from outside the ecosystem's boundaries and do not need to be located within the ecosystem*. While immovable elements are *entrepreneurial ecosystem elements that must be established within the ecosystem or belong to the specific ecosystem*. The elements of an entrepreneurial ecosystem are based on the attributes of entrepreneurial ecosystems by Spigel (2017) (see Appendix C.1.4). The key point we want to emphasize by separating the elements of an entrepreneurial ecosystem based on their mobility is

that the role of intermediary organisations or the ecosystem's connector must actively facilitate the flow of entrepreneurial resources across diverse entrepreneurial ecosystems. If our conceptualization is valid, we would advise ecosystem leaders or policymakers, particularly for a developing entrepreneurial ecosystem, to focus on establishing immovable elements while the ecosystem's connector regulates the flow of movable elements between different entrepreneurial ecosystems. As a result of this strategy, a developing entrepreneurial ecosystem may develop faster.

Table 6.1 The characteristics of a developing and developed entrepreneurial ecosystem.

Characteristics	**Developing entrepreneurial ecosystem**	**Developed entrepreneurial ecosystem**
Successful entrepreneurs	Low	High
Immovable Elements	Lacking or underdeveloped	Sufficient and well-developed
Movable Elements	Underdeveloped or difficult to acquire from outside the boundary	Well-developed or easy to acquire from outside the boundary
Resource flow	Limited and may leak to other ecosystems	Flow freely and may attract from other ecosystems
Ability to reconfigure ecosystem resources in a productive way	No	Yes
Resilient to the shocks	Low	High

While the dynamics of the entrepreneurial ecosystem presented in this study are based on gaps and limited perspectives in the existing literature. The characteristics of a developing and developed entrepreneurial ecosystem were used to distinguish between the two. The characteristics we used include phenomena that can only be observed in a developed entrepreneurial ecosystem, as well as the earlier introduced concept of the mobility of entrepreneurial ecosystem elements (see Table 6.1). A developing entrepreneurial ecosystem is *an entrepreneurial ecosystem that produces a limited number of successful entrepreneurs and cannot productively reconfigure ecosystem resources*. A developed entrepreneurial ecosystem, in contrast, is *an entrepreneurial ecosystem that produces a substantial number of successful entrepreneurs and the ability to reconfigure ecosystem resources in a productive way which helps the ecosystem to be self-sustainable and resilient to shocks*. We aim to introduce the

entrepreneurial ecosystem dynamics in this manner because we believe that the role and impact of science and technology parks will decrease as the entrepreneurial ecosystem grows stronger.

Table 6.2 Theoretical propositions.

Proposition (P)	**Related Elements**
P-A *The science and technology park plays a disproportionately important role in the entrepreneurial ecosystem's evolution and/or transition stages.*	Entire ecosystems
P-B *The science and technology park's role diminishes as the entrepreneurial ecosystem evolves and/or is relatively stable.*	Entire ecosystems
P-1 *Science and technology parks which provide support services and/or mentorship and/or physical infrastructure for new ventures and/or networking with the universities and/or networking with service providers outside the ecosystem are more likely to make a meaningful contribution to developing entrepreneurial ecosystems.*	Support services, Mentors, Physical infrastructure, Universities
P-2 *Science and technology parks that provide venture capital or network with venture capital investors outside the entrepreneurial ecosystem are more likely to make a meaningful contribution to developing entrepreneurial ecosystems.*	Investment capital
P-3 *Science and technology parks that align the university teaching programs and the industry demand so that the university produces human capital more relevant to the industry are more likely to make a meaningful contribution to developing entrepreneurial ecosystems.*	Universities, Worker talents
P-4 *Science and technology parks that actively promote social connections among entrepreneurs and other ecosystem actors through incubation programs and entrepreneurial events strengthen the cultural and social attributes, particularly in developing entrepreneurial ecosystems.*	Networks, Supportive culture, Histories of successful entrepreneurship
P-5 *Science and technology parks may help speed up the evolution of developing entrepreneurial ecosystems by acquiring movable elements from outside of entrepreneurial ecosystems.*	Support services, Target markets, Mentors, Investment capital, Worker talents
P-6 *Science and technology parks may act as entrepreneurial organisations engaging with policymakers to lobby for new policies to support entrepreneurship, particularly in developing entrepreneurial ecosystems.*	Policy and governance

Theoretical propositions in the first research paper were presented in Table 6.2. Propositions A and B provide the relationship between the science and technology park and the entire entrepreneurial ecosystem. While propositions 1 to 6 provide the relationship between the science and technology park and the elements of the entrepreneurial ecosystem.

The theoretical foundation in the first research paper led us to the design of the second research paper which is a single case study of the Northern Science Park in a developing entrepreneurial ecosystem of Chiang Mai, Thailand. Chiang Mai is considered a developing entrepreneurial ecosystem since it has limited successful entrepreneurs that are defined as high-growth entrepreneurs in the entrepreneurial ecosystem literature. In addition, Chiang Mai also has limited investment capital available for entrepreneurs and still suffers from a brain drain issue. This makes Chiang Mai falls into a developing entrepreneurial ecosystem in our conceptualization (see Table 6.1). Furthermore, the Global Startup Ecosystem Index 2021 by StartupBlink (2021) confirms that Chiang Mai is far behind Bangkok in global rankings.

We chose to examine a single case with a developing entrepreneurial ecosystem since it represents a critical case for our propositions where the science and technology parks will contribute the most to developing entrepreneurial ecosystems. We designed research questionnaires to investigate the interaction between the science and technology park with every element of the entrepreneurial ecosystem. Our participants were chosen in collaboration with the management team of the Northern Science Park to ensure that we included the majority of stakeholders in Chiang Mai's entrepreneurial ecosystem.

The findings show that the Northern Science Park does play an important role as a leader of the ecosystem and contributes significantly to the growth of the entrepreneurial ecosystem of Chiang Mai, particularly in terms of entrepreneurial culture. This result partially supports proposition B in the first research paper. More research on a multiple-cases in various contexts is still needed to confirm our main propositions. In addition, the findings reveal that Northern Science Park has a relationship with every element of the entrepreneurial ecosystem. However, the impact on each element is not equal and some elements have not changed much since the Northern Science Park was founded, such as talented workers due to brain drain issues or a limited demand in Chiang Mai's local markets. Table 6.3 illustrates the complete results for the theoretical propositions in the first research paper from our empirical evidence in the second research paper.

Table 6.3 The results for the theoretical propositions.

Proposition (P)	**Empirical Evidence**
P-A *The science and technology park plays a disproportionately important role in the entrepreneurial ecosystem's evolution and/or transition stages.*	Because of the limitations of a single case study and a cross-sectional research approach, this proposition cannot be confirmed until we have more case studies from different phases of entrepreneurial ecosystem evolution.

Proposition (P)	Empirical Evidence
P-B *The science and technology park's role diminishes as the entrepreneurial ecosystem develops and/or is relatively stable.*	The findings show that the science and technology park plays an important role in the evolution of a developing entrepreneurial ecosystem. However, because it is a single case and cross-sectional design, it cannot indicate that the role would decline as the ecosystem grows. A longitudinal research design or a multiple-case study is necessary to fully validate this claim.
P-1 *Science and technology parks which provide support services and/or mentorship and/or physical infrastructure for new ventures and/or networking with the universities and/or networking with service providers outside the ecosystem are more likely to make a meaningful contribution to developing entrepreneurial ecosystems.*	According to the findings, the science and technology park supports a developing entrepreneurial ecosystem by providing support services, physical infrastructure, and a network of mentors from a more developed entrepreneurial ecosystem.
P-2 *Science and technology parks that provide venture capital or network with venture capital investors outside the entrepreneurial ecosystem are more likely to make a meaningful contribution to developing entrepreneurial ecosystems.*	The study suggests that the science and technology park contributes to a developing entrepreneurial ecosystem by providing financial assistance and that they aim to advise entrepreneurs on public funding from other entrepreneurial support organizations.
P-3 *Science and technology parks that align the university teaching programs and the industry demand so that the university produces human capital more relevant to the industry are more likely to make a meaningful contribution to developing entrepreneurial ecosystems.*	Although the science and technology park has entrepreneurship programs to help university students become entrepreneurs, the efforts to support the university in developing talented workers are unclear. Furthermore, the data reveal that Chiang Mai has a brain drain problem, and the science and technology park has taken no concrete efforts to tackle it. As a result, talented workers are still difficult to find in Chiang Mai since they tend to leave.
P-4 *Science and technology parks that actively promote social connections among entrepreneurs and other ecosystem actors through incubation programs and entrepreneurial events strengthen the cultural and social attributes, particularly in developing entrepreneurial ecosystems.*	Based on the findings, the science and technology park greatly encourages interactions in the ecosystem, which improves supportive culture among new entrepreneurs, successful entrepreneurs, and entrepreneurial support organizations.

Proposition (P)	Empirical Evidence
P-5 *Science and technology parks may help speed up the evolution of developing entrepreneurial ecosystems by acquiring movable elements from outside of entrepreneurial ecosystems.*	The results suggest that the science and technology park serves as an ecosystem connector, acquiring resources such as mentors, financial resources, or links to potential markets outside the ecosystem.
P-6 *Science and technology parks may act as entrepreneurial organisations engaging with policymakers to lobby for new policies to support entrepreneurship, particularly in developing entrepreneurial ecosystems.*	The research indicates that the science and technology park has an impact on other public entrepreneurial support organizations as well as the central government when it comes to promoting policies and programs to stimulate entrepreneurship in the ecosystem.

Furthermore, we also observe the phenomenon that successful entrepreneurs who graduate from the incubation programs at the Northern Science Park become mentors, investors, or venture builders to support new entrepreneurs in the entrepreneurial ecosystem. The phenomenon is similar to the entrepreneurial recycling described by Mason and Brown (2014). However, we chose the term *regenerative feedback* to emphasize the phenomenon that successful entrepreneurs or ecosystem outputs return to or remain in the ecosystem to help regenerate new entrepreneurs, rather than the phenomenon that successful or failed entrepreneurs exit their businesses and become available for reuse by other businesses. Furthermore, we developed three frameworks to illustrate the causal relationship between the science and technology park and the elements of the entrepreneurial ecosystem, with every framework incorporating entrepreneurial culture.

The highlight of the second research paper could be the framework in Figure 6.2 as it shows how the science and technology park creates regenerative feedback. The framework also describes how the incubation program of the Northern Science Park related to the elements of the entrepreneurial ecosystem including support services, physical infrastructure, networks, investment capital, mentors and role models, universities, supportive culture, and histories of entrepreneurship. The incubation program at the Northern Science Park provides support services, office spaces, and other physical infrastructure, and linkage to entrepreneurial networks to foster new entrepreneurs. When these entrepreneurs graduated from the program, some of them became investors, mentors, and role models and came back to help new rounds of entrepreneurship as alumni. Through mentorship, new entrepreneurs not only learn entrepreneurial knowledge from alumni but also gain direct experience from these successful entrepreneurs. Furthermore, this type of relationship helps to spread the supportive culture to the broader entrepreneurial community. Furthermore, the findings show that successful entrepreneurs collaborate with other entrepreneurial support organisations and universities in

Chiang Mai as guest speakers, sharing their experiences and inspiring entrepreneurs outside the Northern Science Park, as well as students and university staff. We would want to emphasize the significance of the Northern Science Park's contributions to the cultural elements of the entrepreneurial ecosystem since we view them are crucial in building the *regenerative feedback loop* in our framework.

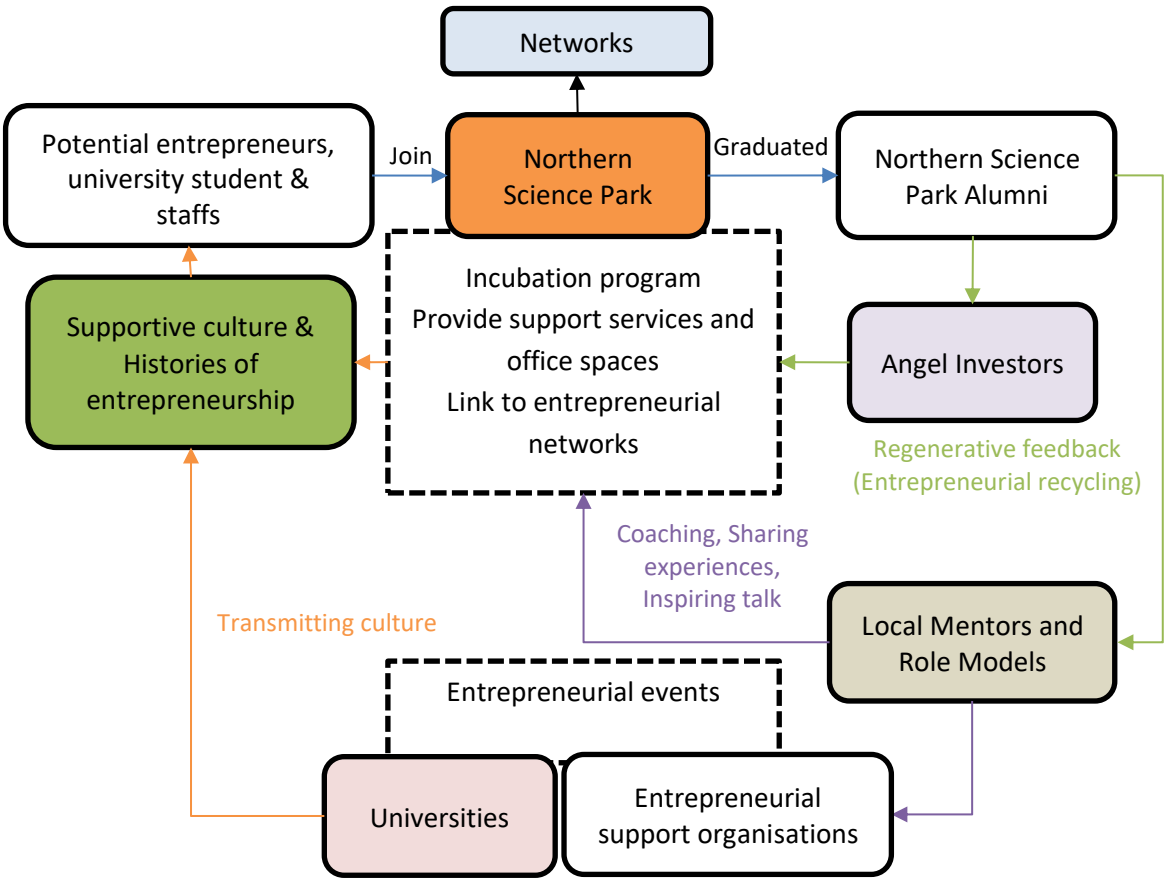


Figure 6.2 Northern Science Park contributions through the incubation program.

Another interesting finding from the second research paper is that the science and technology park does have an impact in terms of policy and governance in the ecosystem as shown in Figure 6.3. First, the Northern Science Park serves as an intermediary organisation between entrepreneurs and the government. On the one hand, Northern Science Park engages closely with local entrepreneurs, so they understand the needs of local entrepreneurs. On the other hand, the Northern Science Park's main source of funding is the Ministry of Higher Education, Science, Research, and Innovation (MHESI), the Royal Thai Government where the Northern Science Park must propose entrepreneurial projects to get funding. As a result, the Northern Science Park has a direct impact on how the government spends its resources on entrepreneurial projects in Chiang Mai, as well as entrepreneurial policy. Second, there are other entrepreneurial support organisations in Chiang Mai, and the Northern Science Park approaches these organisations and acts as a consultant to help them create entrepreneurial projects to get public funding.

Consequently, the Northern Science Park indirectly influences policy and governance through entrepreneurial support organisations in Chiang Mai. In addition, the collaborations between the Northern Science Park and other entrepreneurial support organisations also encourage supportive culture among these organisations as well as align the overall entrepreneurial projects among different entrepreneurial support organisations in Chiang Mai.

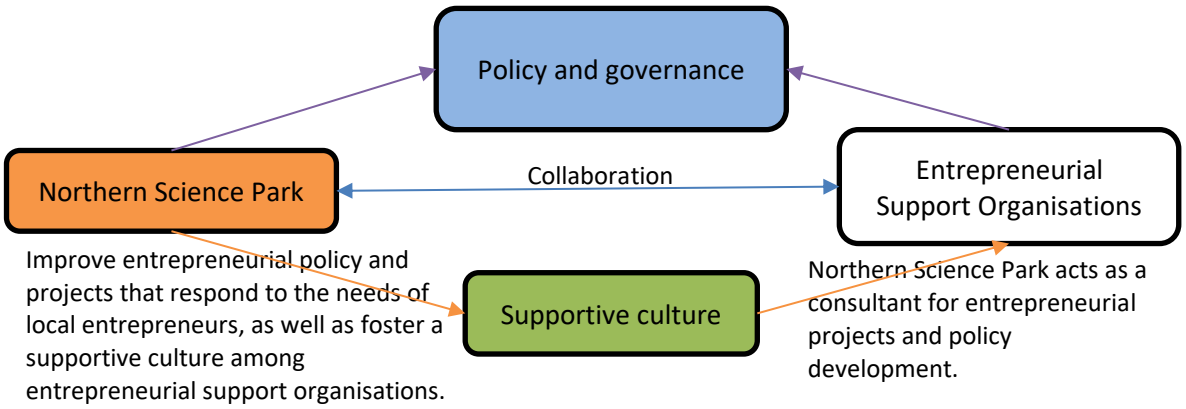


Figure 6.3 Northern Science Park contributions to policy and governance.

The most significant contribution of the science and technology park to the entrepreneurial ecosystem, as discovered in the second research paper, is to foster an entrepreneurial culture, which led us to the third research paper. In the third research paper, we aim to unpack how the mechanisms of the science and technology park impact cultural elements of the entrepreneurial ecosystem. To do this, we revisited the entrepreneurial ecosystem literature, focusing entirely on what constitutes entrepreneurial culture, as shown in Table 6.4. Furthermore, we identified the support mechanisms of the science and technology park based on the previous research on incubators, as seen in Table 6.5.

Table 6.4 The dimensions of entrepreneurial culture.

Cultural dimensions	Description	Examples
Openness and information exchange	Openness creates trust and transparency within the ecosystem.	Feld (2012)
Collaboration	Social values and culture that promote collaboration among the ecosystem's actors.	Isenberg (2011); Feld (2012)
Commitment to the region	The commitment of the ecosystem's actors, particularly leaders, to develop the entrepreneurial ecosystem.	Feld (2012)
Innovation	Social values and culture that promote innovation, creativity, and experimentation.	Isenberg (2011); WEF (2013); Feld (2012); Spigel (2017)

Cultural dimensions	Description	Examples
Tolerance of risk and failure	Social values and culture that normalize risk and failure.	Isenberg (2011); WEF (2013); Motoyama and Knowlton (2014); Spigel (2017)
Positive attitude towards entrepreneurship	Social values and culture that embrace entrepreneurship in the region.	Isenberg (2011); WEF (2013)
Success stories of entrepreneurship	Visible success stories of entrepreneurship in the region.	Isenberg (2011); WEF (2013); Feld (2012)
Geography and climate of the region	The natural landscape and climate of the region that attracts entrepreneurs into the region.	Neck *et al.* (2004); Cohen (2006)
Collective interests and knowledge of the region	The collective interests and knowledge of the region.	Neck *et al.* (2004); Cohen (2006)

Table 6.5 Science and technology park support mechanisms.

Support mechanisms	Description
Business-learning	Providing business-related knowledge for incubated entrepreneurs (coaching, mentoring, consulting, training)
Community-building	Building community within the science and technology park (co-working, social events)
Field-building	Building relationships between incubated entrepreneurs and firms in the same field/industry outside the science park (networking and social events)
VC-networking	Bridging between incubated entrepreneurs and VCs (referrals, encouragement, introductions, providing advice, assisting in negotiation)
University-networking	Bridging between entrepreneurs and universities (co-research, licensing, spinoffs)
Government-networking	Influencing entrepreneurial policy
Entrepreneurial support organisation-networking	Coordinating among entrepreneurial support organisations as a leader, bridging between entrepreneurs and entrepreneurial support organisations

Source: Adapted from van Rijnsoever (2020)

The dimensions of entrepreneurial culture and the support mechanisms of the science and technology park were then used as provisional coding. We used the same data set in the second

research paper and re-analysed using these provisional codes. Thematic analysis was applied, and four themes were identified including *(1) Inspiring new entrepreneurs, (2) Encouraging an entrepreneurial mindset, (3) Embedding supportive culture, and (4) Synergizing entrepreneurial support organisations*, as shown in Table 6.6.

Table 6.6 Mechanisms of cultural change in entrepreneurial ecosystems.

Science and technology park support mechanisms	Entrepreneurial cultural dimensions	Themes
• Business-learning • Community-building • University-networking • Entrepreneurial support organisations-networking • Public relations	• Success stories of entrepreneurship • Positive attitude towards entrepreneurship	• **Inspiring new entrepreneurs**
• Business-learning • Community-building • Field-building • University-networking • Entrepreneurial support organisations-networking	• Innovation • Tolerate risk and failure	• **Encouraging entrepreneurial mindset**
• Business-learning • Community-building • Field-building	• Collaboration • Openness and information exchange • Commitment to the region	• **Embedding supportive culture**
• University-networking • Entrepreneurial support organisations-networking • Government-networking • VCs-networking	• Collaboration • Openness and information exchange • Commitment to the region	• **Synergizing Entrepreneurial support organisations**

As a result, the entrepreneurial culture development model was created, as illustrated in Figure 6.4.

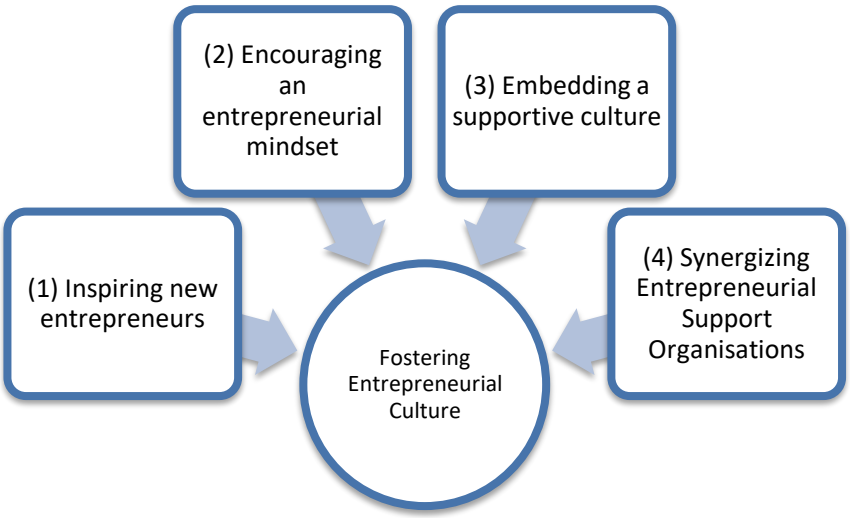


Figure 6.4 The entrepreneurial culture development model.

6.3 Limitations

This study, like all others, has several limitations, which are listed below.

First, a single-case study design is excellent for investigating mechanisms underlying phenomena since it provides extensive information. However, it is challenging to generalise when compared to a multiple-cases study design (Yin, 2018). Each entrepreneurial ecosystem has unique characteristics which require different kinds of support to overcome individual challenges. Furthermore, we have introduced the dynamics of the entrepreneurial ecosystem which includes both developing and developed entrepreneurial ecosystems. Nevertheless, this study focuses only on a developing entrepreneurial ecosystem as it is a critical case for our propositions. As a result, additional research on how a science and technology park would perform in a developed entrepreneurial ecosystem context is required to capture all dimensions that our main propositions aim for.

Second, in our case study, the science and technology park is university-based and government-owned. There are other types of science and technology parks with different ownership models, such as privately and publicly owned science and technology parks, standalone and university-based science and technology parks, and we still do not know which type of science and technology park will perform well in what particular configuration of the entrepreneurial ecosystem. Additionally, other types of entrepreneurial support organisations exist as well, including business parks, business incubators, and accelerators. These organisations may have a varied influence on how entrepreneurial ecosystems develop. Knowing what impact it may have and in which situations could be useful information for policymakers and those in charge of developing entrepreneurial ecosystems.

Third, this study used a theoretical sampling, based on the attributes of entrepreneurial ecosystems by Spigel (2017), to represent various perspectives from different ecosystem actors and organisations. However, to ensure that all important groups were represented in this study, the author only gave the Northern Science Park a participant selection guideline according to the theory. The Northern Science Park may choose participants following our guidelines at its discretion. This could have led to bias in the participant selection as a result.

Fourth, this study emphasizes the benefits that the science and technology park has on the entrepreneurial ecosystem; we have not given much attention to any downsides. While science and technology parks can be considered a positive intervention in the entrepreneurial ecosystem, they may also have unintended effects, even if the main objective of these entrepreneurial support organisations is to stimulate the region's entrepreneurial activity. Due to the lack of understanding regarding the negative impacts, a future study may consider this angle. This contribution may provide insightful information that will help policymakers and management of science and technology parks assess adverse effects more extensively to reduce or prevent unexpected outcomes.

Fifth, this study only looked at one direction of the interaction between science and technology parks and entrepreneurial ecosystems. The performance of science and technology parks may change depending on the setting of entrepreneurial ecosystems. This perspective may be considered in the future study. This understanding may assist policymakers or managers of science and technology parks in developing strategies to overcome the limitations of entrepreneurial ecosystems and leverage their strengths.

Finally, the data collection in this study was initially designed to be face-to-face interviews and observations in Chiang Mai, Thailand. The author was not allowed to travel abroad due to the restrictions set by the Office of the Civil Service Commission, and the Royal Thai Government as well as the restrictions imposed by the University Ethics Committee, which only permits online interviews regarding the COVID-19 situation. As a consequence, the author was unable to completely immerse themselves in the entrepreneurial ecosystem and the Northern Science Park in Chiang Mai, Thailand due to COVID-19 constraints which is important to understand the context setting of the research. Furthermore, an online interview method has disadvantages compared to a traditional face-to-face interview method due to several reasons. For instance, it is impossible to engage a small talk with participants before the interview, which would help the interviewer build a good rapport, especially in Thai culture. In addition, the interviewer cannot watch the body language and non-verbal behaviour of the participants. As a result, a traditional face-to-face interview may give richer information than an online interview.

6.4 Generalisation in qualitative research

In quantitative research, generalisation, which is the act of reasoning that entails deriving general conclusions from specific observations, is universally regarded as high-quality evidence. Nevertheless, generalizability is more contentious in qualitative research due to the problem of small sample size (Tsang, 2014). Most qualitative studies focus on a few specific situations to gain a deep understanding of that component in the social phenomenon through an intensive study (Polit and Beck, 2010). Three generalizability model typologies were defined by Firestone (1993), and they serve as a helpful framework for thinking about generalisations in both quantitative and qualitative research. Generalising from a sample to a population or statistical generalisation or empirical generalisation is the first model, which is the standard approach used in most quantitative studies. The second model, analytical generalisation or theoretical generalisation, is relevant to both qualitative and quantitative research. The third model is referred to as case-to-case translation or transferability or naturalistic generalisation. The latter two models have been characterised as instruments for addressing what seems to be the apparent dichotomy of qualitative research—its emphasis on the specific and concurrent interest in the broad and general. Nonetheless, generalising based on qualitative research must be considerably more detailed and context-dependent than understandings of generalisation as universalizing (Halkier, 2011).

Statistical generalisation aims to generalise from a sample to a population, therefore, it relies on probability sampling which requires a large sample to increase the confidence interval. While analytical generalisation aims to generalise from specific settings to a theory or conceptualization, thus, it relies on the evidence that supports that theory (Firestone, 1993). Transferability or naturalistic generalisation aims to generalise research findings from one case to another similar case. In general, qualitative research involve one of the latter two types of generalisations (Firestone, 1993; Onwuegbuzie and Leech, 2009). The lessons learned from the case can be also served as a working hypothesis that can be applied to reinterpret the findings of other existing case studies (or existing theories) or to define a research foundation on new case studies for creating new theories (Yin, 2018). Although case studies research may be less generalisable than those quantitative research, case studies research outperforms quantitative research in terms of generalising to theory, identifying disconfirming cases, and offering useful information on the context for evaluating the statistical generalizability of the results (Tsang, 2014).

The case study shows that the science and technology park can play a leadership role, especially in a developing entrepreneurial ecosystem influencing the evolution of the entrepreneurial ecosystem elements, particularly the entrepreneurial culture. In addition, the case study also

demonstrates that contrary to what has been suggested in the literature, leaders of entrepreneurial ecosystems do not necessarily need to be entrepreneurs or government officials to be effective. Moreover, the case study introduced a new dimension to distinguish between movable and immovable elements of the entrepreneurial ecosystem. The leader of an ecosystem can focus on the development of immovable within the ecosystem while movable elements can be acquired from outside the ecosystem to compensate for the lack of those entrepreneurial resources and also accelerate the growth of a developing entrepreneurial ecosystem more efficiently. In addition, the case study also highlights the importance of entrepreneurial culture in developing entrepreneurial ecosystems. Therefore, our theory from the case study, or the policy implications is that the leaders of the entrepreneurial ecosystem should probably focus on the entrepreneurial culture to develop an entrepreneurial ecosystem more effectively, particularly a developing one. In addition, the entrepreneurial culture development model defined in this case study (see Figure 6.4) could be transferable to other developing entrepreneurial ecosystems which have science and technology parks play a leadership role in the ecosystems and perhaps to other different settings without science and technology parks and other ecosystem leaders, such as entrepreneurs or government, may play role in developing entrepreneurial culture instead. However, new case studies are required in future studies to strengthen generalization and our frameworks could be used as working hypotheses that must be evaluated.

6.5 Practical Implications

This research project provides several implications for researchers, policymakers, and the leader of the entrepreneurial ecosystem as followed.

6.5.1 Implication for researchers

First, we introduce a new dimension to categorize the elements of an entrepreneurial ecosystem by assessing its mobility characteristics. These new dimensions also build on the idea that each element of the entrepreneurial ecosystem is not equally important and not every element is required to locate within the ecosystem if the resources can be accessed from other entrepreneurial ecosystems. The concept helps identify what elements in the entrepreneurial ecosystem have to be built and rooted within the entrepreneurial ecosystem – we called these *immovable* elements and the *movable* elements that can be accessed or located outside the entrepreneurial ecosystem. As a result, the movable elements are not as important as immovable elements but is required the intermediary to gain access to movable elements outside the ecosystem instead such as a science and technology park evidenced in this study. However, this

classification between movable and immovable elements has not been confirmed by evidence-based studies. Empirical studies are required to elaborate this concept further.

Second, we introduced the definition of the entrepreneurial ecosystem dynamic at both ends of the continuum, a developing and a developed entrepreneurial ecosystem. Unlike the recent works on the assessment of an entrepreneurial ecosystem using the scoring system to measure the maturity of an entrepreneurial ecosystem, which is a relative point of view, our approach utilizes key characteristics of a resilient entrepreneurial ecosystem. This concept builds on the premise that each element of the entrepreneurial ecosystem is not equally important as well as well-developed entrepreneurial ecosystems do not always contain all elements discussed in the existing frameworks. Characteristics that can be observed in resilient entrepreneurial ecosystems are more vital to distinguish between developing and developed entrepreneurial ecosystems in our view. For example, the ability to reconfigure entrepreneurial resources after internal or external shocks, the ability to attract or draw external resources into the entrepreneurial ecosystem, or the regenerative feedback loop, the phenomenon that when the entrepreneurial culture is strong and the level of commitment to the region is high, successful entrepreneurs or the outputs of the entrepreneurial ecosystem will remain or return to the entrepreneurial ecosystem to support new rounds of entrepreneurship. These are just only characteristics of resilient entrepreneurial ecosystems discovered in this project. There is still room to improve, and we call for more research to explore more on other characteristics or phenomena that can be only observed in resilient entrepreneurial ecosystems.

Third, the literature on the entrepreneurial ecosystem has discussed the role of a leader of the entrepreneurial ecosystem which is debated between the entrepreneurs and the government. This study suggested a new option which is the science and technology park which can play a role as an ecosystem's leader and connector in overcoming issues in a developing entrepreneurial ecosystem such as a weak network of entrepreneurial support organisations and a lack of entrepreneurial resources. Science and technology parks are in a good position between entrepreneurs and governments since they understand the needs of local entrepreneurs as well as the protocols of the governments. It is the second single-case study to confirm that a science and technology park can serve as a key player, a manager of the entrepreneurial ecosystem, as suggested by Germain et al. (2022).

Fourth, the findings of this case study bring attention to the importance of entrepreneurial culture development which is still limited. Entrepreneurial culture has been recognized as a fundamental element of the entrepreneurial ecosystem, which is difficult to build, time-consuming, and immovable. Furthermore, the findings indicate that it is critical to enable the

regenerative feedback loop that brings successful entrepreneurs back to help new rounds of entrepreneurship in entrepreneurial ecosystems. Although, this study proposes a framework to develop the entrepreneurial culture based on the case of the science and technology park. This framework may be applied to other ecosystem actors and organisations. Future research is required to elaborate this framework further.

Finally, the majority of empirical research on entrepreneurial ecosystems has been undertaken in large cities with well-developed entrepreneurial ecosystems. This case study contributes empirical evidence from a developing entrepreneurial ecosystem to the literature, which is currently lacking.

6.5.2 Implication for policymakers

First, our findings imply that entrepreneurial culture is the key to harmonising entrepreneurial support organisations in the entrepreneurial ecosystem increasing the connectivity among ecosystem actors to support entrepreneurship in the ecosystem more effectively. A high level of connectivity among ecosystem actors also increases the flow of knowledge and entrepreneurial resources. In our case, the science and technology park plays an important role as a leader of the ecosystem, and a connector both within and between different entrepreneurial ecosystems encouraging entrepreneurial culture among other entrepreneurial support organisations. This theory may be transferable to other similar settings that already have science and technology parks in a developing entrepreneurial ecosystem. The theory may be also transferable to other different settings without science and technology parks in the ecosystem. No matter who plays the role of a leader and a connector in the ecosystem, policy implications should focus on entrepreneurial culture, particularly in a developing entrepreneurial ecosystem, and may elaborate our model, entrepreneurial culture development.

Second, the findings show that a science and technology park can be a key player in an entrepreneurial ecosystem as a leader of the ecosystem and a connector between distinct ecosystems. The idea to establish a science and technology park in a certain region might be one of the approaches for policymakers that aim to create or develop an entrepreneurial ecosystem further. In addition, the notion of the mobility of entrepreneurial ecosystem elements presented in the first research paper, as seen in Figure 6.1, may offer policymakers an idea of which elements to develop first. This approach may assist policymakers in accelerating the growth of developing entrepreneurial ecosystems.

6.5.3 Implication for practitioners

First, the research's implications are targeted directly to the manager of science and technology parks, particularly those that strive to develop entrepreneurial ecosystems, such as other regional science and technology parks in Thailand. Findings from the second research paper show that science and technology parks can be related to almost every element of the entrepreneurial ecosystem, as depicted in Table 6.3. The causal relationships between science and technology parks and elements of entrepreneurial ecosystems provided in the second research paper give the managers an overview of how to focus on particular elements they would like to enhance. Furthermore, this PhD thesis highlights the importance of entrepreneurial culture in developing entrepreneurial ecosystems as well as provides detail on the support mechanisms of science and technology parks that are related to each cultural element in the third research paper, as shown in Table 6.6.

Finally, the empirical evidence in the second research paper points out the area to improve Chiang Mai's entrepreneurial ecosystem in particular (see Table 6.3). To address the brain drain challenges in Chiang Mai, stakeholders from different entities including government, industry, and universities in the entrepreneurial ecosystem must work together. For example, the government could address the issue of low average incomes in the region, as well as improve the quality of life for Chiang Mai citizens or implement particular policies to attract talent to the region. Universities should train excellent graduates to meet the demands of the region's industry while also encouraging them to be more interested in working with new startup companies. Entrepreneurs should be aware of the need of developing a healthy corporate culture and a decent compensation package to recruit and retain these talents in their organisations. The Northern Science Park might facilitate interactions between various entities to ensure that everyone is on the same page.

6.6 Personal Reflection

My decision to study an entrepreneurial ecosystem was motivated by conversations I had with my sponsor, the Northern Science Park, and Chiang Mai University in Thailand, where I will work after finishing my Doctoral program. The Northern Science Park is currently developing Chiang Mai's entrepreneurial ecosystem and would like to know how it may be improved further. Therefore, the primary objective is to investigate strategies to increase the role of the science and technology park in the evolution of the entrepreneurial ecosystem. After conducting a literature review on the entrepreneurial ecosystem, however, it revealed that the literature frequently focuses on developed entrepreneurial ecosystems, with little insight into developing

entrepreneurial ecosystems or how to develop entrepreneurial ecosystems further. Moreover, it appears that the literature on the entrepreneurial ecosystem includes an incubator or accelerator to be part of the ecosystem while ignoring the existence of a science and technology park. Only Germain *et al.* (2022) which we discovered in the last year of my PhD research, explicitly investigated the role of a science and technology park as a key player in the evolution of an entrepreneurial ecosystem. As a result, the Northern Science Park became an excellent case study for entrepreneurial ecosystem evolution. To enhance the processes of developing an entrepreneurial ecosystem, we must first comprehend the underlying mechanisms through which this PhD thesis intends to achieve this goal.

Despite having worked for nearly 10 years before commencing my PhD journey, I had no prior experience in any science and technology park. As a scholarship student, I would want to contribute my knowledge to my sponsorship, the Northern Science Park and Chiang Mai University. This PhD thesis allows me to have a better understanding of the role and impact of the science and technology park on the entrepreneurial ecosystem. When I begin my future job as one of the management team of the Northern Science Park, I wish to discuss my findings in this PhD thesis with others to refine and advance strategies for the Northern Science Park to develop the entrepreneurial ecosystem further. My knowledge may also be used in other regional science and technology parks in Thailand, as well as science and technology parks in other countries with similar context settings, which is my ultimate goal for the contributions from this PhD thesis.

Appendix A ERGO Application forms

A.1 Ethics form

All mandatory fields are marked (M*). Applications without mandatory fields completed are likely to be rejected by reviewers. Other fields are marked "if applicable". Help text is provided, where appropriate, in italics after each question.

1. APPLICANT DETAILS

1.1 (M*) Applicant name:	Rom Pairsuwan
1.2 Supervisor (if applicable):	David Baxter
1.3 Other researchers/collaborators (if applicable): Name, address, email, telephone	N/A

2. STUDY DETAILS

2.1 (M*) Title of study:	The role of Science Park in the Entrepreneurial Ecosystem: A case study of the Northern Science Park, Thailand
2.2 (M*) Type of study (e.g. Undergraduate, Doctorate, Masters, Staff):	Doctorate
2.3 i) (M*) Proposed data collection start date:	25th May 2020
2.3 ii) (M*) Proposed data collection end date:	28th September 2021

2.4 (M*) What are the aims and objectives of this study?
The aim of this study is to examine the interrelationship between a science park and the entrepreneurial ecosystem. There are two objectives in the study. 1. To identify the roles of a science park in the entrepreneurial ecosystem and examine how the science park has an impact on the entrepreneurial ecosystem 2. To examine how the entrepreneurial ecosystem has an impact on the performance of the science park.

2.5 (M*) Background to study *(a **brief** rationale for conducting the study. This involves providing a brief discussion of the past literature relevant to the project):*
Recently, the entrepreneurial ecosystem has gained attention among scholars, practitioners, and policymakers. The concept explains the interrelationship between entrepreneurship and economic, social, political, and cultural elements that promote growth-oriented entrepreneurship. Regarding the Regional Innovation System literature, a science park has been discussed as an institution where it encourages collaboration between public, private, and academic sectors to promote entrepreneurship in a region.

Though a considerable amount of research has identified what could be essential elements in the entrepreneurial ecosystem, a science park has been largely ignored. Thus, this study aims to explore the potential roles of a science park and its impact on the entrepreneurial ecosystem. The study also examines the impact of the entrepreneurial ecosystem on the performance of a science park.

Feld, B. (2012) *Startup communities: Building an entrepreneurial ecosystem in your city*. New York: NY:Willey.

Isenberg, D. (2011) 'The Entrepreneurship Ecosystem Strategy as a New Paradigm for Economic Policy: Principles for Cultivating Entrepreneurships', *The Babson Entrepreneurship Ecosystem Project*, 1(781), pp. 1–13.

Lamine, W. et al. (2018) 'Technology business incubation mechanisms and sustainable regional development', *Journal of Technology Transfer*, 43(5), pp. 1121–1141.

2.6 (M*) Key research question *(Specify hypothesis if applicable):*

The study aims to answer two main research questions.

RQ1: Which roles can a science park play in an entrepreneurial ecosystem?

RQ2: How do a science park and an entrepreneurial ecosystem impact each other?

2.7 (M*) Study design *(Give a **brief** outline of basic study design)*

Outline what approach is being used, why certain methods have been chosen.

Since this study is exploratory research, therefore, a qualitative analysis is the most appropriate tool to get insights into the field. Potential participants will have to meet two criteria.

First, they have to be in the same entrepreneurial ecosystem which in this case is Chiang Mai, Thailand.

Second, participants have to be one of the elements in the entrepreneurial ecosystem which can be entrepreneurial actors or a person who represents entrepreneurial organisations including a science park. The researcher will interview participants using semi-structured interview questions.

3. SAMPLE AND SETTING

3.1 (M*) How are participants to be *approached?* *Give details of what you will do if recruitment is insufficient. If participants will be accessed through a third party (e.g. children accessed via a school, employees accessed via a specific organisation) state if you have permission to contact them and **upload any letters of agreement to your submission in ERGO or provide the name and contact details of the person granting you permission to access the sample (to check that permission has been granted).***

The researcher will directly approach managers of the Northern Science Park of Thailand first where the researcher is one of their employees. Then a snowball sampling technique will be used to recruit future participants who meet the criteria in this study.

3.2 (M*) Who are the proposed sample and where are they from (e.g. fellow students, club members)? How many participants do you intend to recruit? *List inclusion/exclusion criteria if applicable. NB The University does not condone the use of 'blanket emails' for contacting potential participants (i.e. fellow staff and/or students).*

It is usually advised to ensure groups of students/staff have given prior permission to be contacted in this way, or to use of a third party to pass on these requests. This is because there is

a potential to take advantage of the access to 'group emails' and the relationship with colleagues and subordinates; we therefore generally do not support this method of approach. If this is the only way to access a chosen cohort, a reasonable compromise is to obtain explicit approval from the Faculty Ethics Committee (FEC) and also from a senior member of the faculty in case of complaint.

The proposed sample is employees of the Northern Science Park of Thailand and the researcher is one of their employees. The future participants will be recruited using a snowball sampling technique. Potential participants can be entrepreneurs, investors, scientists, employees who work with the science park, Chiang Mai University, and related public and private organisations in Chiang Mai, Thailand. About 20 to 50 participants are expected to be in this study.

3.3 (M*) Describe the relationship between researcher and sample *(Describe any relationship e.g. teacher, friend, boss, clinician, etc.)*

The researcher is a scholarship student who is funded by the Northern Science Park of Thailand. For other potential participants, there is no relationship between researcher and sample.

3.4 (M*) Describe how you will ensure that fully informed consent is being given. *You must specify how participants will be told what to expect by participating in your research. For example, will participants be given a participant information sheet before being asked to provide their consent?* ***Upload copies of the participant information sheet and consent form to your submission in ERGO.***

A participant information sheet will be given before being asked to provide their consent. The interview will be arranged after participants sign the consent form.

3.5 (M*) Describe the plans that you have for feeding back the findings of the study to participants. *You must specify how participants will be informed of your research questions and/or hypotheses. For example, will participants be given a debriefing form at the end of your study?* ***Upload a copy of the debriefing form to your submission in ERGO.***

Participants will be given a debriefing form at the end of the study.

4. RESEARCH PROCEDURES, INTERVENTIONS AND MEASUREMENTS

4.1 (M*) Give a brief account of the procedure as experienced by the participant

Make clear who does what, how many times and in what order. Make clear the role of all assistants and collaborators. Make clear total demands made on participants, including time and travel. You must also describe the content of your questionnaire/interview questions and EXPLICITLY state if you are using existing measures. If you are using existing measures, please provide the full academic reference as to where the measures can be found. ***Upload any copies of questionnaires and interview schedules to your submission in ERGO.***

The interview will be a one-on-one session between a participant and a researcher. After the participants decide to be in the study by signing the consent form, the researcher will contact them and arrange the interview session. To maintain social distancing during the COVID-19 crisis, the interview will be conducted through online interview platforms such as skype/zoom/Microsoft Teams etc. The time of the interview will depend on the convenience of the participants. Normally, the interview should be completed within one session and last between 30-60 minutes. The researcher will begin by introducing himself and explaining the overview of the interview to the participant. Then participants will have to answer the interview

questions regarding the interview question guideline; however, some questions may emerge during the interview. When the interview is completed, the researcher will ask the participants whether they have any questions about the interview. Then the researcher will end the conversation politely and thank the participants for contributing to the study.

5. STUDY MANAGEMENT

5.1 (M*) State any potential for psychological or physical discomfort and/or distress?
Regarding the interview questions, the potential for psychological and physical discomfort or distress is minimal.

5.2 Explain how you intend to alleviate any psychological or physical discomfort and/or distress that may arise? (if applicable)
Not applicable.

5.3 Explain how you will care for any participants in 'special groups' *(i.e. those in a dependent relationship, vulnerable or lacking in mental capacity)* **(if applicable)?**
Not applicable.

5.4 Please give details of any payments or incentives being used to recruit participants (if applicable)?
Not applicable.

5.5 i) (M*) How will participant anonymity and/or data anonymity be maintained (if applicable)? *Two definitions of anonymity exist:* *i) Unlinked anonymity - Complete anonymity can only be promised if questionnaires or other requests for information are not targeted to, or received from, individuals using their name or address or any other identifiable characteristics. For example, if questionnaires are sent out with no possible identifiers when returned, or if they are picked up by respondents in a public place, then anonymity can be claimed. Research methods using interviews cannot usually claim anonymity – unless using telephone interviews when participants dial in.* *ii) Linked anonymity - Using this method, complete anonymity cannot be promised because participants can be identified; their data may be coded so that participants are not identified by researchers, but the information provided to participants should indicate that they could be linked to their data.*
Participant anonymity will be maintained using linked anonymity. Participants can be identified using code. Therefore, complete anonymity cannot be promised. However, the coding will be stored in the encrypted files which the researcher will be the only person who has access.

5.5 ii) (M*) How will participant confidentiality be maintained (if applicable)? *Confidentiality is defined as the non-disclosure of research information except to another authorised person. Confidential information can be shared with those who are already party to it and may also be disclosed where the person providing the information provides explicit consent.*

The researcher will respect the privacy of participants and do not utilise this data for other purposes. Audio-record and written note during the interview will be destroyed after the transcription has been completed. Personal information will be removed from the transcription and replaced with the code. All personal detail including the consent form will be stored in encrypted files and separate from the transcription.

5.6 (M*) How will personal data and study results be stored securely during and after the study? *Researchers should be aware of, and compliant with, the Data Protection policy of the University (for more information see www.southampton.ac.uk/inf/dppolicy.pdf). You must be able to demonstrate this in respect of handling, storage and retention of data (e.g. you must specify that personal identifiable data, such as consent forms, will be separate from other data and that the data will either be stored as an **encrypted file and/or stored in a locked filing cabinet).***
All personally identifiable data and consent forms will be stored as an encrypted file, which only the researcher can access, and will be separate from a pseudonymised transcription.

5.7 (M*) Who will have access to these data?
The researcher of this study (Rom Pairsuwan)

N.B. – Before you upload this document to your ERGO submission remember to:

1. Complete ALL mandatory sections in this form

2. Upload any letters of agreement referred to in question 3.1 to your ERGO submission

3. Upload copies of your participant information sheet, consent form and debriefing form referred to in questions 3.4 and 3.5 to your ERGO submission

4. Upload any interview schedules and copies of questionnaires referred to in question 4.1

A.2 Consent form

Study title: The roles of Science Park in the Entrepreneurial Ecosystem: A case study of the Northern Science Park, Thailand

Researcher name: Rom Pairsuwan

ERGO number: 56362

Participant Identification Number:

Please initial the box(es) if you agree with the statement(s):

I have read and understood the information sheet [07/04/2020] [Version 1] and have had the opportunity to ask questions about the study.	
I agree to take part in this research project and agree for my data to be used for the purpose of this study.	
I understand my participation is voluntary and I may withdraw at any time for any reason without my participation rights being affected.	
I understand that I may be quoted directly in reports of the research but that I will not be directly identified.	
I agree to take part in the interview for the purposes set out in the participation information sheet and understand that these will be recorded using audio and written notes.	

Name of participant (print name)……

Signature of participant……

Date……

Name of researcher (print name)……

Signature of researcher ……

Date……..

A.3 Participant information sheet

Study Title: The roles of Science Park in the Entrepreneurial Ecosystem: A case study of the Northern Science Park, Thailand

Researcher: Rom Pairsuwan

ERGO number: 56362

You are invited to take part in the above research study. To help you decide whether you would like to take part or not, it is important that you understand why the research is being done and what it will involve. Please read the information below carefully and ask questions if anything is not clear or if you would like more information before you decide to take part in this research. You may like to discuss it with others, but it is up to you to decide whether or not to take part. If you are happy to participate you will be asked to sign a consent form.

What is the research about?

I am Rom Pairsuwan, a PhD candidate at the University of Southampton. I am requesting your participation in a study regarding **the role of Science Park in the Entrepreneurial Ecosystem: A case study of the Northern Science Park, Thailand.** You will be asked about your roles or your affiliation's roles in the entrepreneurial ecosystem which in this case is Chiang Mai, Thailand, your view towards the role of the Northern Science Park in the ecosystem, and how the science park impacts the entrepreneurial ecosystem or how the ecosystem impacts the science park. The objective of the study is to examine the interrelationship between the science park and the entrepreneurial ecosystem which may lead to the expected outcome of sustainable growth of the science park along with the entrepreneurial ecosystem.

Why have I been asked to participate?

You are qualified as a potential participant because you are one of the entrepreneurial actors; such as entrepreneurs, investors, or scientists; or a representation of entrepreneurial institutions; for example, science parks, universities, private companies, financial institutions, related public/private organisations; in the entrepreneurial ecosystem which this case is Chiang Mai, Thailand. Therefore, your view toward the science park and the entrepreneurial ecosystem is valuable for this study. About 50 participants from different affiliations will be involved in the study.

What will happen to me if I take part?

If you decide to take part in this study by signing the consent form. The researcher will contact you afterwards to arrange an interview which should last approximately 30-60 minutes. The interview can be conducted using Skype or a face-to-face session and the place and time of the interview will depend on the convenience of the participant. The interview should be a one-on-one session with the researcher, and it should be done within one session. It will be a semi-structured interview which means that some questions may emerge during the interview apart from the main questions in the guideline.

Audio-record will be required during the interview. It will be used for analysis only. Therefore, the audio record will be destroyed after the completion of the transcription. A direct quote may be used in the research paper; however, it will not be directly identified.

Are there any benefits in my taking part?

There may be no direct benefit to the participant other than the sense of helping the public at large and contributing to knowledge and improving our current understanding of the area of study.

Are there any risks involved?

The study involves minimal risk to participants (i.e., the level of risk encountered in daily life). Any information you give will be kept confidential.

Participation is voluntary, refusal to take part in the study involves no penalty or loss of benefits to which participants are otherwise entitled, and participants may withdraw from the study at any time without penalty or loss of benefits to which they are otherwise entitled.

What data will be collected?

The audio record of the interview and the written notes will be collected by the researcher. Personal information including name, job, and affiliation will be collected for analysis.

Will my participation be confidential?

Your participation and the information we collect about you during the research will be kept strictly confidential.

Only members of the research team and responsible members of the University of Southampton may be given access to data about you for monitoring purposes and/or to carry out an audit of the study to ensure that the research is complying with applicable regulations. Individuals from regulatory authorities (people who check that we are carrying out the study correctly) may require access to your data. All of these people must keep your information, as a research participant, strictly confidential.

Data collected in the form of documents including consent forms and written notes will be converted to electronic data and destroyed securely. Audio-record files will be encrypted, and password protected. Once recordings have been transcribed, they will be securely deleted. Identifiable data will be removed from the transcription using code to reduce the risk of identification. Identifiable data will be stored using encryption and password-protected access. Only the researcher will have access to the identifiable data.

Supervisors of the researcher will only have access to the non-identifiable data collected in this study to carry out the research.

Do I have to take part?

No, it is entirely up to you to decide whether or not to take part. If you decide you want to take part, you will need to sign a consent form to show you have agreed to take part.

What happens if I change my mind?

You have the right to change your mind and withdraw at any time without giving a reason and without your participant rights being affected.

If you wish to withdraw from the study please contact the researcher, Rom Pairsuwan, at R.Pairsuwan@soton.ac.uk

What will happen to the results of the research?

Your details will remain strictly confidential. Research findings made available in any reports or publications will not include information that can directly identify you without your specific consent.

Research findings will be written up as part of a PhD thesis.

Where can I get more information?

If participants have further questions about the study, they may contact the principal investigator, Rom Pairsuwan, at R.Pairsuwan@soton.ac.uk

What happens if there is a problem?

If you have a concern about any aspect of this study, you should speak to the researchers who will do their best to answer your questions.

If you remain unhappy or have a complaint about any aspect of this study, please contact the University of Southampton Research Integrity and Governance Manager (023 8059 5058, rgoinfo@soton.ac.uk).

Researcher:	Rom Pairsuwan	(R.Pairsuwan@soton.ac.uk)
Supervisor:	David Baxter	(D.Baxter@soton.ac.uk)

Data Protection Privacy Notice

The University of Southampton conducts research to the highest standards of research integrity. As a publicly-funded organisation, the University has to ensure that it is in the public interest when we use personally-identifiable information about people who have agreed to take part in research. This means that when you agree to take part in a research study, we will use information about you in the ways needed, and for the purposes specified, to conduct and complete the research project. Under data protection law, 'Personal data' means any information that relates to and is capable of identifying a living individual. The University's data protection policy governing the use of personal data by the University can be found on its website (https://www.southampton.ac.uk/legalservices/what-we-do/data-protection-and-foi.page).

This Participant Information Sheet tells you what data will be collected for this project and whether this includes any personal data. Please ask the research team if you have any questions or are unclear what data is being collected about you.

Our privacy notice for research participants provides more information on how the University of Southampton collects and uses your personal data when you take part in one of our research projects and can be found at http://www.southampton.ac.uk/assets/sharepoint/intranet/ls/Public/Research%20and%20Integrity%20Privacy%20Notice/Privacy%20Notice%20for%20Research%20Participants.pdf

Any personal data we collect in this study will be used only for the purposes of carrying out our research and will be handled according to the University's policies in line with data protection law. If any personal data is used from which you can be identified directly, it will not be disclosed to anyone else without your consent unless the University of Southampton is required by law to disclose it.

Appendix A

Data protection law requires us to have a valid legal reason ('lawful basis') to process and use your Personal data. The lawful basis for processing personal information in this research study is for the performance of a task carried out in the public interest. Personal data collected for research will not be used for any other purpose.

For the purposes of data protection law, the University of Southampton is the 'Data Controller' for this study, which means that we are responsible for looking after your information and using it properly. The University of Southampton will keep identifiable information about you for 10 years after the study has finished after which time any link between you and your information will be removed.

To safeguard your rights, we will use the minimum personal data necessary to achieve our research study objectives. Your data protection rights – such as to access, change, or transfer such information - may be limited, however, in order for the research output to be reliable and accurate. The University will not do anything with your personal data that you would not reasonably expect.

If you have any questions about how your personal data is used, or wish to exercise any of your rights, please consult the University's data protection webpage (https://www.southampton.ac.uk/legalservices/what-we-do/data-protection-and-foi.page) where you can make a request using our online form. If you need further assistance, please contact the University's Data Protection Officer (data.protection@soton.ac.uk).

Any data collected during the interview will be turned into pseudonymised transcription through key-coding and removal of personal identifiers. Only the researcher, Rom Pairsuwan, can access the codes.

Thank you for taking the time to read the information sheet and considering taking part in the research.

A.4 Debriefing

Study Title: The roles of Science Park in the Entrepreneurial Ecosystem: A case study of the Northern Science Park, Thailand

Researcher Name: Rom Pairsuwan **Ethics Number:** 56362

Thank you so much for participating in this study. Your participation was very valuable. It has been acknowledged that you are very busy and very much appreciate the time you devoted to participating in this study. There was some information about the study that could not be discussed with you prior to the study, because doing so probably would have impacted your actions and thus skewed the study results. This form explains these things to you now.

What is the research about?

The main purpose of this study is to examine the roles of a science park in the entrepreneurial ecosystem and how they may impact each other. The entrepreneurial ecosystem concept explains the interrelationship between a variety of elements, which can be categorized into three main groups including cultural, social, and material, that promotes new venture formation and growth. However, the roles of a science park have been under-explored in the entrepreneurial ecosystem study. Therefore, this study aims to answer these two research questions.

RQ1: Which roles can a science park play in the entrepreneurial ecosystem?

RQ2: How do a science park and the entrepreneurial ecosystem have an impact on each other?

A better understanding of the interrelationship between the two may lead to the sustainable growth of a science park along with the entrepreneurial ecosystem in the region.

Use of active deception or misleading participants

There is no active deception or misleading used in this study.

We hope this clarifies the purpose of the research, and the reason why we could not tell you all of the details about the study prior to your participation. If you would like more information about the research, you may be interested in the following:

Feld, B. (2012) *Startup communities: Building an entrepreneurial ecosystem in your city.* New York: NY:Willey.

Isenberg, D. (2010) 'How to start an entrepreneurial revolution', *Harvard Business Review*, pp. 40–50.

Spigel, B. (2017) 'The Relational Organization of Entrepreneurial Ecosystems', *Entrepreneurship Theory and Practice*, 41(1), pp. 49–72.

If you have any questions or concerns, you may contact me:

Rom Pairsuwan (R.Pairsuwan@soton.ac.uk)

If you have questions about your rights as a participant in this research, or if you feel that you have been placed at risk, you may contact the Research and Integrity Governance Manager, University of Southampton, Southampton, SO17 1BJ. Phone: 02380 595058, Email: rgoinfo@soton.ac.uk

A.5 Interview Guideline

Study Title: The roles of Science Park in the Entrepreneurial Ecosystem: A case study of the Northern Science Park, Thailand

Principal Investigator: Rom Pairsuwan

Interview protocol (The interview should last between 60 – 90 minutes.)

1. **Greeting** – Principal Investigator introduces himself to a participant and gives him/her a brief overview of the study and interview procedure.
2. **Preliminary Interview** – Principal Investigator asks a participant to briefly talk about his/her background and current job/business.
3. **Main Interview** - Principal Investigator begins the interview using a set of questions which is specifically designed for each type of participant (see Interview). Some questions may be skipped or emerged during the interview as appropriate.
4. **Ending Interview** – Principal Investigator closes the interview and thanks the participant for his/her contribution to the study.

Appendix B Interview Questions

B.1 Interview Questions for Entrepreneurs.

Type of attribute	Entrepreneurial Ecosystem attribute	Questions
Cultural	Histories of entrepreneurship	Have you ever heard of or exchanged entrepreneurial ventures with others, especially with successful local entrepreneurs? Did that happen because of the science park? How did those stories have an impact on you? Did your decision to join the science park influenced by other entrepreneurial ventures?
	Supportive culture	Did you feel a strong and supportive culture for entrepreneurship working with the science park? Would you please share your impressions? Have you ever tried to start a business and failed? How did you get back in the game? How did the science park support you?
Social	Entrepreneurial Networks	How did you get into pre-existing entrepreneurial networks in Chiang Mai? Has the science park supported you in this regard? How? (establishing/improving/maintaining/filtering relationships, etc.) How did the networks make difference to your business? (business advice, new knowledge and skills, entrepreneurial opportunities, access to financing, access to suppliers and customers, etc.)
	Workers	Did you have difficulties in hiring and retaining qualified workers? Has the science park ever supported you in this regard? How? **If the participant is not involved in recruitment, use the following questions.* Did you have difficulties finding a job in Chiang Mai? Did you find this job because of the science park? Why did you willing to work with start-ups rather than large corporations?
	Investment capital	**If the participant has no external funding, skip the questions.* How did your business get funding? Did you have difficulties accessing investment capital? Has the science park ever helped you to access a pool of capital? How?

Appendix B

Type of attribute	Entrepreneurial Ecosystem attribute	Questions
Material	Policy and governance	How did you benefit from the entrepreneurial policies? (Such as state-run campaigns, and regulations) Has the science park ever supported you in this regard?
	Universities	**Skip this question if the participant has never collaborated with the university.* How did the science park make difference to your business in collaboration with the universities? **Skip the questions if the participant is currently not a student or did not graduate from universities in Chiang Mai.* Have you ever attended any activities hosted by the science park when you are/were a student? How did the science park have an impact on your entrepreneurial venture?
	Markets	Where are your target markets located? Did you have difficulties accessing those markets? Has the science park ever created an opportunity for you to reach the markets? How?
	Support services and physical infrastructures	What kind of support services offered by the science park have you ever used? (lawyers, accountants, marketing consultants, recruiters, incubators, office space, laboratory) Why did you decide to use the science park's services instead of other providers in Chiang Mai?

B.2 Interview Questions for Science and Technology Park.

Type of attribute	Entrepreneurial Ecosystem attribute	Questions
Cultural	Histories of entrepreneurship	How did the science park work with successful local entrepreneurs? How did the stories of successful local entrepreneurs have an impact on the science park?
	Supportive culture	How did the science park create and sustain a strong and supportive culture for entrepreneurship? How did the science park support entrepreneurs who failed? How did the entrepreneurial culture in Chiang Mai have an impact on the science park?
Social	Entrepreneurial Networks	How did the science park support entrepreneurs in terms of networking? How did the entrepreneurial networks in Chiang Mai have an impact on the science park?
	Workers	Has the science park ever helped entrepreneurs to recruit and retain qualified workers? How? How did a pool of workers in Chiang Mai have an impact on the science park? **If the participant is not involved in recruitment, use the following questions.* How did you know about this job? Why did you willing to work with the science park?
	Investment capital	**If the participant is not involved in business funding, skip the questions.* How did the science park support entrepreneurs to get access to investment capital? How did a pool of capital in Chiang Mai have an impact on the science park?
Material	Policy and governance	How did the science park support entrepreneurs in terms of governmental policies? How did the governmental policies have an impact on the science park?
	Universities	How has the science park changed due to the collaboration with the universities in Chiang Mai? (Such as research capability, knowledge spill-over, entrepreneurial training, shared facilities, etc.) How many graduate students from universities in Chiang Mai become entrepreneurs or science park staff? How about academic spin-offs?

Type of attribute	Entrepreneurial Ecosystem attribute	Questions
	Markets	How did the science park create opportunities for entrepreneurs to access their target markets? How did the local markets in Chiang Mai have an impact on the science park?
	Support services and physical infrastructures	What kind of support services and physical infrastructures does the science park provide for entrepreneurs? How did the other service providers in Chiang Mai have an impact on the science park?

B.3 Interview Questions for Entrepreneurial Support Organisations.

Type of attribute	Entrepreneurial Ecosystem attribute	Questions
Cultural	Histories of entrepreneurship	**For private institutions* Has the science park created more successful entrepreneurs in Chiang Mai?
	Supportive culture	**For private institutions* How has the entrepreneurial culture in Chiang Mai changed because of the science park?
Social	Entrepreneurial Networks	**For private institutions & other actors in the network.* How has the science park changed the entrepreneurial networks in Chiang Mai? (entrepreneurial density, social ties, social circle, structural holes, etc)
	Workers	**For private institutions* How has the science park changed the pool of workers in Chiang Mai? (attracting more workers into the region?)
	Investment capital	**For financial bodies.* How has the venture capital in Chiang Mai changed because of the science park? (attract more capital into the region?)
Material	Policy and governance	**For governmental agencies.* Did the science park influence entrepreneurial policies? How?
	Universities	**For university.* How has the university changed because of the collaboration with the science park? (Such as entrepreneurship programs, TTO, academic spin-off, culture, etc.)
	Markets	**For private institutions.* How have local markets in Chiang Mai changed because of the science park?
	Support services and physical infrastructures	**For other service providers.* How have service providers in Chiang Mai changed because of the science park?

Appendix C Entrepreneurial ecosystem literature

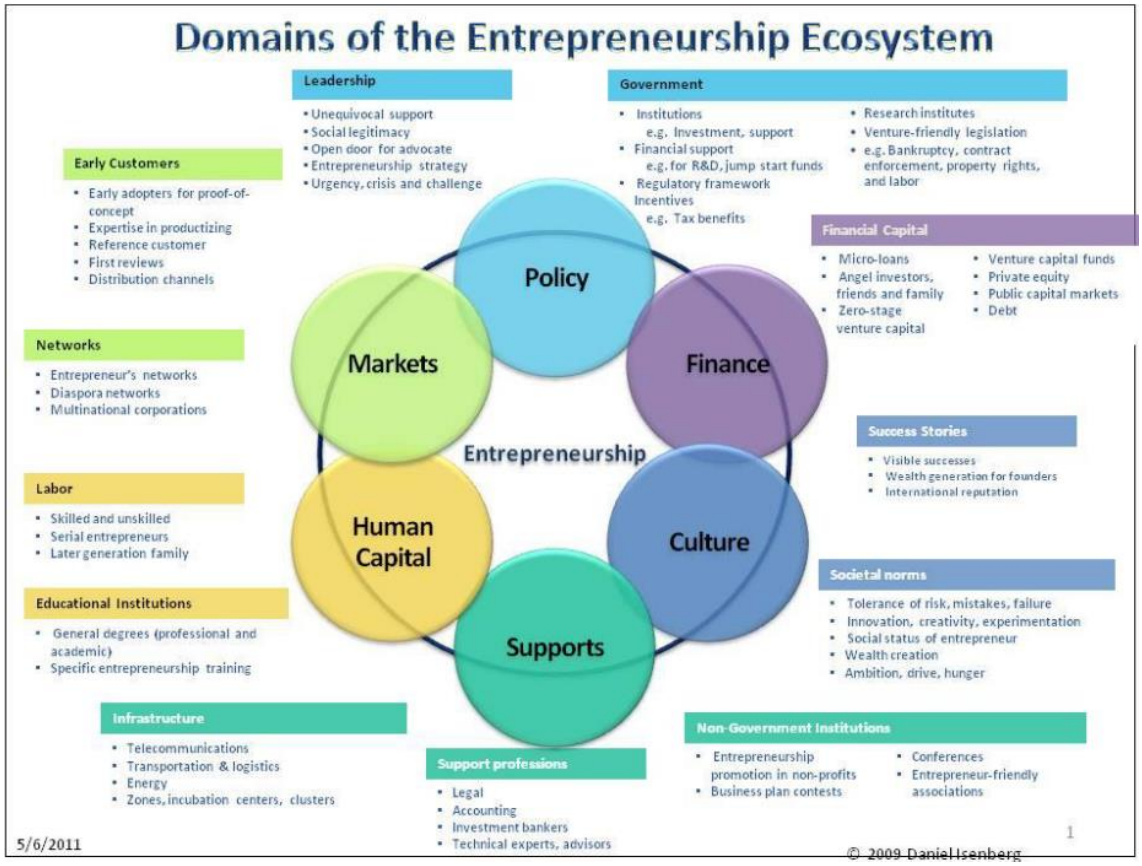
C.1 The elements of an entrepreneurial ecosystem.

C.1.1 Entrepreneurial ecosystem components applied to sustainable entrepreneurial ecosystems.

System component	Definition/applicability to traditional systems	Application to sustainable entrepreneurial ecosystem (SEE)
Informal network	Represents the entrepreneur's friends, families, colleagues and informal relations with similar companies (Neck *et al.*, 2004; Birley, 1985).	The same members of an informal network can assist (or hinder) an entrepreneur in pursuit of sustainable innovations. Sustainable entrepreneurs sometimes face more barriers from the formal network so the importance of the informal may be even greater.
Formal network	Is a diverse group of actors in an economic community such as a research university, government, professional and support services, capital sources, talent and large corporations (Neck *et al.*, 2004; Birley, 1985).	Members of the formal network often cause challenges for sustainable entrepreneurs due to lack of understanding/expertise in sustainability. Formal network actors are addressed individually below.
University	Research universities can have a significant impact on the evolution of an ecosystem through primary research and education of skilled workers (Bruno and Tybejee, 1982; Neck *et al.*, 2004).	Research universities can create and disseminate knowledge regarding sustainability and even developing and commercializing technologies, prior impacts of unsustainable behaviour and raising awareness in the community at large, particularly through leading by example.
Government	Federal, regional and local governments foster or hinder the development of entrepreneurial ecosystems through tax rates and incentives, subsidies and grants and eliminating the bureaucratic 'red tape' (Siegel *et al.*, 2003).	Governments can play a significant role in fostering an SEE through policies that encourage or mandate more sustainable behaviour on the part of consumers and firms. Much innovation can actually be compelled through proper policy application (e.g. mandating reduced vehicle emissions).
Professional and support services	Entrepreneurial support services include entrepreneurial tax and legal support, consultants, and firms in the supply chain (Neck *et al.*, 2004).	To support the SEE, a variety of specialty advisers who understand and value sustainability principles should be present to overcome barriers from traditional advisers who do not understand the challenges faced by these ventures (Schick *et al.*, 2002).
Capital services	Access to start-up capital such as venture capital or angel investors for new ventures is of critical importance in the development of entrepreneurial ecosystems (Prevezer, 2001; Neck *et al.*, 2004).	Sustainable ventures are also dependent upon access to start-up capital, and often have challenges finding investors who understand their businesses and share their values (Schick *et al.*, 2002). Specialized 'green investors' are needed.
Talent pool	Access to a large number of qualified employees is critical for the success of an entrepreneurial ecosystem (Neck *et al.*, 2004).	Access to qualified employees with knowledge and values relating to sustainability would be helpful. Employees looking for sustainable innovations are also necessary.

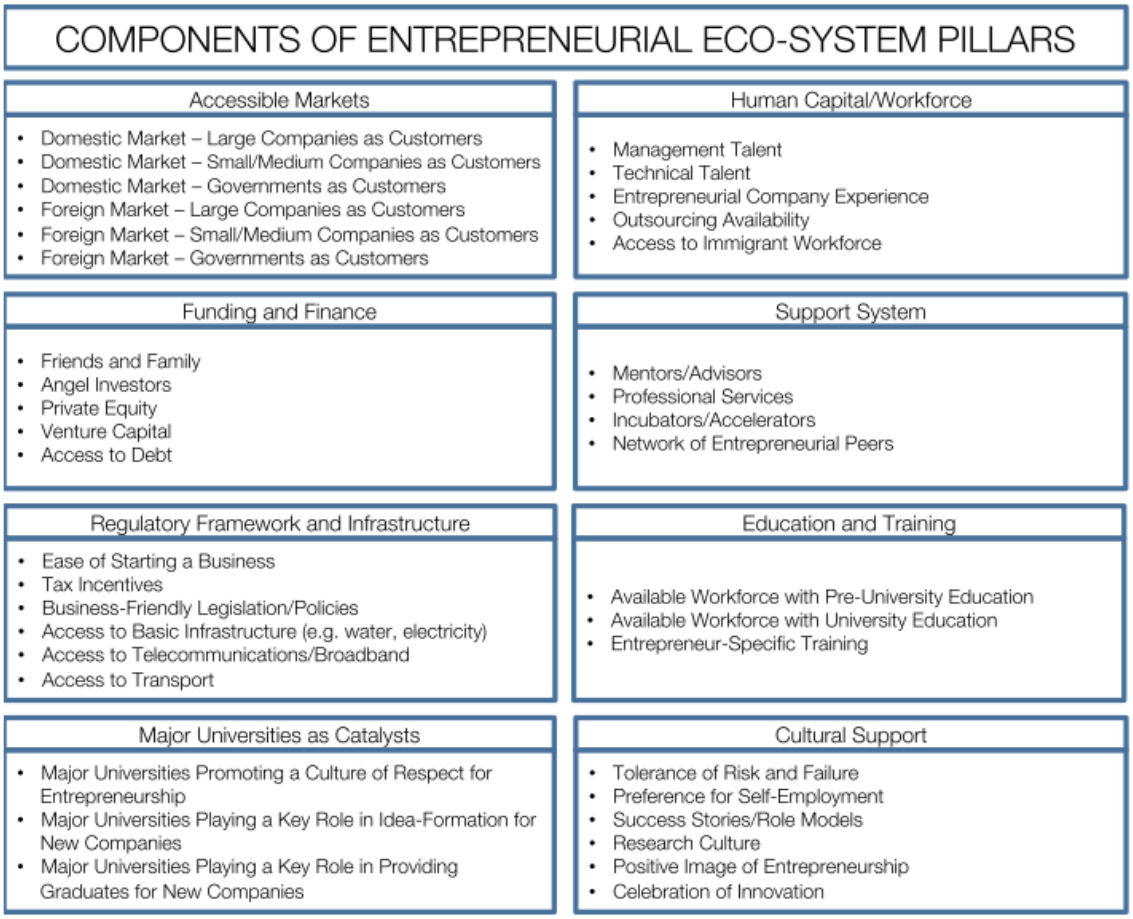
Source: Cohen (2006, p. 4)

C.1.2 Domains of the entrepreneurship ecosystem.



Source: Isenberg (2011, p. 7)

C.1.3 Components of entrepreneurial eco-system pillars.



Source: WEF (2013, p. 7)

C.1.4 Attributes of entrepreneurial ecosystems.

Type of Attribute	Attribute	Description	Examples
Cultural	Supportive culture	Cultural attitudes which support and normalize entrepreneurial activities, risk taking, and innovation.	Aoyama (2009); Feldman (2001); Julien (2007)
	Histories of entrepreneurship	Prominent local example of successful entrepreneurial ventures.	Nelles et al. (2005); Feld (2012)
Social	Worker talent	Presence of skilled workers who are willing to work at startups.	Arruda, Nogueira, and Costa (2014); Audretsch et al. (2011); Bahrami and Evans (1995); Harrison and Leitch (2010)
	Investment capital	Availability of investment capital from family and friends, angel investors, and venture capitalists.	van der Borgh, Cloodt, and Romme (2012); Kenney and Patton (2005); Malecki (2009)
	Networks	Presence of social networks that connect entrepreneurs, advisors, investors, and workers and that allow the free flow of knowledge and skills.	Dubini (1989); Malecki (1997); Neck et al. (2004)
	Mentors and role models	Local successful entrepreneurs and business people who provide advice for younger entrepreneurs	Feld (2012); Kenney and Patton (2005); World Economic Forum (2013)
Material	Policy and governance	State-run programs or regulations that either support entrepreneurship through direct funding or remove barriers to new venture creation.	Desrochers and Saulet (2008); Isenberg (2010)
	Universities	Universities and other higher education institutions which both train new entrepreneurs and produce new knowledge spillovers.	Audretsch et al. (2011); Dubini (1989); Feldman et al. (2005); Wolfe (2005)
	Support services	Firms and organizations that provide ancillary services to new ventures, for example, patent lawyers, incubators, or accountancies.	Kenney and Patton (2005); Patton and Kenney (2005); Startup Genome Project (2012)
	Physical infrastructure	Availability of sufficient office space, telecommunication facilities, and transportation infrastructure to enable venture creation and growth.	Audretsch et al. (2011); Mack and Rey (2014)
	Open markets	Presence of sufficient local opportunities to enable venture creation and unimpeded access to global markets.	Spilling (1996); World Economic Forum (2013)

Source: Spigel (2017, p. 56)

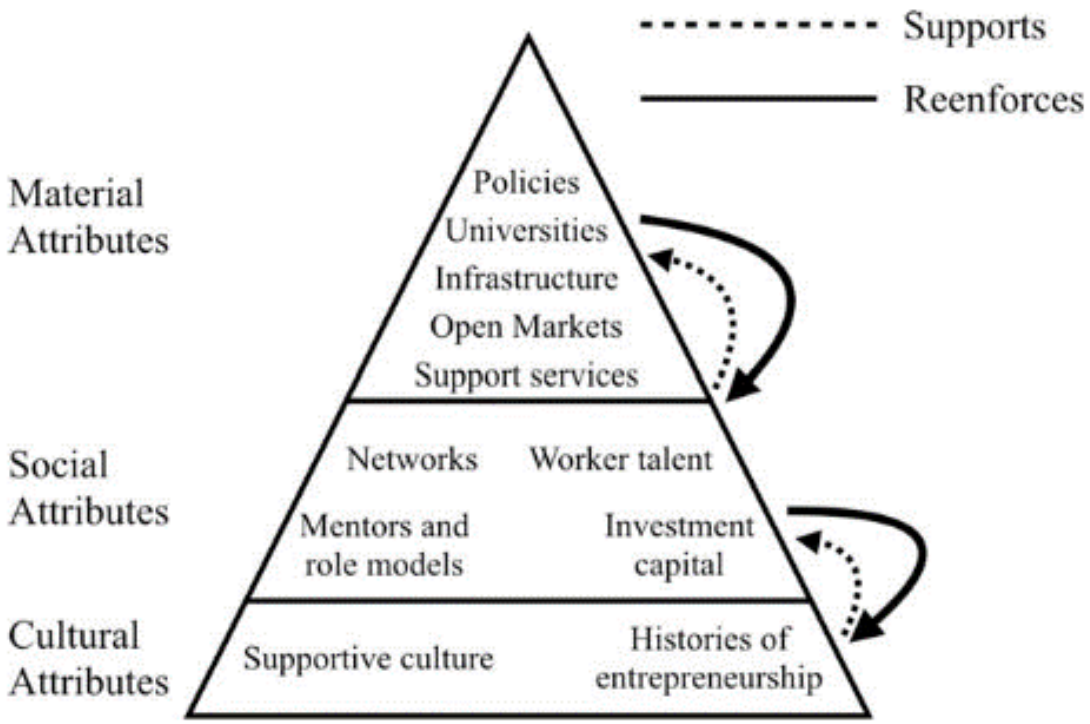
C.1.5 Constructs of entrepreneurial ecosystem elements and outputs.

Concept	Construct	Definition	Element
Institutions	Formal institutions	The rules of the game in society	Formal institutions
	Informal institutions	Cultural context	Culture
	Social networks	The social context of actors, especially the degree to which they are socially connected	Networks
Resources	Physical resources	The physical context of actors that enables them to meet other actors in physical proximity	Physical infrastructure
	Financial resources	The presence of financial means to invest in activities that do not yet deliver financial means	Finance
	Leadership	Leadership that provides guidance for, and direction of, collective action	Leadership
	Human capital	The skills, knowledge and experience possessed by individuals	Talent
	Knowledge	Investments in (scientific and technological) knowledge creation	Knowledge
	Means of consumption	The presence of financial means in the population to purchase goods and services	Demand
	Producer services	The intermediate service inputs into proprietary functions	Intermediate services
New value creation	Productive entrepreneurship	Any entrepreneurial activity that contributes (in)directly to net output of the economy or to the capacity to produce additional output	Productive entrepreneurship

Source: Stam and van de Ven (2021, p. 814)

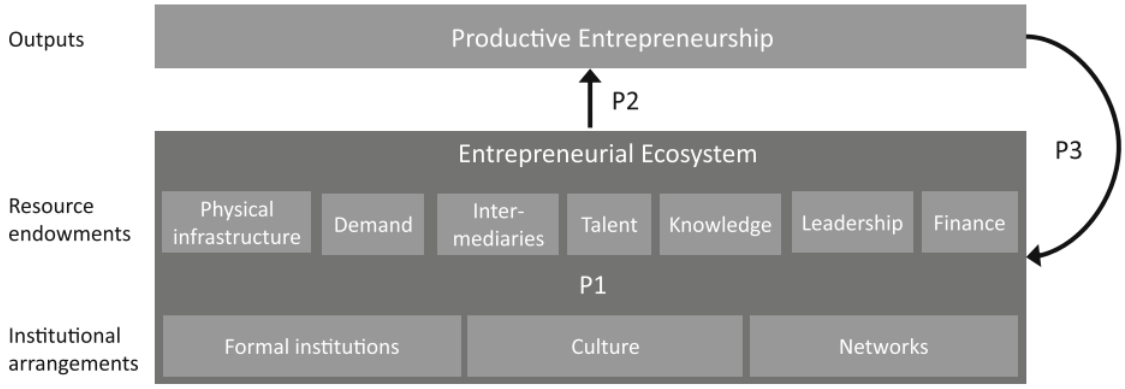
C.2 The causal relationship among the elements of an entrepreneurial ecosystem.

C.2.1 Relationships among ecosystem attributes.



Source: Spigel (2017, p. 57)

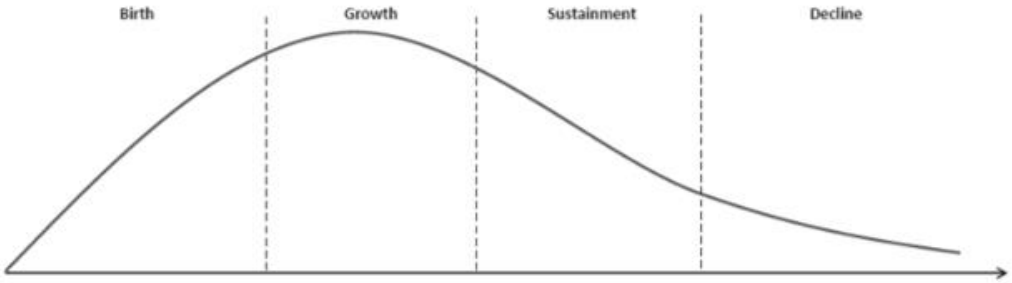
C.2.2 Elements and outputs of the entrepreneurial ecosystem.



Source: Stam and van de Ven (2021, p. 813)

C.3 The evolution of an entrepreneurial ecosystem.

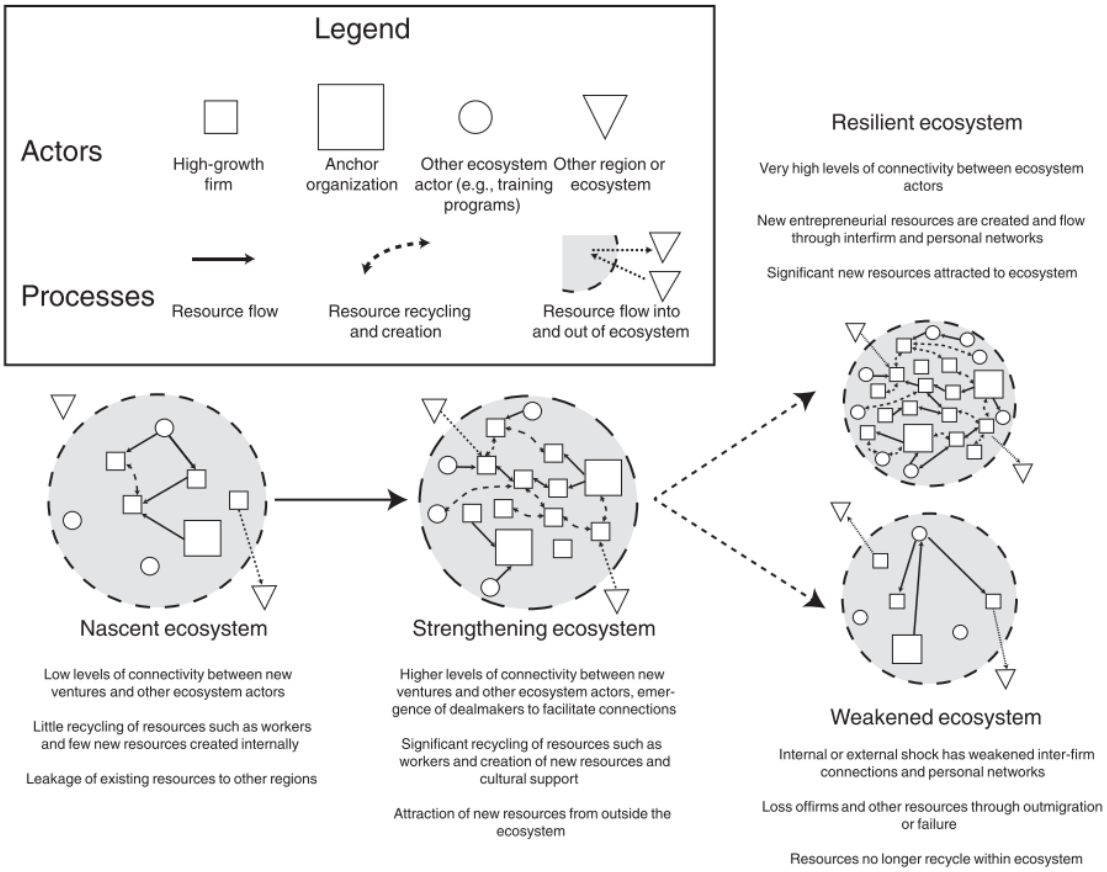
C.3.1 Evolution of an Entrepreneurial Ecosystem.



Firm entries and exits	Low firm birth rates, few to no firm exits, firm births > firm deaths	Growing firm birth rates, but also growing number of firm exits, firm births > firm deaths	Declining firm birth rates, firm births < firm deaths	Low firm birth rates, Firm births < firm deaths
Policy	Policy oriented towards traditional economic development efforts (clusters, firm attraction and retention). Not yet oriented towards entrepreneurship.	Growing perception among regional policymakers about the need to build EE, first activities to tailor policy towards entrepreneurship	Dedicated and widespread leadership in support of entrepreneurship is critical to sustain evolution of EE	Leadership in favor of EE starts to disappear, possibly reoriented towards other types of economic development efforts (boosterism, firm attraction, etc.)
Finance	Financial capital is becoming available and starts to be more risk-oriented, but limited in terms of quantity and risk-orientation	Financial capital is getting easier to access as investors have started to develop trust in EE	Financial capital still available, but harder to access because trust is starting to decline	Decline of financial capital
Culture	Few success stories, tolerance of risk and failures not yet developed, few personalities who stand out as entrepreneurs	Networks among entrepreneurs in the region become important as entrepreneurs are better known; societal norms may change in favor of EE	Success stories become critical as firm deaths are starting to increase	Entrepreneurial culture starts to decline in terms of both success stories and favorable societal norms
Support	Emergence of pioneering support organizations such as incubators, nonprofit groups, entrepreneurship-oriented infrastructure etc	Non-governmental institutions in support of entrepreneurship start to become more specialized and targeted towards new firm creation	Non-governmental institutions start to diversify, possibly away from EE support	Loss of support through non-governmental institutions
Human Capital	Educational institutions mostly oriented towards general degrees, no serial entrepreneurs	EE starts to see first serial entrepreneurs, educational institutions start offering specific entrepreneurship training programs	Decline of serial entrepreneurship	Entrepreneurship is not seen as a career option anymore
Markets	Markets for entrepreneurs not yet developed; Firms - often large firms - in the region do not function as incubators nor are they customers for regional entrepreneurial firms	Market opportunities for entrepreneurs in the region develop, also start to see national and international market opportunities	Market opportunities decline (regionally, nationally and internationally), networks start to decline	Market connections and networks disappear
Policy Implications	Lowering the hurdles for entrepreneurship, networking existing and nascent entrepreneurs, building an entrepreneurship-friendly support infrastructure	Expansion of firm births through support in terms of financial capital, but also networking oppts, etc. important	Strengthening of networks: particularly diaspora and multinational networks	Avoid lock-in of EE through e.g. infusion of new ideas, connections to other entrepreneurial ecosystems nationally and internationally

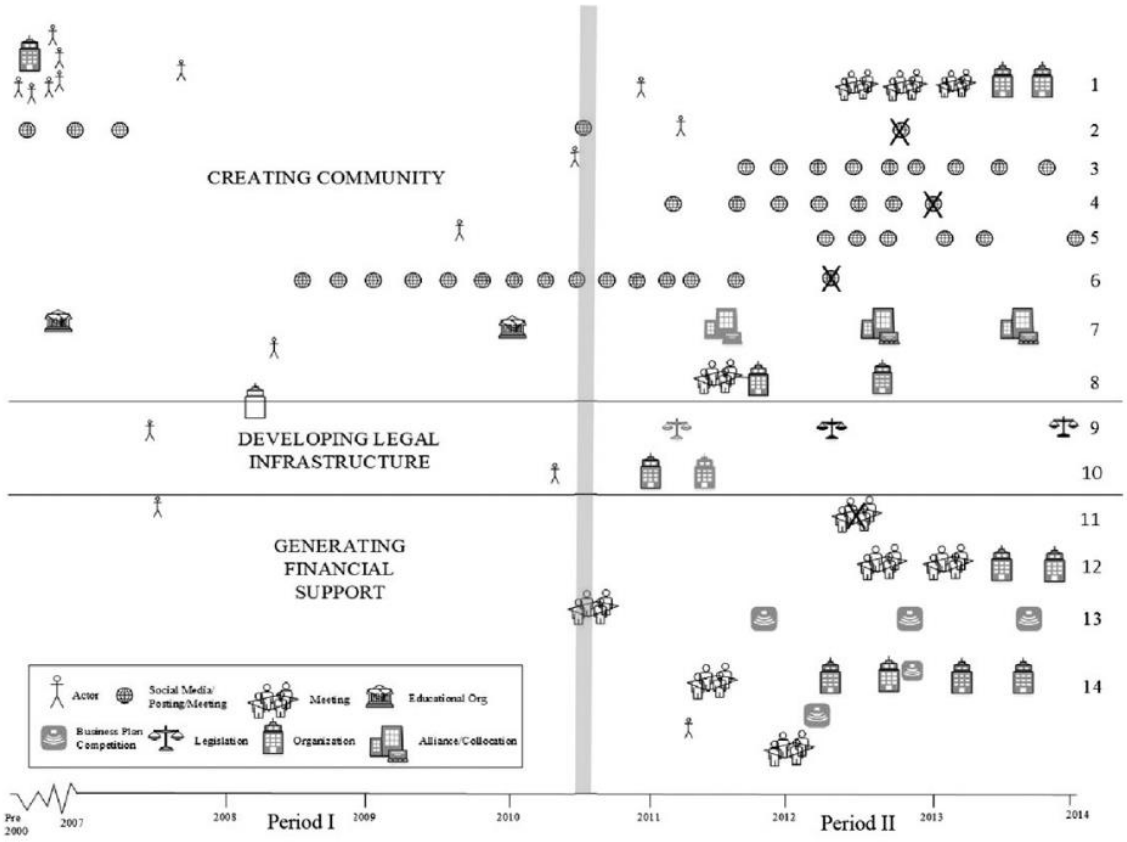
Source: Mack and Mayer (2016, pp. 2122-2123)

C.3.2 Transformation of entrepreneurial ecosystem.



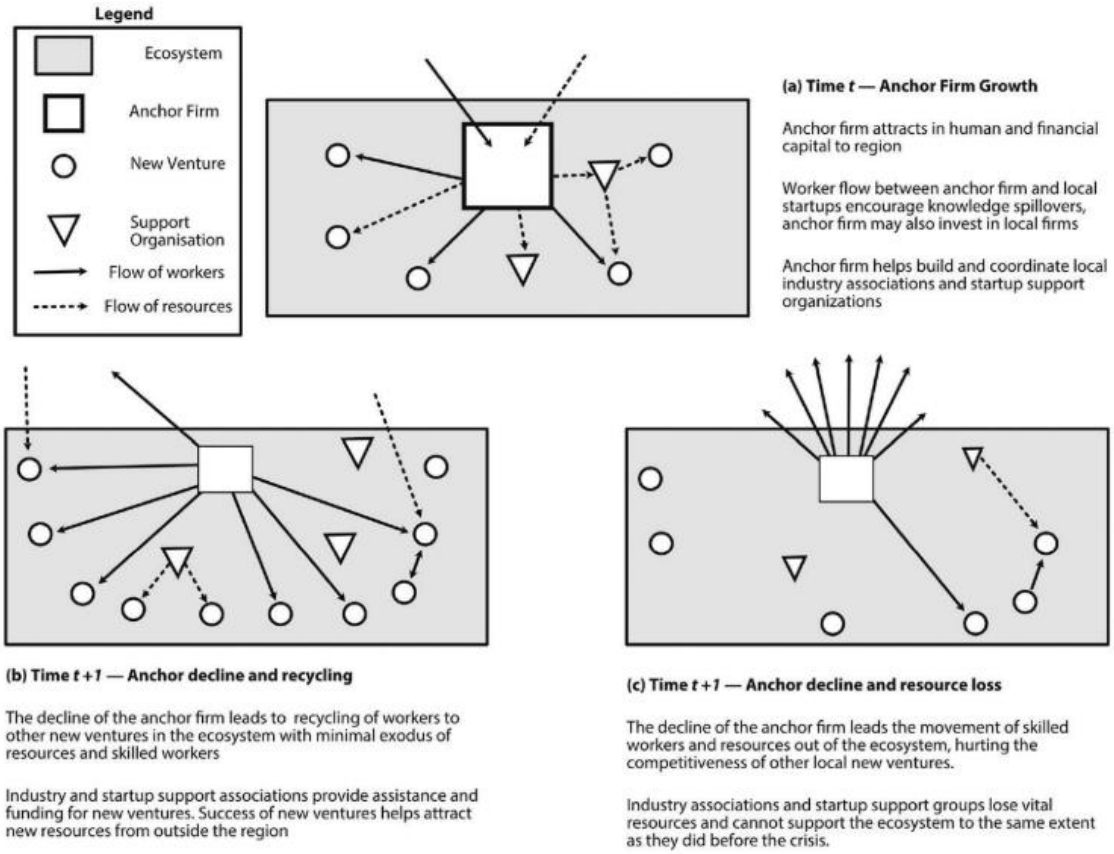
Source: Spigel and Harrison (2018, p. 162)

C.3.3 Development of intra-thread patterns of activity, Seattle social impact business entrepreneurial ecosystem, 2000-2014.



Source: Thompson, Purdy and Ventresca (2018, p. 107)

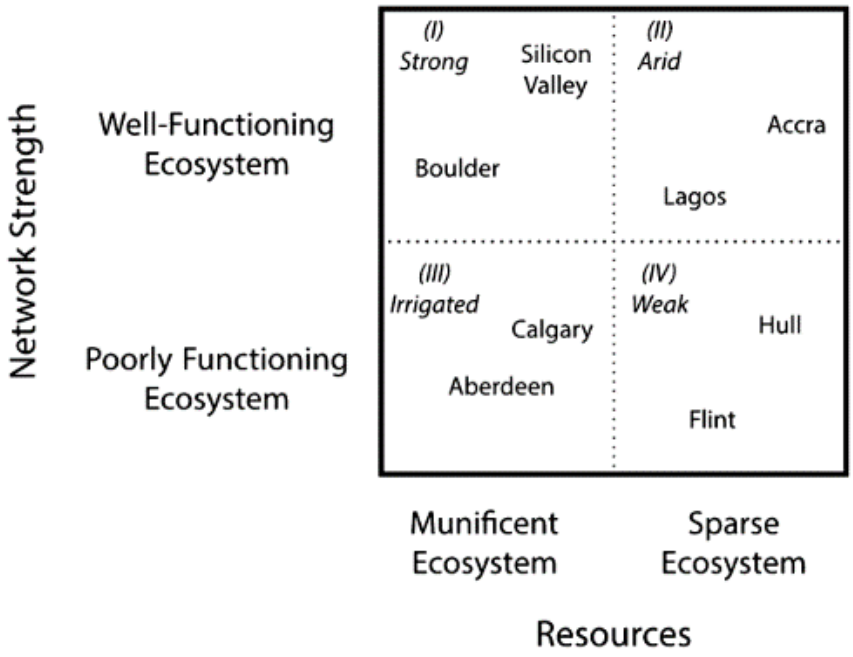
C.3.4 Entrepreneurial ecosystem pathways after anchor collapse.



Source: Spigel and Vinodrai (2020, p. 9)

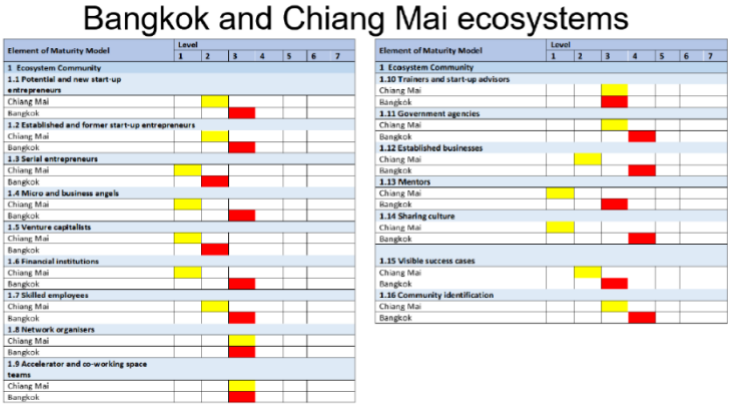
C.4 The strength of an entrepreneurial ecosystem.

C.4.1 Representative schematic of ecosystem types.



Source: Spigel and Harrison (2018, p. 163)

C.4.2 Entrepreneurial ecosystem maturity model.



Source: Autio *et al.* (2019)

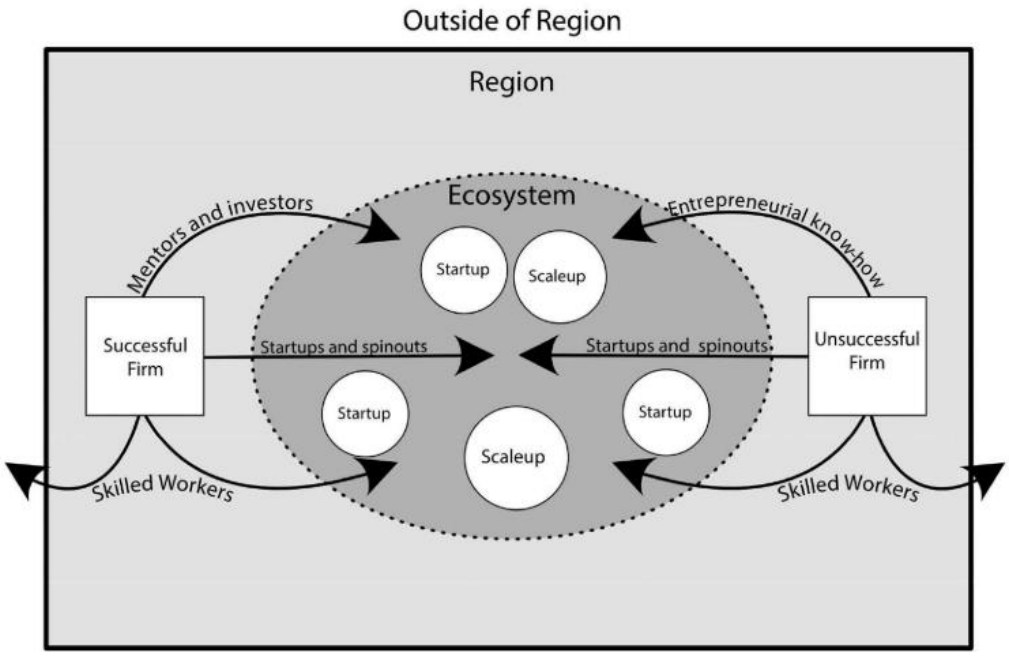
C.4.3 Operationalization of the indicators of entrepreneurial ecosystem elements and output.

Elements	Description	Empirical indicators	Data source
Formal institutions	The rules of the game in society	Two composite indicators measuring the overall quality of government (consisting of scores for corruption, accountability, and impartiality) and the ease of doing business	Quality of Government Survey (QOG) and the World Bank Doing Business Report
Entrepreneurship culture	The degree to which entrepreneurship is valued in a region	A composite measure capturing the regional entrepreneurial culture, consisting of entrepreneurial motivation, cultural and social norms, importance to be innovative, and trust in others	Global Entrepreneurship Monitor (GEM) and European Social Survey (ESS)
Networks	The connectedness of businesses for new value creation	Percentage of SMEs that engage in innovative collaborations as a percentage of all SMEs in the business population	Regional Innovation Scoreboard (RIS)
Physical Infrastructure	Transportation infrastructure and digital infrastructure	Four components in which the transportation infrastructure is measured as the accessibility by road, accessibility by railway and number of passenger flights and digital infrastructure is measured by the percentage of households with access to internet	Regional Competitiveness Index (RCI)
Finance	The availability of venture capital and access to finance	Two components: The average amount of venture capital per capita and the percentage of SMEs that is credit constrained	Invest Europe and European Investment Bank (EIB)
Leadership	The presence of actors taking a leadership role in the ecosystem	The number of coordinators on H2020 innovation projects per capita	Community Research and Development Information Service (CORDIS)
Talent	The prevalence of individuals with high levels of human capital, both in terms of formal education and skills	Four components: The percentage of the population with tertiary education, the percentage of the working population engaged in lifelong learning, the percentage of the population with an entrepreneurship education, the percentage of the population with e-skills	Eurostat and the Global Entrepreneurship Monitor (GEM)
New Knowledge	Investments in new knowledge	Intramural R&D expenditure as a percentage of Gross Regional Product	Eurostat
Demand	Potential market demand	Three components: disposable income per capita, potential market size expressed in GRP, potential market size in population. All relative to EU average.	Regional Competitiveness Index (RCI)
Intermediate services	The supply and accessibility of intermediate business services	Two components: the percentage of employment in knowledge-intensive market services and the number of incubators/ accelerators per capita	Eurostat and Crunchbase
Output	Entrepreneurial output	The number of Crunchbase firms founded in the past five years per capita	Crunchbase
	Unicorn output	The absolute number of unicorns in the region founded in the last ten years	CB Insights and Dealroom

Source: Leendertse, Schrijvers and Stam (2022, p. 4)

C.5 The entrepreneurial recycling in the entrepreneurial ecosystem.

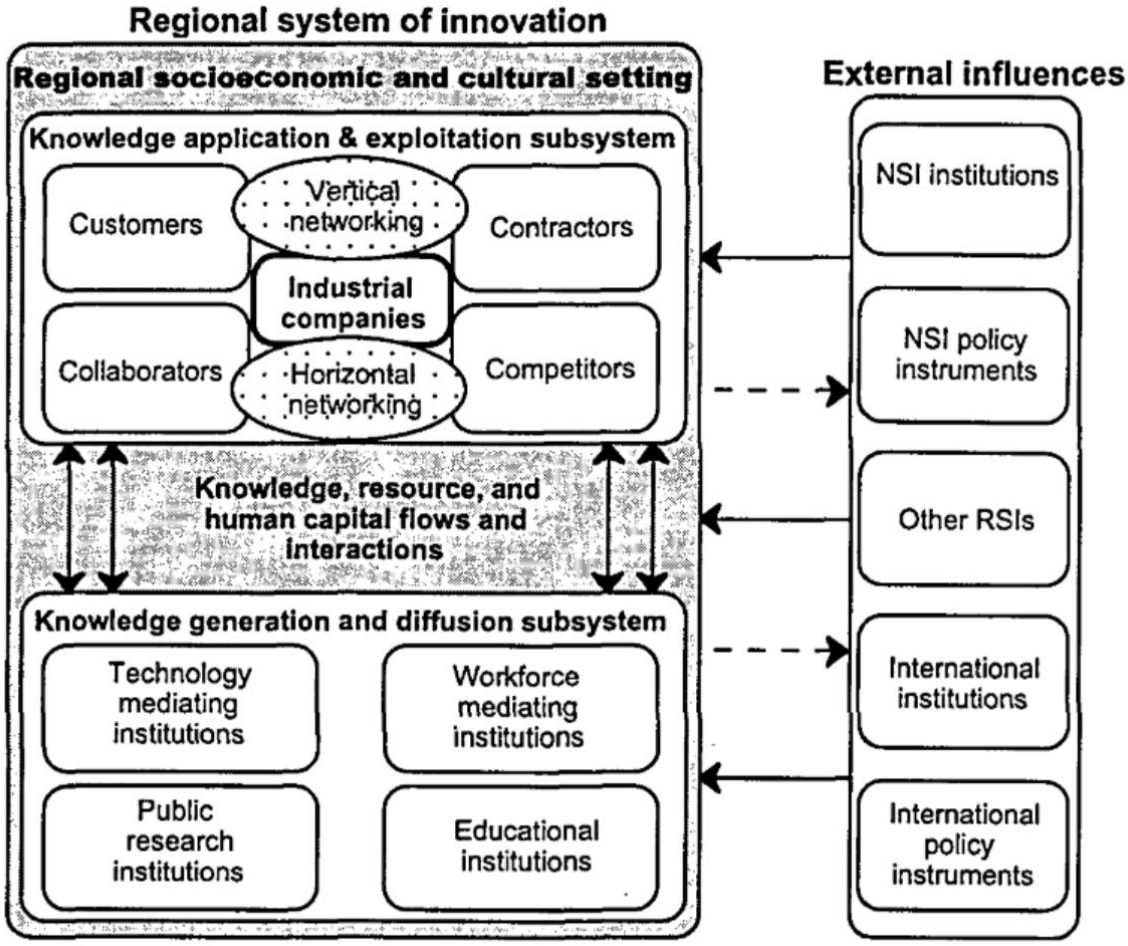
C.5.1 Recycling within entrepreneurial ecosystems.



Source: Spigel and Vinodrai (2020, p. 5)

Appendix D Science and technology park literature

D.1 Schematic illustration of the structuring of Regional System of Innovations.



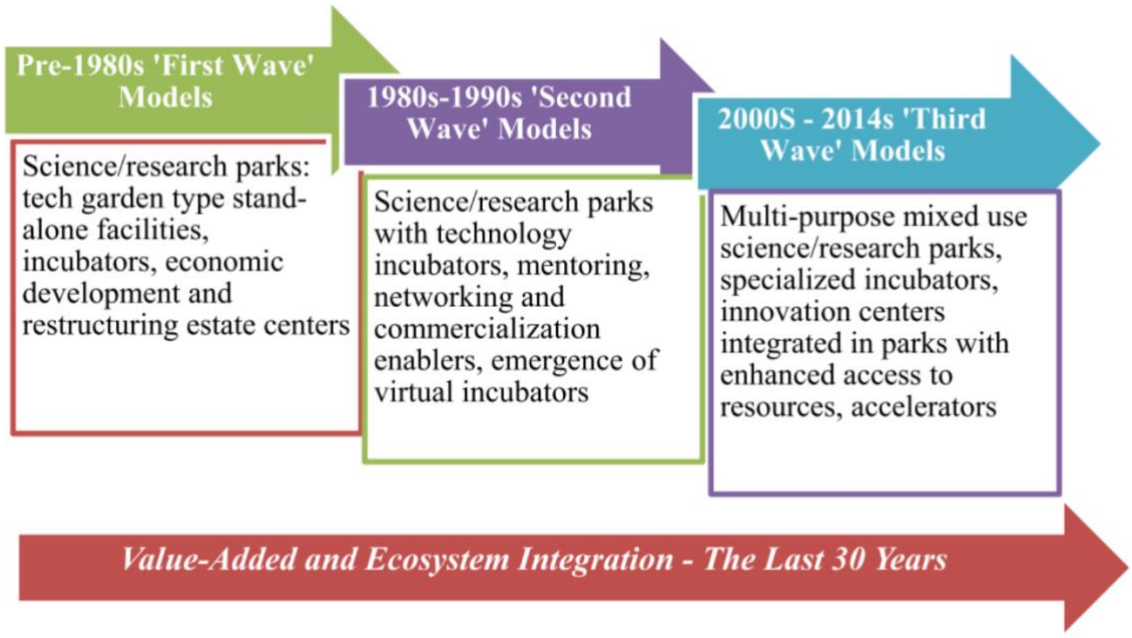
Source: Autio (1998, p. 134)

D.2 Phases of the Incubation Process and associated Technology Business Incubator Mechanisms.

Phase 1: Pre-Incubation/Idea development	Phase 2: Incubation and Acceleration	Phase 3: Post-Incubation, Consolidation and Growth
Technology Business Incubator/ German Innovation Center		
	Science Park/Research Park Accelerator	
French Academic Incubator	*Pépinière* and Hatchery	Technopolis

Source: Mian, Lamine and Fayolle (2016, p. 2)

D.3 The Evolution of Technology Business Incubation Models.



Source: Mian, Lamine and Fayolle (2016, p. 3)

List of References

Acs, Z. J., Stam, E., Audretsch, D. B. and O'Connor, A. (2017) 'The lineages of the entrepreneurial ecosystem approach', *Small Business Economics,* 49(1), pp. 1-10.

Adams, S. B. (2021) 'From orchards to chips: Silicon Valley's evolving entrepreneurial ecosystem', *Entrepreneurship & Regional Development,* 33(1-2), pp. 15-35.

Alvedalen, J. and Boschma, R. (2017) 'A critical review of entrepreneurial ecosystems research: towards a future research agenda', *European Planning Studies,* 25(6), pp. 887-903.

Aoyama, Y. (2009) 'Entrepreneurship and Regional Culture: The Case of Hamamatsu and Kyoto, Japan', *Regional Studies,* 43(3), pp. 495-512.

Audretsch, D., Mason, C., Miles, M. P. and O'Connor, A. (2021) 'Time and the dynamics of entrepreneurial ecosystems', *Entrepreneurship & Regional Development,* 33(1-2), pp. 1-14.

Audretsch, D. B. and Link, A. N. (2012) 'Entrepreneurship and innovation: Public policy frameworks', *The Journal of Technology Transfer,* 37(1), pp. 1-17.

Auerswald, P. E. (2015) *Enabling entrepreneurial ecosystems: Insights from ecology to inform effective entrepreneurship policy*, United States: Ewing Marion Kauffman Foundation. Available at: https://www.kauffman.org/wp-content/uploads/2019/12/enabling_entrepreneurial_ecosystems.pdf (Accessed: 5 September 2022).

AURP (2022) *What is a Research Park/Innovation District?*: Association of University Research Parks. Available at: https://www.aurp.net/what-is-a-research-park (Accessed: 5 September 2022).

Autio, E. (1998) 'Evaluation of RTD in regional systems of innovation', *European Planning Studies,* 6(2), pp. 131-140.

Autio, E., Cao, Z., Chumjit, S., Kaensup, P. and Temsiripoj, W. (2019) 'Entrepreneurial Ecosystem Advantage: Ecosystem Interactions and Business Model Innovation'. *AOM Annual Meeting Proceedings 2019*, Boston, 13 August 2019: Academy of Management.

Autio, E., Kenney, M., Mustar, P., Siegel, D. and Wright, M. (2014) 'Entrepreneurial innovation: The importance of context', *Research Policy,* 43(7), pp. 1097-1108.

Autio, E., Nambisan, S., Thomas, L. D. W. and Wright, M. (2018) 'Digital affordances, spatial affordances, and the genesis of entrepreneurial ecosystems', *Strategic Entrepreneurship Journal,* 12(1), pp. 72-95.

Bakouros, Y. L., Mardas, D. C. and Varsakelis, N. C. (2002) 'Science park, a high tech fantasy?: An analysis of the science parks of Greece', *Technovation,* 22(2), pp. 123-128.

Baumol, W. J. (1968) 'Entrepreneurship in Economic Theory', *American Economic Review,* 58(2), pp. 64-71.

BOI (2015) *Thailand Moving Ahead with Cluster Development*: Thailand Board of Investment. Available at: https://www.boi.go.th/upload/content/BOI-brochure-cluster%20area-EN-20151116_53354.pdf (Accessed: 2 September 2022).

Bramwell, A. and Wolfe, D. A. (2008) 'Universities and regional economic development: The entrepreneurial University of Waterloo', *Research Policy,* 37(8), pp. 1175-1187.

List of References

Brown, R. and Mason, C. (2017) 'Looking inside the spiky bits: a critical review and conceptualisation of entrepreneurial ecosystems', *Small Business Economics,* 49(1), pp. 11-30.

Brown, R. and Mawson, S. (2019) 'Entrepreneurial ecosystems and public policy in action: a critique of the latest industrial policy blockbuster', *Cambridge Journal of Regions Economy and Society,* 12(3), pp. 347-368.

Cavallo, A., Ghezzi, A. and Balocco, R. (2019) 'Entrepreneurial ecosystem research: present debates and future directions', *International Entrepreneurship and Management Journal,* 15(4), pp. 1291-1321.

Champenois, C. and Etzkowitz, H. (2018) 'From boundary line to boundary space: The creation of hybrid organizations as a Triple Helix micro-foundation', *Technovation,* 76-77, pp. 28-39.

Chan, K. F. and Lau, T. (2005) 'Assessing technology incubator programs in the science park: the good, the bad and the ugly', *Technovation,* 25(10), pp. 1215-1228.

Chapin, F. S., Matson, P. A. and Vitousek, P. M. (2002) *Principles of Terrestrial Ecosystem Ecology.* 2nd edn. New York: Springer.

Charmaz, K. (2006) *Constructing grounded theory: A practical guide through qualitative analysis.* 2nd edn. London: SAGE Publications.

Chen, J. Y., Cai, L., Bruton, G. R. R. and Sheng, N. H. (2020) 'Entrepreneurial ecosystems: what we know and where we move as we build an understanding of China', *Entrepreneurship & Regional Development,* 32(5-6), pp. 370-388.

Chiang Mai Municipality (2022) *Chiang Mai Municipality, then and now*: Chiang Mai Municipality. Available at: http://www.cmcity.go.th/list/page/334/%E0%B8%9B%E0%B8%A3%E0%B8%B0%E0%B8%A7%E0%B8%B1%E0%B8%95%E0%B8%B4%E0%B8%84%E0%B8%A7%E0%B8%B2%E0%B8%A1%E0%B9%80%E0%B8%9B%E0%B9%87%E0%B8%99%E0%B8%A1%E0%B8%B2/ (Accessed: 2 September 2022).

Cohen, B. (2006) 'Sustainable valley entrepreneurial ecosystems', *Business Strategy and the Environment,* 15(1), pp. 1-14.

Cohen, W. M., Nelson, R. R. and Walsh, J. P. (2002) 'Links and Impacts: The Influence of Public Research on Industrial R&D', *Management Science,* 48(1), pp. 1-23.

Cooke, P., Gomez Uranga, M. and Etxebarria, G. (1997) 'Regional innovation systems: Institutional and organisational dimensions', *Research Policy,* 26(4-5), pp. 475-491.

Crotty, M. J. (1998) *The Foundations of Social Research: Meaning and Perspective in the Research Process.* London: SAGE Publications.

DBD (2021) 'Registered companies by province', *Department of Business Development*. Available at: https://www.dbd.go.th/download/document_file/Statisic/2564/province/P2021_12.xls (Accessed 2 September 2022).

Denzin, N. K. and Lincoln, Y. S. (2005) *The SAGE Handbook of Qualitative Research.* 5th edn. London: SAGE Publications.

DEPA (2022) *Smart City Thailand*: Digital Economy Promotion Agency. Available at: https://www.depa.or.th/th/smart-city-plan (Accessed: 2 September 2022).

Diez-Vial, I. and Montoro-Sanchez, A. (2017) 'Research evolution in science parks and incubators: foundations and new trends', *Scientometrics,* 110(3), pp. 1243-1272.

Doloreux, D. and Porto Gomez, I. (2017) 'A review of (almost) 20 years of regional innovation systems research', *European Planning Studies,* 25(3), pp. 371-387.

DOPA (2021) 'Thailand's population by province', *Department of Provincial Administration*. Available at: https://stat.bora.dopa.go.th/stat/pk/pk_64.pdf (Accessed 2 September 2022).

Easter-Smith, M., Thorpe, R. and Jackson, P. (2015) *Management & Business Research.* 5th edn. London: SAGE Publications.

Edquist, C. (1997) 'Systems of innovation approaches–their emergence and characteristics', *Systems of Innovation: Technologies, Institutions and Organizations*. London: Pinter, pp. 3-37.

Eisenhardt, K. M. (1989) 'Building Theories from Case-Study Research', *Academy of Management Review,* 14(4), pp. 532-550.

Eisenhardt, K. M. and Graebner, M. E. (2007) 'Theory building from cases: Opportunities and challenges', *Academy of Management Journal,* 50(1), pp. 25-32.

Etzkowitz, H. (2002) 'Incubation of incubators: innovation as a triple helix of university-industry-government networks', *Science and Public Policy,* 29(2), pp. 115-128.

Etzkowitz, H. (2003) 'Research groups as 'quasi-firms': the invention of the entrepreneurial university', *Research Policy,* 32(1), pp. 109-121.

Eveleens, C. P., van Rijnsoever, F. J. and Niesten, E. M. M. I. (2017) 'How network-based incubation helps start-up performance: a systematic review against the background of management theories', *The Journal of Technology Transfer,* 42(3), pp. 676-713.

Fagerberg, J. and Srholec, M. (2008) 'National innovation systems, capabilities and economic development', *Research Policy,* 37(9), pp. 1417-1435.

Fayolle, A. (2013) 'Personal views on the future of entrepreneurship education', *Entrepreneurship & Regional Development,* 25(7-8), pp. 692-701.

Feld, B. (2012) *Startup communities: Building an entrepreneurial ecosystem in your city.* New York: Wiley.

Feldman, M. P. (2001) 'The Entrepreneurial Event Revisited: Firm Formation in a Regional Context', *Industrial and Corporate Change,* 10(4), pp. 861-891.

Fernández Fernández, M. T., Blanco Jiménez, F. J. and Cuadrado Roura, J. R. (2015) 'Business incubation: innovative services in an entrepreneurship ecosystem', *Service Industries Journal,* 35(14), pp. 783-800.

Fernández-Esquinas, M., Merchán-Hernández, C. and Valmaseda-Andía, O. (2016) 'How effective are interface organizations in the promotion of university-industry links? Evidence from a regional innovation system', *European Journal of Innovation Management,* 19(3), pp. 424-442.

Firestone, W. A. (1993) 'Alternative Arguments for Generalizing from Data as Applied to Qualitative Research', *Educational Researcher,* 22(4), pp. 16-23.

Freeman, C. (1987) *National Systems of Innovation: The Case of Japan Technology Policy and Economics Performance - Lessons from Japan.* London: Pinter.

Germain, E., Klofsten, M., Löfsten, H. and Mian, S. (2022) 'Science parks as key players in entrepreneurial ecosystems', *R&D Management*.

Gkypali, A., Kokkinos, V., Bouras, C. and Tsekouras, K. (2016) 'Science parks and regional innovation performance in fiscal austerity era: Less is more?', *Small Business Economics,* 47(2), pp. 313-330.

Grimaldi, R., Kenney, M., Siegel, D. S. and Wright, M. (2011) '30 years after Bayh–Dole: Reassessing academic entrepreneurship', *Research Policy,* 40(8), pp. 1045-1057.

Halkier, B. (2011) 'Methodological Practicalities in Analytical Generalization', *Qualitative Inquiry,* 17(9), pp. 787-797.

Harima, A., Harima, J. and Freiling, J. (2021) 'The injection of resources by transnational entrepreneurs: towards a model of the early evolution of an entrepreneurial ecosystem', *Entrepreneurship & Regional Development,* 33(1-2), pp. 80-107.

Harper-Anderson, E. (2018) 'Intersections of Partnership and Leadership in Entrepreneurial Ecosystems: Comparing Three U.S. Regions', *Economic Development Quarterly,* 32(2), pp. 119-134.

Hayton, J. C. and Cacciotti, G. (2013) 'Is there an entrepreneurial culture? A review of empirical research', *Entrepreneurship & Regional Development,* 25(9-10), pp. 708-731.

Hayton, J. C., George, G. and Zahra, S. A. (2002) 'National culture and entrepreneurship: A review of behavioral research', *Entrepreneurship Theory and Practice,* 26(4), pp. 33-52.

Heron, J. (1996) *Co-operative Inquiry: Research into the Human Condition.* London: SAGE Publications.

Hicks, W. (2018) 'Making a home for digital nomads', *Bangkok Post*. Available at: https://www.bangkokpost.com/tech/1579618/making-a-home-for-digital-nomads (Accessed: 2 September 2022).

Hobbs, K. G., Link, A. N. and Scott, J. T. (2017) 'Science and technology parks: an annotated and analytical literature review', *The Journal of Technology Transfer,* 42(4), pp. 957-976.

Hofstede, G. (1980) *Culture's consequences: International differences in work related values. Cross Cultural Research and Methodology* Beverly Hills, CA: SAGE Publications.

Hynes, C. (2016) 'Why Digital Nomads & Entrepreneurs Keep Choosing Chiang Mai'. Available at: https://www.forbes.com/sites/chynes/2016/07/19/why-digital-nomads-entrepreneurs-keep-choosing-chiang-mai/?sh=64999a2c38ed (Accessed: 2 September 2022).

IASP (2022) *The role of STPs and areas of innovation*: International Association of Science Parks and Areas of Innovation. Available at: https://www.iasp.ws/our-industry/the-role-of-stps-and-areas-of-innovation (Accessed: 5 September 2022).

Intarakumnerd, P., Chairatana, P.-a. and Tangchitpiboon, T. (2002) 'National innovation system in less successful developing countries: the case of Thailand', *Research Policy,* 31(8-9), pp. 1445-1457.

Isenberg, D. (2010) *How to start an entrepreneurial revolution*. Harvard Business Review: Harvard Business Review. Available at: https://hbr.org/2010/06/the-big-idea-how-to-start-an-entrepreneurial-revolution (Accessed: 2 September 2022).

Isenberg, D. (2011) *The Entrepreneurship Ecosystem Strategy as a New Paradigm for Economic Policy: Principles for Cultivating Entrepreneurship* [Presentation], *The Babson Entrepreneurship Ecosystem Project*. Institute of International and European Affairs: Dublin, Ireland. 11 May. Available at: http://www.innovationamerica.us/images/stories/2011/The-entrepreneurship-

ecosystem-strategy-for-economic-growth-policy-20110620183915.pdf (Accessed: 5 September 2022).

Johnson, P. and Clark, M. (2006) *Business and Management Research Methodologies. SAGE Library in Business and Management* 1st edn. London: SAGE Publications.

Kansheba, J. M. P. and Wald, A. E. (2020) 'Entrepreneurial ecosystems: a systematic literature review and research agenda', *Journal of Small Business and Enterprise Development,* 27(6), pp. 943-964.

Kim, Y., Kim, W. and Yang, T. (2012) 'The effect of the triple helix system and habitat on regional entrepreneurship: Empirical evidence from the U.S', *Research Policy,* 41(1), pp. 154-166.

Lamine, W., Mian, S., Fayolle, A., Wright, M., Klofsten, M. and Etzkowitz, H. (2018) 'Technology business incubation mechanisms and sustainable regional development', *The Journal of Technology Transfer,* 43(5), pp. 1121-1141.

Leendertse, J., Schrijvers, M. and Stam, E. (2022) 'Measure Twice, Cut Once: Entrepreneurial Ecosystem Metrics', *Research Policy,* 51(9), pp. 104336.

Leesa-nguansuk, S. (2018) 'French model applied for Chiang Mai smart city', *Bangkok Post*. Available at: https://www.bangkokpost.com/business/1496426/french-model-applied-for-chiang-mai-smart-city (Accessed: 2 September 2022).

Leff, N. H. (1979) 'Entrepreneurship and Economic Development: The Problem Revisited', *Journal of Economic Literature,* 17(1), pp. 46-64.

Link, A. N. and Siegel, D. S. (2005) 'University-based technology initiatives: Quantitative and qualitative evidence', *Research Policy,* 34(3), pp. 253-257.

Lundvall, B.-A. (2010) *National Systems of Innovation: Towards a Theory of Innovation and Interactive Learning. Anthem Other Canon Economics* London: Anthem Press.

Mack, E. and Mayer, H. (2016) 'The evolutionary dynamics of entrepreneurial ecosystems', *Urban Studies,* 53(10), pp. 2118-2133.

Maietta, O. W. (2015) 'Determinants of university–firm R&D collaboration and its impact on innovation: A perspective from a low-tech industry', *Research Policy,* 44(7), pp. 1341-1359.

Malecki, E. J. (2018) 'Entrepreneurship and entrepreneurial ecosystems', *Geography Compass,* 12(3), pp. e12359.

Malerba, F. (1993) 'The National System of Innovation: Italy', *National innovation systems: A comparative analysis*. Oxford: Oxford University Press, pp. 230-259.

Mansfield, E. and Lee, J.-Y. (1996) 'The modern university: contributor to industrial innovation and recipient of industrial R&D support', *Research Policy,* 25(7), pp. 1047-1058.

Markman, G. D., Phan, P. H., Balkin, D. B. and Gianiodis, P. T. (2005) 'Entrepreneurship and university-based technology transfer', *Journal of Business Venturing,* 20(2), pp. 241-263.

Mason, C. and Brown, R. (2014) *Entrepreneurial ecosystems and growth oriented entrepreneurship* [Background paper]. OECD LEED Programme and the Dutch Ministry of Economic Affairs: The Hague, Netherlands. 7th November 2013. Available at: https://www.oecd.org/cfe/leed/Entrepreneurial-ecosystems.pdf (Accessed: 2 September 2022).

Mason, C. M. and Harrison, R. T. (2006) 'After the exit: Acquisitions, entrepreneurial recycling and regional economic development', *Regional Studies,* 40(1), pp. 55-73.

McAdam, M., Galbraith, B., McAdam, R. and Humphreys, P. (2006) 'Business processes and networks in university incubators: A review and research agendas', *Technology Analysis & Strategic Management,* 18(5), pp. 451-472.

McCarthy, I. P., Silvestre, B. S., von Nordenflycht, A. and Breznitz, S. M. (2018) 'A typology of university research park strategies: What parks do and why it matters', *Journal of Engineering and Technology Management,* 47, pp. 110-122.

Mian, S., Lamine, W. and Fayolle, A. (2016) 'Technology Business Incubation: An overview of the state of knowledge', *Technovation,* 50-51, pp. 1-12.

Miles, M. P. and Morrison, M. (2020) 'An effectual leadership perspective for developing rural entrepreneurial ecosystems', *Small Business Economics,* 54(4), pp. 933-949.

Minguillo, D., Tijssen, R. and Thelwall, M. (2015) 'Do science parks promote research and technology? A scientometric analysis of the UK', *Scientometrics,* 102(1), pp. 701-725.

Moore, J. F. (1993) 'Predators and Prey: A New Ecology of Competition', *Harvard Business Review,* 71(3), pp. 75-86.

Motoyama, Y., Fetsch, E., Jackson, C. and Wiens, J. (2016) *Little town, layered ecosystem: a case study of Chattanooga*, United States: Ewing Marion Kauffman Foundation. Available at: https://www.kauffman.org/wp-content/uploads/2019/12/chattanooga_entrepreneurship_ecosystem_study.pdf (Accessed: 2 September 2022).

Motoyama, Y. and Knowlton, K. (2014) *Examining the Connections within the Startup Ecosystem: A Case Study of St. Louis*, United States: Ewing Marion Kauffman Foundation. Available at: https://www.kauffman.org/wp-content/uploads/2019/12/examining_the_connections_within_the_startup_ecosystem.pdf (Accessed: 2 September 2022).

MOTS (2017) *Thailand Tourism Statistics Report*, Thailand: Ministry of Tourism & Sports. Available at: https://www.mots.go.th/download/article/article_20190516131031.pdf (Accessed: 2 September 2022).

Mueller, P. (2006) 'Exploring the knowledge filter: How entrepreneurship and university-industry relationships drive economic growth', *Research Policy,* 35(10), pp. 1499-1508.

National Research Council (2009) *Understanding research, science and technology parks: Global best practices. Report of Symposium* Washington, D.C.: The National Academies Press.

Neck, H. M., Meyer, G. D., Cohen, B. and Corbett, A. C. (2004) 'An Entrepreneurial System View of New Venture Creation', *Journal of Small Business Management,* 42(2), pp. 190-208.

Nelson, R. R. (1993) *National Innovation Systems: A Comparative Analysis.* Oxford: Oxford University Press.

NESDC (2019) 'Gross Regional and Provincial Product Chain Volume Measures 2019 Edition', *Office of the National Economic and Social Development Council*. Available at: https://www.nesdc.go.th/nesdb_en/ewt_dl_link.php?nid=4317&filename=national_account (Accessed 2 September 2022).

Ng, W. K. B., Appel-Meulenbroek, R., Cloodt, M. and Arentze, T. (2019) 'Towards a segmentation of science parks: A typology study on science parks in Europe', *Research Policy,* 48(3), pp. 719-732.

NSO (2010) 'Number of Thai population by sex, region, province, and municipality in 2000 and 2010', *National Statistical Office*. Available at: http://statbbi.nso.go.th/staticreport/Page/sector/TH/report/sector_01_11153_TH_.xlsx (Accessed 2 September 2022).

NSP (2020) *Strategy and Action Plan of the 3rd Term of Management (2020-2023)*, Thailand: Northern Science Park. Available at: https://www.step.cmu.ac.th/oit/files/OIT04.pdf (Accessed: 2 September 2022).

NSP (2021) *Target Innovation Profile as of 2021*, Thailand: Northern Science Park. Available at: https://www.step.cmu.ac.th/oit/files/OIT12.pdf (Accessed: 2 September 2022).

OECD (2021) 'Entrepreneurship in Regional Innovation Clusters: Case Study of Chiang Mai and Chiang Rai, Thailand', *OECD Studies on SMEs and Entrepreneurship*, Available: OECD Publishing. DOI: https://doi.org/10.1787/2a24a552-en.

Onwuegbuzie, A. J. and Leech, N. L. (2009) 'Generalization practices in qualitative research: a mixed methods case study', *Quality & Quantity,* 44(5), pp. 881-892.

Perkmann, M., Tartari, V., McKelvey, M., Autio, E., Broström, A., D'Este, P., Fini, R., Geuna, A., Grimaldi, R., Hughes, A., Krabel, S., Kitson, M., Llerena, P., Lissoni, F., Salter, A. and Sobrero, M. (2013) 'Academic engagement and commercialisation: A review of the literature on university–industry relations', *Research Policy,* 42(2), pp. 423-442.

Phan, P. H., Siegel, D. S. and Wright, M. (2005) 'Science parks and incubators: Observations, synthesis and future research', *Journal of Business Venturing,* 20(2), pp. 165-182.

Polit, D. F. and Beck, C. T. (2010) 'Generalization in quantitative and qualitative research: myths and strategies', *Int J Nurs Stud,* 47(11), pp. 1451-8.

Quintas, P., Wield, D. and Massey, D. (1992) 'Academic-industry links and innovation: questioning the science park model', *Technovation,* 12(3), pp. 161-175.

Roundy, P. T. (2016) 'Start-up Community Narratives: The Discursive Construction of Entrepreneurial Ecosystems', *The Journal of Entrepreneurship,* 25(2), pp. 232-248.

Roundy, P. T. (2017a) 'Hybrid organizations and the logics of entrepreneurial ecosystems', *International Entrepreneurship and Management Journal,* 13(4), pp. 1221-1237.

Roundy, P. T. (2017b) '"Small town" entrepreneurial ecosystems', *Journal of Entrepreneurship in Emerging Economies,* 9(3), pp. 238-262.

Roundy, P. T. (2017c) 'Social entrepreneurship and entrepreneurial ecosystems Complementary or disjoint phenomena?', *International Journal of Social Economics,* 44(9), pp. 1252-1267.

Roundy, P. T. (2020) 'Do we Lead Together? Leadership Behavioral Integration and Coordination in Entrepreneurial Ecosystems', *Journal of Leadership Studies,* 14(1), pp. 6-25.

Roundy, P. T. and Bayer, M. A. (2019) 'To bridge or buffer? A resource dependence theory of nascent entrepreneurial ecosystems', *Journal of Entrepreneurship in Emerging Economies,* 11(4), pp. 550-575.

Roundy, P. T., Bradshaw, M. and Brockman, B. K. (2018) 'The emergence of entrepreneurial ecosystems: A complex adaptive systems approach', *Journal of Business Research,* 86, pp. 1-10.

Roundy, P. T., Brockman, B. K. and Bradshaw, M. (2017) 'The resilience of entrepreneurial ecosystems', *Journal of Business Venturing Insights,* 8, pp. 99-104.

Ryan, P., Giblin, M., Buciuni, G. and Kogler, D. F. (2021) 'The role of MNEs in the genesis and growth of a resilient entrepreneurial ecosystem', *Entrepreneurship & Regional Development,* 33(1-2), pp. 36-53.

Saldaña, J. (2013) *The Coding Manual for Qualitative Researchers.* 2nd edn. London: SAGE Publications.

Saunders, M., Lewis, P. and Thornhill, A. (2012) *Research Methods for Business Students.* 6th edn. Essex: Pearson Education.

Saxenian, A. (1996) *Inside-Out: Regional Networks and Industrial Adaptation in Silicon Valley and Route 128. Cityscape: A Journal of Policy Development and Research* Cambridge, MA: Harvard University Press.

Scandura, A. (2016) 'University–industry collaboration and firms' R&D effort', *Research Policy,* 45(9), pp. 1907-1922.

Schaeffer, V. and Matt, M. (2016) 'Development of academic entrepreneurship in a non-mature context: the role of the university as a hub-organisation', *Entrepreneurship & Regional Development,* 28(9-10), pp. 724-745.

Scheidgen, K. (2021) 'Degrees of integration: how a fragmented entrepreneurial ecosystem promotes different types of entrepreneurs', *Entrepreneurship & Regional Development,* 33(1-2), pp. 54-79.

Science Park Promotion Agency, Ministry of Higher Education, Science, Research and Innovation (2014) *A study of strategic factors to develop a successful science park - international best practices.* Bangkok: National Science Technology and Innovation Policy Office.

Shane, S. (1993) 'Cultural influences on national rates of innovation', *Journal of Business Venturing,* 8(1), pp. 59-73.

Siegel, D. S., Wright, M. and Lockett, A. (2007) 'The rise of entrepreneurial activity at universities: organizational and societal implications', *Industrial and Corporate Change,* 16(4), pp. 489-504.

Spigel, B. (2016) 'Developing and governing entrepreneurial ecosystems: the structure of entrepreneurial support programs in Edinburgh, Scotland', *International Journal of Innovation and Regional Development,* 7(2), pp. 141-160.

Spigel, B. (2017) 'The Relational Organization of Entrepreneurial Ecosystems', *Entrepreneurship Theory and Practice,* 41(1), pp. 49-72.

Spigel, B. and Harrison, R. (2018) 'Toward a process theory of entrepreneurial ecosystems', *Strategic Entrepreneurship Journal,* 12(1), pp. 151-168.

Spigel, B. and Vinodrai, T. (2020) 'Meeting its Waterloo? Recycling in entrepreneurial ecosystems after anchor firm collapse', *Entrepreneurship & Regional Development,* 33(7-8), pp. 599-620.

Stam, E. (2007) 'Why butterflies don't leave: Locational behavior of entrepreneurial firms', *Economic Geography,* 83(1), pp. 27-50.

Stam, E. (2015) 'Entrepreneurial Ecosystems and Regional Policy: A Sympathetic Critique', *European Planning Studies,* 23(9), pp. 1759-1769.

Stam, E. and Spigel, B. (2017) 'Entrepreneurial ecosystems', in Blackburn, R., De Clercq, D. and Heinonen, J. (eds.) *The SAGE Handbook of Small Business and Entrepreneurship: Vol. 21*. London: SAGE Publications, pp. 407-421.

Stam, E. and van de Ven, A. (2021) 'Entrepreneurial ecosystem elements', *Small Business Economics,* 56(2), pp. 809-832.

StartupBlink (2021) *Global Startup Ecosystem Index 2021*: StartupBlink. Available at: https://www.startupblink.com/startupecosystemreport.pdf?mc_cid=9dc40ae5f2&mc_eid=f81d6e1f78 (Accessed: 5 February 2022).

Stephan, U. and Uhlaner, L. M. (2010) 'Performance-based vs socially supportive culture: A cross-national study of descriptive norms and entrepreneurship', *Journal of International Business Studies,* 41(8), pp. 1347-1364.

Thomas, L. D. W. and Autio, E. (2020) 'Innovation ecosystems in management: An organizing typology', *Oxford Encyclopedia of Business and Management*. Oxford: Oxford University Press.

Thompson, T. A., Purdy, J. M. and Ventresca, M. J. (2018) 'How entrepreneurial ecosystems take form: Evidence from social impact initiatives in Seattle', *Strategic Entrepreneurship Journal,* 12(1), pp. 96-116.

Tödtling, F. and Trippl, M. (2005) 'One size fits all?: Towards a differentiated regional innovation policy approach', *Research Policy,* 34(8), pp. 1203-1219.

Trudgill, S. (2007) 'Tansley, A.G. 1935: The use and abuse of vegetational concepts and terms. Ecology 16, 284-307 (Reprinted)', *Progress in Physical Geography-Earth and Environment,* 31(5), pp. 517-522.

Tsang, E. W. K. (2014) 'Generalizing from Research Findings: The Merits of Case Studies', *International Journal of Management Reviews,* 16(4), pp. 369-383.

UKSPA (2019) *About UKSPA*: The United Kingdom Science Park Association. Available at: http://www.ukspa.org.uk/our-association/about-us (Accessed: 19 February 2019).

UNESCO (2017) *Science parks around the world | United Nations Educational, Scientific and Cultural Organization*: The United Nations Educational, Scientific and Cultural Organization. Available at: http://www.unesco.org/new/en/natural-sciences/science-technology/university-industry-partnerships/science-parks-around-the-world/ (Accessed: 19 February 2019).

van Rijnsoever, F. J. (2020) 'Meeting, mating, and intermediating: How incubators can overcome weak network problems in entrepreneurial ecosystems', *Research Policy,* 49(1), pp. 103884.

van Weele, M., van Rijnsoever, F. J., Eveleens, C. P., Steinz, H., van Stijn, N. and Groen, M. (2018) 'Start-EU-up! Lessons from international incubation practices to address the challenges faced by Western European start-ups', *The Journal of Technology Transfer,* 43(5), pp. 1161-1189.

Villani, E., Rasmussen, E. and Grimaldi, R. (2017) 'How intermediary organizations facilitate university–industry technology transfer: A proximity approach', *Technological Forecasting and Social Change,* 114, pp. 86-102.

WEF (2013) *Entrepreneurial Ecosystems Around the Globe and Company Growth Dynamics*, Switzerland: World Economic Forum (17720311. Available at: https://www3.weforum.org/docs/WEF_EntrepreneurialEcosystems_Report_2013.pdf (Accessed: 5 September 2022).

Wennekers, S., Thurik, R., van Stel, A. and Noorderhaven, N. (2007) 'Uncertainty avoidance and the rate of business ownership across 21 OECD countries, 1976–2004', *Journal of Evolutionary Economics,* 17(2), pp. 133-160.

WTO (2019) *International Tourism Highlights*, Spain: World Tourism Organization (9789284421152. Available at: https://www.e-unwto.org/doi/pdf/10.18111/9789284421152 (Accessed: 5 September 2022).

Xiao, L. and North, D. (2018) 'The role of Technological Business Incubators in supporting business innovation in China: a case of regional adaptability?', *Entrepreneurship & Regional Development,* 30(1-2), pp. 29-57.

Yin, R. K. (2018) *Case Study Research and Applications: Design and Methods.* 6th edn. Thousand Oaks, CA: SAGE Publications.

Zhang, Y. (2005) 'The science park phenomenon: development, evolution and typology', *International Journal of Entrepreneurship and Innovation Management,* 5(1-2), pp. 138-154.

Zhu, D. and Tann, J. (2005) 'A regional innovation system in a small-sized region: A clustering model in Zhongguancun Science Park', *Technology Analysis & Strategic Management,* 17(3), pp. 375-390.