The Roles of Thailand Science Park in Supporting the Development of Innovation Clusters in Thailand:

Comparative Case Study - Thailand Science Park, Surrey Research Park, and Hong Kong Science and Technology Park

by

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AUTHOR'S DECLARATION

This thesis is the result of the author's original research. It has been composed by the author and has not been previously submitted for examination which has led to the award of a degree.

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ABSTRACT

This thesis investigates the role of Science Parks (SPs) in supporting the development of Innovation Clusters (ICs), with a specific focus on Thailand Science Park (TSP). It adopts a comparative approach, examining the operational strategies of TSP alongside Surrey Research Park (SRP) in the UK and Hong Kong Science and Technology Park (HKSTP). The qualitative methodology is employed; questionnaires were emailed to 58 European and 13 Asian SPs, including SRP and HKSTP, to select two SPs for comparison with TSP. Subsequently, semi-structured interviews were conducted with 53 stakeholders from these three Parks.

The study addresses three pivotal questions: Firstly, it explores how SPs in developing countries, like Thailand, differ in their approach to fostering long-lasting ICs compared to those in more developed economies. The research highlights unique challenges such as bureaucratic governance and cultural barriers, drawing lessons from HKSTP's flexible approach and collaborative culture. Secondly, the thesis delves into the management of R&D infrastructure, services, and networking in SPs. It reveals varied strategies across TSP, HKSTP, and SRP, underscoring the need for context-specific approaches in developing countries. Finally, the research examines the essential strategic elements for IC development in SPs, focusing on the necessity of support from policymakers and stakeholders in infrastructure, services, and financial backing.

This research contributes significantly to the field by providing a comparative strategic analysis of SPs in various economic contexts, identifying strategies to address challenges, and emphasising the importance of public-private partnerships. Additionally, it offers insights into aligning performance indicators with SPs' goals, the criticality of rigorous tenant selection, and the evolving nature of infrastructure and innovation services in SPs.

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Throughout this journey, I faced numerous instances of trial and error. Please remember, you are allowed to feel disappointment as many times as needed. However, trust that each stumble will only quicken your pace on your journey to the summit.

I recall the first time I met my two advisors: Prof Tim Bedford and Prof Robert Van Der Meer. Despite their high-level positions, they were incredibly sympathetic and kind to me. Their aptitude and ability to advise doctoral students are beyond doubt. Their tireless efforts transformed an ordinary student like me into a better one. I felt greatly proud of this achievement, under their constant support.

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List of Abbreviations

Abbreviation	Definition
AIR	Artificial Intelligence and Robotics
AIT	Asian Institute of Technology
AURP	Association of University Research Parks
BIOTEC	National Centre for Genetic Engineering and Biotechnology
BOI	Board of Investment Thailand
CUHK	Chinese University of Hong Kong
EECi	Eastern Economic Corridor of Innovation
GBA	Greater Bay Area
GERD	Gross Expenditure on Research and Development
HEIs	Higher Education Institutions
HKSAR	Hong Kong Special Administrative Region
HKSTP	Hong Kong Science and Technology Park
HKSTPC	Hong Kong Science and Technology Park Coporation
CVF	HKSTP's Corporate Venture Fund
IASP	International Association of Science Park and Areas of Innovation
ICT	Information and Communications Technology
IC	Innovation Cluster
ITAP	Technology Assistance Programme
JETRO	Japan External Trade Organisation
KPIs	Key Performance Indicators
KTP	Knowledge Transfer Partnerships
LEP	Local Enterprise Partnership
MHESI	Ministry of Higher Education, Science, Research, and Innovation
MNCs	Multinational Corporations
MOU	Memorandum of understanding
MTEC	National Metal and Materials Technology Centre

NANOTEC	National Nanotechnology Centre
NECTEC	National Electronics and Computer Technology Centre
NIA	National Innovation Agency
NSTDA	National Science and Technology Development Agency
PMUC	Program Management Unit for Competitiveness
R&D	Research and Development
RTH	Research Talent Hub
S3	Strategies for smart specialisation
SMEs	Small and medium-sized enterprises
SP	Science Park
SPRINT	Space Research and Innovation Network for Technology
SRP	Surrey Research Park
SSTL	Surrey Satellite Technology Limited
TDX	Thailand Science Park & depa Acceleration Center
TMC	Technology Management Centre
TSP	Thailand Science Park
UKSPA	United Kingdom Science Park Association

Chapter 1: Introduction

1.1 Background of study

Science parks (SPs) function as research and development (R&D) hubs that provide specialised infrastructure and facilities to accelerate the growth of knowledge-based companies. In addition to offering physical resources, SPs foster dynamic environments for R&D activities by encouraging collaboration with anchor players such as research institutions and higher education institutions (Díez-Vial and Fernández-Olmos, 2015) and facilitating the sharing of knowledge and essential resources (Salvador et al., 2013, Minguillo et al., 2015) to catalyse innovation and growth for start-ups and technology companies in their early stages. SPs also supply innovation services, funding, and access to relevant networks (Henriques et al., 2018), further enhancing the prestige, visibility, and reliability of tech businesses among stakeholders (Lecluyse and Knockaert, 2020). In middle-income countries, are additionally a vehicle for attracting international investment. Simultaneously, they drive a shift from a labour-intensive approach towards cultivating a knowledge-driven economy (Sawasdee, 2021).

For governments SPs act as potent policy tools that foster innovation and economic growth by providing tenant companies with support services and resources. These services and resources help to localise knowledge and promote collaboration, creativity, and entrepreneurship. Most SPs are policy-driven initiatives that receive sponsorship and resource allocation from the government (Cheng et al., 2014). Government support is crucial for SPs' success and stimulate innovation systems within their region and nation (Lecluyse et al., 2019).

Typically, SPs employ a focused generalist strategy to manage their facilities, beginning as non-focused clusters and gradually evolving into more specialised, focused clusters over time. The concept of clusters refers to the geographic proximity of enterprises that enhances collaborative and interactive learning and generates positive spillover effects for participating entities (Porter, 1998b). This proximity often attracts like-minded companies and other actors interested in interactive learning to join the cluster.

In terms of innovation clusters (ICs), these would be more specific, emphasising technology-economic networks formed by regular collaborations between enterprises and their affiliates, often located close together to facilitate collaboration among cluster members (Porter, 2003). Essentially, an IC is a networking group of innovation actors and locations. In this context, these actors engage, compete, and collaborate in innovation processes with other actors to generate technological value (Yim, 2014).

Nonetheless, SPs play multiple roles in supporting ICs. This study focuses on three aspects of SPs' roles: Firstly, as R&D hubs, SPs provide infrastructure and equipment (Minguillo et al., 2015) that is often unaffordable for technology businesses, reducing costs (Diez-Vial and Fernández-Olmos, 2017). They enable companies to access new knowledge (Zhou, 2018) and share common facilities such as meeting rooms. These benefits facilitate start-up launches in the early stages of business (Yan, 2020).

Secondly, SPs function as intermediaries (Fukugawa, 2006), offering both R&D and business services to entrepreneurs. Governments typically allocate most services and funding, with SPs being responsible for facilitating access to financial support, incentives, and privileges for tech businesses (Yan et al., 2018). However, the services provided for R&D businesses within each SP vary according to the policies and clusters prioritised by each park.

Lastly, SPs create vibrant R&D and innovation ecosystems that attract anchor players and key stakeholders to join the SP community. This creates opportunities for tenant companies to expand their network for business and research purposes. Attracting international investors or partners to engage with SP companies remains a challenge for SP owners, such as the government (IASP, 2022, Poonjan and Tanner, 2020), and even for SP managers. To overcome this challenge, SPs need managers with diverse skills in both research and business. The role of the SP manager extends beyond operating the park as a landlord to that of a network builder who encourages tenant companies to engage with innovative actors both inside and outside the park. This fosters collaboration in university-industry relationships (Jacobsen et al., 2022), as well as with other R&D organisations and universities.

Developing ICs is a strategy employed by SPs to enhance their performance. To determine which clusters they should prioritise, SPs aim to identify key characteristics such as facilities, research specialists, service offerings, and the existence of clusters within the parks. The aggregation of like-minded experts in innovation within a specific cluster promotes the sharing of essential resources, both tangible (advanced equipment, transaction costs, networking activities, etc.) and intangible (tacit and explicit knowledge, network building, etc.) (O'Dwyer et al., 2015, Wang et al., 2017). This sharing of resources cultivates mutual trust (Kowalski, 2014) and provides opportunities for business transactions and collaborative research projects (Mazur et al., 2016).

However, when considering clusters to be developed within the Park, SPs need to evaluate their characteristics, the number of SP companies and stakeholders within the clusters (Ylinenpää, 2001), the flow of knowledge sharing (Wang et al., 2017), and other factors that could contribute to their long-lasting development, such as the direction of government policy related to the innovation system (Arthurs et al., 2009). Another challenge is in fostering collaboration and knowledge-sharing within the clusters, which may require considerable effort and resources to sustain (Jacobsen et al., 2022).

This study presents a comparative case study of the roles of three distinct SPs in different locations and with varying organisational structures: the TSP, HKSTP, and SRP. All of these Parks have implemented a focused cluster strategy to operate and enhance the performance of both the SPs and their associated companies. The study aims to investigate how these three SPs develop long-lasting ICs and build networks between the public and private sectors to facilitate collaborative R&D activities among their members.

This study endeavours to identify the primary success factors and challenges associated with the roles of SPs in supporting the long-lasting growth of ICs within TSP. The insights gathered from this research could offer value to policymakers and SP practitioners. While this investigation is primarily focused on TSP, it could be applied to other SPs that utilise similar focused cluster strategies at a comparable stage of cluster development as TSP. These insights, therefore, can function as a robust instrument for encouraging innovation and economic progress through SP operation.

1.2 Research Gap

Although a growing number of SPs adopt a specialisation-focused strategy (European Investment Bank, 2010), and clustering as a development strategy (Wang et al., 2017), current research on ICs has primarily focused on aspects such as regional economy, network proximity, public-private partnership roles, and success indicators (Shivakumar, 2021) and create economic and technological value (Yim, 2014).

Various quantitative and qualitative methodologies have been employed to investigate the contributions of SPs to their companies, from surveys (Cadorin et al., 2021) to in-depth interviews and comparative case studies (Aslani et al., 2015, Guadix et al., 2016) , and even mixed-method approaches (Kharabsheh, 2012).

Some studies have also employed mixed-method approaches, combining both quantitative and qualitative methods. For instance, Ratinho and Henriques (2010) undertook a research titled "The role of SPs and business incubators in converging countries: Evidence from Portugal." This research combined case studies with a survey and semi-open phone interviews. Despite these methodological variations, the study of ICs development has primarily concentrated on diverse aspects such as regional economy (Herliana, 2015, Turkina et al., 2019), network proximity (Zhou et al., 2020), roles of public-private partnerships (Ablaev and Akhmetshina, 2016), and assessment of success indicators or features (Preissl, 2003, O'Dwyer et al., 2015, Wang et al., 2017).

However, most studies have centred on developed countries, leaving a significant gap in understanding the role of SPs in developing nations. While some studies have examined SPs in Thailand (Phongthiya et al., 2021, Sawasdee, 2021, Poonjan and Tanner, 2020), there is a notable lack of comparative studies investigating the roles that SPs play in supporting the development of ICs in Thailand.

This study examines three empirical case studies located in Thailand, Hong Kong, and the United Kingdom to enhance our understanding of the operational strategies, best practices, and essential factors that are critical to accelerating innovation within regional innovation clusters. It advances its thesis through a comparative analysis of three SPs, employing a qualitative research methodology. The aim is to make improvement suggestions for TSP to ensure its sustainable performance and continue contributions to the nation's economic development and growth.

1.3 Objectives and Research Questions

The objectives of this study are:

- To examine the concept of science parks and innovation clusters and their significance in promoting economic growth and development.
- To identify the key factors that contribute to the success of science parks in supporting the development of innovation clusters.
- To provide recommendations for policymakers and stakeholders in developing countries on how to enhance the effectiveness of science parks in promoting the development of innovation clusters.

These broader objectives lead us to our three research questions:

RQ1: How do science parks in developing countries, as compared to SPs in more developed economies, currently seek to develop long-lasting innovation clusters?

We have deepened our understanding of other SPs by reviewing relevant literature and administering a survey. The research focuses on the pivotal mechanisms that bolster the development of ICs, including R&D infrastructure, innovation services, and networking. Two additional SPs have been examined as case studies to derive deeper insights into the effective use of these mechanisms to enhance the competitiveness of their tenants. The study is directed towards proposing enhancements for SPs in developing countries, with a particular emphasis on TSP, to ensure its sustainable performance as an IC and its continued contribution to the economic development and growth of the nation. This leads us to the second research question:

RQ2: How do science parks in developing countries manage research and development infrastructure, services, and networking in support of innovation cluster development?

The knowledge gained from RQ1 and RQ2 will help to understand the developing country trajectory and broaden experiences from other SPs studied.

RQ3: What key elements should such Science Parks focus on in their strategy for the development of innovation clusters, and where do they need support from policymakers and stakeholders?

This study is not only intended to improve TSP performance but also to provide guidance for other SPs, particularly those in developing countries.

1.4 Research Scope

The research aims to provide a comprehensive understanding of the different approaches and strategies employed by SPs in supporting the development of ICs, as well as the factors that contribute to their success.

The research scope of this thesis will cover the following aspects:

1. Overview of SPs: The study will provide a background of SPs, their functions, and how they support ICs through R&D infrastructure, innovation services, and stakeholder engagement.
2. Comparative Analysis: The study will conduct a comparative analysis of three SPs in Thailand, the UK, and Hong Kong. The analysis will examine the similarities and differences in their strategies, policies, and programs, as well as the challenges and opportunities faced by each SP.
3. IC Development: The study will examine the process of IC development, including the various factors that contribute to long-lasting innovation clusters. The research will analyse how SPs play a role in fostering ICs and the different approaches they use.
4. Stakeholder Engagement: The study will explore the involvement of stakeholders in SPs, including the government, industry, academia, and other key players in the innovation ecosystem. The study will analyse the roles played by these stakeholders in the development of ICs.

Overall, this thesis will provide insights into the roles of SPs in supporting the development of ICs in Thailand and other developed countries, as well as the factors that contribute to their success in the long-lasting development of ICs.

1.5 Thesis Structure

Chapter 1 describes an overview of the research background and scope. In addition, research questions and objectives are presented based on the identified research gap.

Chapter 2 reviews the related academic literature on SPs and innovation clusters. Reviewing empirical studies regarding SPs and innovation clusters leads to identifying the research gap. This chapter also reviews the literature on the roles of SPs in contributing to the building of relationships between SPs companies and their stakeholders, such as partner institutions close to the SP and outside partners, as well as the development of ICs within SPs through the provision of R&D SP tenants.

Chapter 3 describes the research strategies and methods employed in this study. This chapter reviews the research methodology employed in the related empirical studies to justify the reasons for using mixed-method research. In addition, this chapter draws on the process of designing a survey for selecting case studies and collecting data from interviews. The last section illustrates how to utilise NVivo to analyse the data.

Chapter 4 provides empirical case studies with an overview of three SPs: TSP, HKSTP, and SRP, respectively. The content of this chapter includes strategic objectives, strategies, indicators to assess SP performance, and methods to develop innovation clusters in terms of the provision of R&D infrastructure, innovation services, and building engagement between SP tenants and stakeholders.

Chapter 5 discusses the results of the empirical study and explains the comparative case studies of IC development. We analyse the similarities and differences in the approaches of the three SPs, particularly in terms of their objectives, strategies, and indicators used to assess park performance and their effectiveness in achieving success in developing long-lasting ICs.

Chapter 6 presents the discussion. It delves into the comparative case studies of the three SPs in the context of strategic and operational comparisons, as well as the advantages and disadvantages of innovation policy and SP location.

Chapter 7 serves as the conclusion of the thesis, addressing the research questions. It underscores the significance of this research, extending its application beyond Thailand to other developing countries that manage SPs using a strategy similar to Thailand's. The chapter concludes by outlining the limitations of the study and pointing out opportunities for future research.

Chapter 2:
Literature Review

This chapter aims to provide an overview of the prominent aspects of previous research on SPs. Academic literature published between 1998 and 2022 has been reviewed to establish both the conceptual and empirical foundation for this study. As such, the concept of innovation is examined not only as a theoretical construct but also in relation to how SPs function as policy instruments to encourage innovation as a strategy for propelling a knowledge-based national economy and for cultivating innovative, competitive businesses.

Our study centres on analysing the roles of SPs in supporting the development of ICs. This chapter is structured into two primary sections: an overview of SPs (Section 2.1) and ICs (Section 2.2). The first part, section 2.1.1, outlines the definitions, development types and objectives of SPs, while section 2.1.2 delves into the history of SP establishment. The key actors and benefits of an SP are explicated in sections 2.1.3 and 2.1.4 respectively. Sections 2.1.5 and 2.1.6 provide insight into SP strategies and empirical research. The final section of the first part discusses the factors contributing to the success of an SP.

The second part provides detailed insights into the concept of ICs. Sections 2.2.1 and 2.2.2 discuss the definitions and the processes of formation and development of an IC. The characteristics, benefits, and life cycle of an IC are explained in sections 2.2.3, 2.2.4, and 2.2.5. The final two sections discuss the significance of proximity in contributing to the development of an IC, and the factors contributing to the success of an IC.

2.1. Science parks

2.1.1 Definition, development types, and objectives of science parks

SPs display considerable heterogeneity in terms of size, geographical coverage, and the services they offer (Poonjan and Tanner, 2020, Cadorin et al., 2019). According to a study by Vähä-Savo et al. (2022) citing a UNESCO report, there were more than 400 SPs worldwide in 2018, each unique in its composition and operation. As such, there is no universally accepted definition of SPs. A practical approach to defining as SP might be to draw upon descriptions provided by professional associations of SPs, researchers, and practitioners in the field.

The International Association of Science Parks and Areas of Innovation (IASP), the worldwide network of SPs and areas of innovation states

“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, an SP 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, p.1, Albahari et al., 2010, p.4).

The United Kingdom Science Park Association (UKSPA) defines an SP as *"a business and technology transfer initiative that: (1) encourages the growth and development of innovation-led, knowledge-based firms, (2) provides and environment where firms can develop interactions with centre of knowledge creation, and (3) has formal and operational links with academic institutions" (Lecluyse and Knockaert, 2020 ,p.1).*

On the other hand, the Association of University Research Parks (AURP), a non-profit international organisation, represents the leadership of these technological developments, which aim to promote research institute-industry relations and innovation districts, foster innovation, and facilitate the transfer of technology from such institutions to the industrial sector, states.

"a university research park is a property-based venture, which: (1) Master plans property designed for research and commercialization; (2) creates partnerships with universities and research institutions; (3) encourages the growth of new companies; (4) translates technology; (5) Drives technology-led economic development" (Albahari et al., 2010, p.4)

According to the definitions proffered by professional associations of SPs, it can be observed that the IASP focuses on those individuals tasked with managing SPs, the intent being to foster a vibrant environment conducive to the growth of innovation-centric businesses and the propagation of knowledge. These specialised professionals liaise with R&D institutions, aiming to stimulate regional economic development. In contrast, the AURP is designed to promote and cultivate technological companies with the backing of R&D institutions, aligning with the UKSPA emphasis on incubators, start-ups, and knowledge-based enterprises.

The characteristics and developmental trajectories of SPs significantly vary across different countries and regions. Terms such as 'SP', 'research park', 'technology park', and 'business park' are often used synonymously, each signifying a unique type of development. Specifically, a 'research park' is typically characterised as a model primarily focused on academic research and/or engagement with state-of-the-art technology. Conversely, an 'SP' shares some similarities with a research park, especially in terms of its location—often near to or within a university campus—but it balances its emphasis between developmental work and pure research and may also host prototype production facilities. Lastly, a 'technology park' is generally tailored for businesses engaged in the commercial deployment of advanced technologies (Nahm, 2000). Despite these differences, terms like 'technology park',

‘technopole’, ‘research park’, or ‘science park’ are often used interchangeably in literature (IASP, 2022, Poonjan and Tanner, 2020, Albahari et al., 2010).

From a supply-driven side in the innovation economy, an SP is a physical framework designed to kick-start and accelerate the growth of knowledge-based companies by improving networking and collaboration between SP tenants (Ng et al., 2020b) and SP stakeholders. This acceleration occurs by providing high-quality R&D infrastructure, facilitating technical and business services, and fostering R&D activities (Kharabsheh, 2012) in collaboration with anchor players in universities, research institutions, HEIs, etc. (Díez-Vial and Fernández-Olmos, 2015). Hansson et al. (2005) concluded that two main functions of SPs are instruments of technology transfer for value-added, high-tech production systems and property based on developing operations and combining the locations and scientific expertise from HEIs.

Nevertheless, it is important to note that SPs are heterogeneous in terms of size, geographical coverage, and the services they provide, making a universal definition elusive (Poonjan and Tanner, 2020). SPs play a critical role in encouraging companies to develop new products and enhance growth potential (Diez-Vial and Fernández-Olmos, 2017). This encouragement is provided through hard services in the form of R&D infrastructure and supplies, such as laboratories and advanced equipment, and soft services like financial support, funding, and incentives (Phan et al., 2005, Chan and Lau, 2005). The government provides these services to assist knowledge-based industries in accelerating their growth, thereby enhancing a country's competitive capabilities.

To accomplish their goals, SPs provide property-linked services, business services, innovation services, and networking services, fostering an innovative environment (Rowe, 2013) In addition to basic infrastructure like laboratories, meeting rooms, and internet broadband, they also provide social facilities (Poonjan and Tanner, 2020). Business and innovation services assist SP companies in developing profitable products, services, and processes by leveraging government mechanisms, such as financial support and incentives (The Economist Intelligence Unit, 2016) and educational institutions, for technology transfer and knowledge sharing (Herliana, 2015).

SPs play the role of a bridging agent, linking these players to benefit SP residents and prioritising geographical proximity (Lamperti et al., 2017). They utilise the proximity of relationships between researchers and companies to transfer knowledge into commercialisation (Hansson et al., 2005, Henriques et al., 2018). Fukugawa (2006) explains that geographical proximity is vital for tenant companies to easily communicate with HEIs and reduce transaction costs of knowledge transfer. The agglomeration of R&D agencies, technology-based businesses, and knowledge-intensive service providers creates an environment conducive to continuous innovation (Yan, 2019).

SPs play a critical role in aiding small tenants to overcome both internal and external challenges. These hurdles may include aspects of technology development, lack of experience

or management skills, and marketing costs. SPs provide resources that sustain R&D, sales, and improved management capabilities (Löfsten and Lindelöf, 2005). By nurturing and accelerating their tenants, SPs assist in launching high-tech, value-added products into the market. In addition to tenant support, SPs are anticipated to act as catalysts, aiding start-ups or small companies to innovate and grow (Henriques et al., 2018). As a result, the primary reasons companies locate in the SP are to access the park's resources, prestige, visibility and reliability (Lecluyse and Knockaert, 2020). This view aligns with the empirical investigation of the Italian Bioindustry Park and BioPmed Innovation Cluster by Salvador et al. (Salvador et al., 2013).

Unquestionably, SPs make a substantial contribution to the development of a country's knowledge-based economy. They enhance the capabilities of technology-based businesses by facilitating access to business and innovation services. This facilitation accelerates business growth through the creation of R&D activities and social events, enabling anchor players to exchange knowledge or common interests. However, it is worth noting that the objectives of SPs in Asian middle-income countries slightly deviate from those in Europe. These Asian SPs emphasise promoting international investment and accelerating the transition from a labour-intensive to a knowledge-intensive economy (Sawasdee, 2021).

2.1.2 The History of science park establishment and classification

The first SP was established in the United States during the 1950s, known as the Stanford Research Park (Link and Link, 2003, Salvador et al., 2013). Situated in the heart of Silicon Valley in Northern California, the Stanford Research Park is regarded as a pivotal force within the region's business community. Despite this, the SP phenomenon did not witness widespread adoption until the 1980s when it emerged as a favoured regional development initiative (Plaeksakul, 2013). SPs of this era were principally motivated by the pursuit of economic development and local prosperity, leveraging universities as a nexus for promoting collaboration amongst government, educational, and industrial sectors - these being the essential catalysts of SP progression (Lecluyse et al., 2019).

The number of SPs has dramatically increased worldwide since the 1960s and 1970s, particularly in Europe and Asia. Established in 1965 in Edinburgh, Scotland, the Heriot-Watt Research Park is recognised as the first SP in Europe (Ylinenpää, 2001). In Asia, the first SP, Tsukuba Science City, emerged in Japan in the early 1970s (Phan et al., 2005). Another notable success story in Asia is the Hsinchu Science Park in Taiwan, which was established in 1979. This SP played a pivotal role in steering the country towards future industrial and economic prosperity. As a result, Taiwan has earned a reputation as one of the world's leading high-tech countries, especially in the field of semiconductors (Yan et al., 2018).

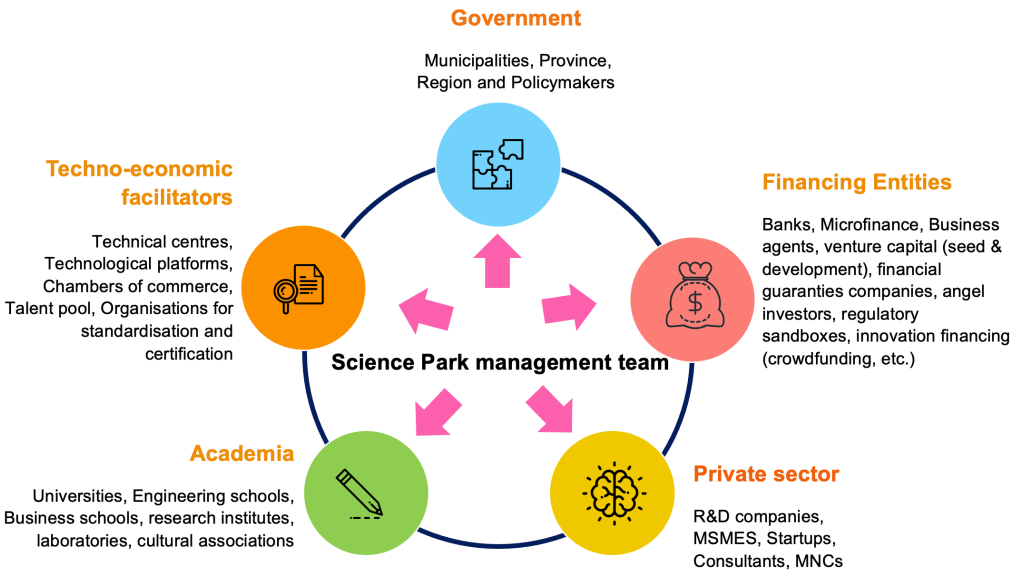
The study by Nahm (2000) aligns with Lecluyse et al.'s research (2019), which analysed 175 journal articles to investigate the contributions of SPs. Both studies classify SPs based on their ownership and governance structures. Typically, SPs are initiated by a variety

of entities. Generally, these entities can be classified into three broad groups: governmental bodies, such as the TSP and HKSTP; universities and other HEIs, like the SRP (Wasim, 2014); and private sector interest groups, such as the Eindhoven Science Park (Parry, 2018) and the Berlin Innovation Centre.

2.1.3 The relevant actors of a science park

SPs interact with several other pivotal actors (Cadorin et al., 2019). Figure 2.1 depicts the stakeholders involved in propelling an SP and developing ICs within SPs. The roles of relevant actors within an SP are outlined below.

Figure 2. 1: Stakeholders involved in a science park



Source: Adapted from (UNIDO “A New Generation of Science and Technology Parks”, 2021)

- **The Government** plays a pivotal role in shaping the landscape of SPs. It establishes a comprehensive policy and regulatory framework that not only facilitates the creation of SPs but also often contributes the majority of the initial investment, as highlighted by Wasim (2014). Furthermore, Yan (2019) underscores the government's capacity to stimulate innovation and entrepreneurship through the provision of indirect incentives. This includes the development of capabilities for monitoring mid- to long-term trends in science and technology, planning research on key issues, and supplying decision-makers with comprehensive analyses for informed decision-making. (Yan et al., 2018) .

Additionally, the government is instrumental in fostering connections among a diverse array of stakeholders. This collaborative network encompasses universities, research institutions, technology-based businesses, intermediary institutions, and regional public agencies, embodying the government-academia-industry collaboration model. Such integration is critical for driving innovation and aligning efforts across various sectors (Jacobsen et al., 2022).

Government-led infrastructure facilitates knowledge agglomeration and self-renewal through continuous startup creation. By fostering sustained R&D and initiating new businesses, government support serves as the primary growth mechanism for the innovation ecosystem. This notion aligns with the strategies of some countries, where the government has invested significant budgets for constructing high-class infrastructure and implementing specific incentives to build potential for economic growth and competitiveness (Poonjan and Tanner, 2020).

- **Academia and related institutions** provide essential R&D expertise, skilled labour, and access to costly testing and research equipment. An example can be seen in Yang and Lee's (2021) study of 145 Chinese SPs. The study found that parks working closely with universities or research centres in R&D collaboration can effectively allocate R&D budgets, thereby avoiding redundant project requests.

Furthermore, they offer vital R&D activities and services to the industrial sector. Institutions, deeply embedded in societal culture and interaction norms, significantly influence the innovation capacity of societies and the success of SPs. Their impact diffuses through all elements of SP operations, moulding the attitudes and actions of various stakeholders, from entrepreneurs and venture capitalists to collaborative partners and park managers. This impact extends to risk-taking, trust-based partnership development, and beyond. While formal institutions, like policies and regulations, exert significant influence, informal institutions hold equal importance, shaping behaviour and fostering societal trust (Poonjan and Tanner, 2020).

- **The Private sector** forms the connection between R&D departments and the market segment, thereby enhancing the development and commercialisation of innovative solutions, products, and technology-enabled business models. These contribute towards generating a financial return by developing technology-based products.
- **Financing entities** invest in projects developed within an SP, contributing to social, environmental, and investment impacts alongside a financial return. Financial support is a crucial component of all economic activity and the innovation process (Poonjan and Tanner, 2020).
- **Techno-economic facilitators** offer a variety of services, among others, to facilitate market access. In order to produce profitable products, companies require support from advanced equipment which comes at a significant cost (Albahari et al., 2019) to test and certify their products for standardisation.
- **Science Park management team** acts as a key mechanism in connecting the actors mentioned above. The functions of the SP management team may vary, but can also encompass property management as the landlord, equipping technical centres, standardisation, and certification centres (Ylinenpää, 2001), and supporting SP companies in order to encourage and manage the flow of knowledge and technology, thereby facilitating communication and collaboration. SP managers can stimulate technology transfer by fostering ties between local higher education institutions and tenant businesses (Siegel et al., 2003).

They need to enhance coordination between actors, particularly promoting collaboration between innovative actors inside and outside the region and fostering collaboration in university-industry relationships (Jacobsen et al., 2022). They should also integrate venture capital groups and seed money providers, both public and private, into their networks, such as banks and venture capitalists (Albahari et al., 2019).

Albahari et al. (2018a) further indicated that on-site management is responsible for creating an R&D environment and assisting technology companies, particularly fledgling companies that face numerous constraints, such as financial liquidity, management, and marketing. They achieve this by facilitating business and financial services. Additionally, SP managers act as gatekeepers, nurturing their community and developing relationships with a diverse range of key players within and outside the park (Siegel et al., 2003, Fukugawa, 2006). This viewpoint aligns with Lecluyse et al.,(2019) emphasising that SP managers may require a variety of skills, including management, marketing, and promotion, to attract new members to the park and social competencies to develop a network that benefits their members.

The management team often needs to select companies to be tenants. They consider the criteria of tenant selection and entry restrictions carefully for SPs (Lecluyse et al., 2019). SPs with judicious tenant selection criteria are more likely to succeed than those without such criteria. This is in agreement with the findings of Link and Scott (2003), who studied 50 SPs in the United States and found that companies meeting rigorous criteria to become tenants grow faster and are more likely to collaborate closely with other park members. Furthermore, Hansson et al. (2005) while examining the Symbion SP in Denmark, noted that the Park would assess a business based on the following criteria:

The company must focus on research-based or knowledge-intensive operations.

- It must be innovative, with no direct or indirect rivals at a national or global level.
- Its products or services must be profitable.
- Its products or services should have potential for patenting.
- The company's management team must be competent enough to execute the business growth strategy.

In summary, SPs are fundamental to the development of innovation ecosystems. These parks serve as specialised environments that catalyse collaboration among academia, industry, and entrepreneurs, forming R&D and knowledge exchange hubs. This unique role significantly contributes to the growth and sustainability of innovation ecosystems in their respective regions. SPs create favourable conditions for research and development, bridge connections between universities and businesses, and provide vital support services to startups and innovative ventures, thus aligning with the broader objective of amplifying innovation within the ecosystem. The convergence of government policies and investments, academia's research and development expertise, and the private sector's market insights, along with financial and techno-economic support, underpins the strategic management of

SPs. This synergy is crucial in crafting dynamic, innovative environments that not only foster regional growth but also propel technological advancement, highlighting the pivotal role of Science Parks in nurturing and sustaining robust innovation ecosystems.

2.1.4 The benefits of a science park

SPs serve as catalysts for establishing and expanding technology-based businesses (Yan, 2020). The support they provide empowers business startups. Take, for example, Southampton Science Park's 'Catalyst Programme,' which offers startups comprehensive support. This programme not only provides high-quality specialist facilities such as pay-as-you-go laboratories but also flexible leases, and access to grants, funding, and investment opportunities, enabling these startups to scale up quickly. With a reliable supply of skilled labour, businesses are attracted to the region, and the promising career prospects draw students in science and technology fields. Creating a 'centre of excellence' in specific fields engenders a mutually beneficial environment for businesses and individuals. Maintaining a high-quality, collaborative environment to nurture the growth of knowledge-based businesses can boost both local and national economies (Procure Partnerships, 2020).

To streamline the discussion, we categorise the benefits of SPs into three dimensions based on the focus of our study: R&D infrastructure, services, and the facilitation of networking between SP tenants and other key players. This categorisation aligns with Poonjan and Tanner's (2020) study, which stated that the primary goal of SP management is to support the development of SP tenants by offering varied infrastructural support, facilitating R&D-based technological services and building networks.

- **The Strategic importance of infrastructure in science park Development and Performance**

SPs serve as specialised environments that accelerate research and technology activities (Minguillo and Thelwall, 2015). As a physical setting, an SP offers infrastructure and general facilities, including office spaces, meeting rooms, and shared areas. These amenities accommodate a variety of companies and facilitate their interaction with key entities such as universities and R&D institutions. These organisations act as sources of knowledge, sharing and transmitting valuable insights with businesses (Etzkowitz and Zhou, 2018). Being in close proximity to these organisations provides a distinct advantage to SP tenants, as it reduces communication and coordination costs (Diez-Vial and Fernández-Olmos, 2017). This advantage is particularly evident in face-to-face communication, which remains a crucial form of interaction (Boschma and Frenken, 2009). The construction of infrastructure that meets the needs of potential clients not only facilitates the initial settlement of suitable SP tenants in the SP but also significantly contributes to their chances of success. Furthermore, this strategic provision of infrastructure plays a pivotal role in enhancing the overall effectiveness and prosperity of the SP itself (Wasim, 2014).

A significant portion of the government budget is invested in SPs, providing high-class R&D infrastructure and advanced equipment that may be unaffordable for small-scale companies, such as testing laboratories and pilot plants (Arauzo-Carod et al., 2018) Empirical evidence from Mjärdevi SP and Norrköping SP in Sweden supports this, revealing that attractive infrastructure positively influences companies' decisions to rent or invest in the park (Albahari et al., 2019). This suggests that enhancing SPs' vibrancy in the context of research activities and quality of life for inhabitants can attract more companies and new partners interested in engaging in research and business activities.

It is noteworthy that a primary motivation for many Asian governments, including those of Malaysia, Thailand, and Singapore, is the provision of infrastructure. The development of high-quality infrastructure forms part of a strategic initiative to attract MNCs to invest and establish manufacturing and R&D operations in these Asian economies. The presence of an SP, even one with moderate physical infrastructure and minimal links to universities and research institutions, signals a country's commitment to a high-tech economic growth strategy. As foreign investments increase and more MNCs establish bases in the SPs, the benefits of these parks are amplified (Koh et al., 2005).

- **Access to innovation and business services or incentives**

SPs offer incentives, funding, and services to foster technology transfer from academia to commercialisation. These include training, counselling, tax exemption, subsidies, and grants. Governments enhance these benefits for SP tenants (Wasim, 2014). Companies, especially startups and SMEs, choose an SP as their location because they can access shared facilities without heavy capital investments themselves (Parry, 2018) and obtained incentives (Ng et al., 2020a).

Providing grants to R&D businesses can reinforce the feedback loops that drive technical innovation and its subsequent impact. Government resources, including budget and market channels, will be directed towards successful business models that meet certain performance criteria. Incentives for company innovation can strengthen these feedback loops and overcome potential governmental opposition to an innovation-driven economy. Cross-disciplinary thinking and boundary-pushing actions often require technological advancements and new business models. Proper deregulation and incentives for creative ideas and business models are critical elements of the eco-innovation system (Yan et al., 2018).

- **Creating opportunities to engage with other anchor players**

An SP that houses knowledge-intensive actors from diverse industries and technology fields provides multiple opportunities for innovative combinations and cross-innovation. SPs build networks with departments of different educational and research entities and facilitate the exchange of knowledge and technology between universities, R&D institutes, businesses, and markets (Link and Scott, 2006). The SP collaboration network provides businesses with

rapid access to complementary skills, knowledge, and resources crucial to their innovation endeavours.

Additionally, collaboration with various external actors can enhance knowledge production, creativity, and innovation. Collaboration is a process for sharing resources and resolving issues, and problems can be solved by exchanging knowledge and resources between companies in an SP and between SP companies and third parties (Yan, 2019). SPs would recruit talent, and identify contract and agreement partners, resulting in lower managed costs (Cadorin et al., 2019). The more substantial Park's collaboration with all these actors, the more influential the SP will be in connecting Park members (Poonjan and Tanner, 2020).

In the discussion, we will explore the extensive networks formed by SPs and their diverse interactions with various stakeholders. We will then focus specifically on three key facets of these networks: the relationships between an SP tenant and other tenants within the same park, the connections between an SP tenant and nearby HEIs or research centres, and the interactions between an SP tenant and external companies or R&D organisations that are not housed within the SPs.

- **Collaboration between a science park tenant and other co-located tenants**

Establishing connections among SP tenants is critical, as it aids the development of value chains through forward and backward linkages, thereby facilitating access to both domestic and international investments and markets (Wasim, 2014). Forward linkages, in this context, may refer to the transfer of technologies or services from a tenant, acting as a producer, to the industries or markets utilising these outputs. Conversely, backward linkages can refer to the relationship between a tenant and its suppliers of technology, raw materials, information, or other operational necessities.

The nature of tenant networking within SPs is often informally established (Lecluyse et al., 2019). Yan (2019) indicated that young companies within an SP, typically those with less technical and managerial expertise, stand to gain significantly from the local network. This network creates an environment where companies at various stages of development, can exchange knowledge in a mutually beneficial manner. Such an exchange serves to mitigate risks and compensate for resource gaps. Moreover, internal networking equips SP tenants with the means to reduce transaction costs and expedite the innovation process. Nevertheless, it is essential for SPs to take into account the heterogeneity amongst their tenants. This diversity could potentially lead to a lack of common interest, resulting in tenants being hesitant to exchange knowledge.

This is supported by research from Diez-Vial and Fernández-Olmos (2017), who found that although the relationships among SP companies may appear robust, they often have low levels of knowledge exchange. Maintaining effective relationships between SP tenants presents a significant challenge. To overcome this, SP managers must have a high strategic

profile, strong legitimacy, and credibility. They must be proactive, creative, and skilled in fostering a collaborative environment (Nauwelaers et al., 2014).

Isabel Diez-Vial (2016) added another layer of complexity by highlighting that the age of SP companies plays a role in the success of their engagement. Younger SP companies, lacking in technical and managerial experience, may struggle to connect and collaborate with more established entities. However, a well-structured local network within an SP can provide a platform for companies at different stages of development and from various industries to exchange knowledge in a complementary manner, helping to bridge this gap.

- **Collaboration between a science park tenant and nearby partner institutions**

The proximity of a university allows SP tenants to potentially access research and human capital (Ng et al., 2020b). However, these partnerships necessitate regular engagement with the university on focused issues. Often, these formal activities originate from informal interactions, such as personal communication with academic staff or attending seminars (Yan, 2019). When tenants cultivate enduring relationships, they are more likely to establish cognitive proximity, which enhances their capacity to acquire and integrate new knowledge. This encourages the exploration of novel ideas and relevant information. Consequently, long-term affiliations with universities facilitate more straightforward, practical knowledge sharing than sporadic or purely commercially driven relationships. Such interaction fosters the development of tacit knowledge, reinforcing mutual understanding. Tenants invest considerable time and effort in maintaining these collaborations, tending to provide mutual assistance and trying to create mutual understanding with nearby institutions (Díez-Vial and Montoro-Sánchez, 2016).

Therefore, one principal advantage that SPs offer to attract companies is the closeness to a pool of talented individuals from universities or research centres in the vicinity. Engel's (2015) empirical study found that Silicon Valley startups profit significantly from their surrounding environment. Proximity to human and financial resources facilitates trial and learning cycles. Direct interaction decreases transaction costs, which in turn reduces technical knowledge costs (Yan, 2019, Sawasdee, 2021). Further, the capacity for flexible strategic modification leads to a decrease in risk and a favourable enhancement in competitive capability (Engel, 2015). R&D institutions co-located within SPs grant early insights into technological progress and market needs – crucial components for innovation. These institutions foster their clients' understanding and analysis of information, thereby bolstering problem-solving skills. Their involvement enhances the ability to identify existing issues and to consolidate or harness knowledge for more efficient resolution (Yan, 2019).

Collaborations between SP companies and universities or R&D research centres within SPs can benefit from knowledge spillover, technology transfer, and the use of university resources (Ng et al., 2020b). SMEs often constrained by financial limitations, can access these resources within the host universities. Universities, in turn, can seek private funding through

the creation of spin-off companies and nurturing relationships with on-park businesses. This also allows universities to generate revenue and employment opportunities for their students and researchers (Phongthiya et al., 2021). Rowe (2013) indicated that proximity to R&D agencies and universities strengthens the connections between SP tenants and these institutions. This has led to the establishment of some SPs within partners' campuses to facilitate access to their services. This echoes Díez-Vial and Montoro-Sánchez (2016), who found that physical proximity expedites knowledge transfer and enhances universities' reputations.

Yan's (2020) empirical study revealed that the participation of tenant companies in SP cooperation networks significantly boosts their innovation capabilities. The collaboration networks of SPs have a considerable effect on organisational learning, ideation, and product and process development skills. Companies investing time and resources in external interactions can derive substantial benefits from their SP locations. Innovation, being time-consuming and high-risk, necessitates connections with various actors, allowing for quick, straightforward access to complementary skills, expertise, and resources required for operations. SP cooperation networks enhance the generation and dissemination of business information, thereby promoting knowledge growth and incremental innovation.

Geographic proximity further reduces communication costs when these organisations adopt similar principles and standards. It also encourages the development of trust among co-located actors, rooted in shared values, histories, and habits. As a result, technology companies within SPs tend to foster greater mutual trust, enhancing readiness to share expertise and assimilate information from others (Diez-Vial and Fernández-Olmos, 2017). Building relationships centred on mutual dependence results from interactions involving the creation, exchange, transformation, absorption, and exploitation of resources within formal and informal relationships (Sala et al., 2011). This model is evident in the United Kingdom's SPs, spurred by geographical proximity between industries and HEIs (Minguillo et al., 2015).

- **Collaboration between a science park tenant and external/ international partners**

Companies within SPs predominantly focus on building relationships with the private sector, both regionally and internationally. Their aim is to develop and commercialise innovative, technology-enabled solutions and products (UNIDO, 2021). When scaling up becomes necessary, these companies seek partners to expedite their innovation. This partnership can take the form of grants or long-term loans from the government, or co-investments with multinational corporations, to facilitate expansion into the global market. Establishing collaborations between SP tenants and international partners necessitates facilitation by SP management. Managers need to liaise with international parks, arranging exchange programme training and conferences involving leading experts and scholars from around the globe. This allows SP members to engage with a broader network and enhances

the SP's reputation. Thus, collaboration can be viewed as a cultural necessity for all SPs, requiring active nurturing and reinforcement among SP tenants, researchers, HEIs, companies within the SP, and those outside it (European Investment Bank, 2010).

While academic literature recognises the benefits and value propositions that SPs offer stakeholders – such as comprehensive hard and soft services for entrepreneurs to transition from ideation to market – some empirical studies have questioned the value of SPs. For instance, Liberati et al.,(2016) in Italian SPs and Chan et al.,(2009) compared the performance of SP tenants and non-tenant companies in Italian SPs and South Africa's Innovation Hub, respectively. They reported no positive effects on the companies' propensity to innovate. This is consistent with Chan and Lau's(2005) study, which concluded that startups in Hong Kong's SP did not benefit from networking and clustering.

In summary, SPs play a crucial role in fostering innovation and creating opportunities for engagement with a multitude of key players. Such parks provide a fertile ground for cross-innovation by housing knowledge-intensive actors from diverse industries and technology fields, thereby enabling the exchange of knowledge and technology between various entities. This robust network of collaboration accelerates businesses' access to complementary skills, knowledge, and resources, thus boosting their innovation capabilities. Furthermore, proximity to universities facilitates the exchange of ideas and knowledge.

However, successful collaboration within SPs and with external partners relies on strategic management, which involves fostering a collaborative environment and bridging the gap between companies at different stages of development. Simultaneously, geographical proximity reduces communication costs and fosters mutual trust among co-located actors. Despite the benefits and value propositions offered by SPs, the effectiveness of SPs has been questioned in some empirical studies, citing the lack of research collaborations and no positive effects on the propensity to innovate.

2.1.5 The strategy of a science park

The European Investment Bank (2010) emphasised that SP strategies should align with the government's territorial strategies in the regions where the parks are located. However, government policy support is not the only determining factor for a park's success. The necessity for scientific excellence is recognised within SPs. Concurrently, the research base could be connected to local industrial value chains to achieve commercial success and market viability. SPs that possess self-organising abilities have a significantly greater potential for engaging in cross-fertilisation and multi-dimensional innovation.

Location is a crucial decision for park development. The park should ideally be in close proximity to an urban or metropolitan centre and equipped with education, conference, and telecommunications facilities (Boschma and Frenken, 2009). Essential physical facilities include purpose-built, multi-tenant buildings with modules of varying sizes and access to

specific centralised services. Depending on the park's technological or industrial scope, industry-specific specialised infrastructure may include prototype and pilot plants, testing facilities, laboratories, and calibration laboratories (Link and Scott, 2018).

A strategic choice of SPs is whether to adopt a strong technology or cluster focus or a more generalised approach. This decision is influenced by the economic sectors or government policies intended to be accommodated within the SP (Wasim, 2014). This notion aligns with the findings of the IASP statistical survey conducted in 2002. The European Investment Bank (2010) has identified that SPs typically employ one of three specialisation strategies for their management:

- 27 per cent are **"generalists"** welcoming companies and activities from various industries and technological fields, as long as they meet the park's entry requirements.
- 25 per cent are **"specialists"** designed for one or more specific industries, clusters or technologies, such as biotechnology or Information and Communications Technology (ICT).
- 48 per cent are **"focused generalists"** which were initially designed as generalist parks but have gradually become more specialised.

It is observed that the majority of SPs at that time were categorised as 'focused generalists', managed with strategic opportunism. Daniel Isenberg, writing for the Harvard Business Review, defines 'strategic opportunism' as the ability to maintain focus on long-term objectives while demonstrating enough flexibility to address immediate problems and identify new opportunities. This strategy does not target a specific goal, demands minimal preparation, and capitalises on opportunities as they arise (news, n.d., Isenberg, 1987). It can be inferred that these SPs gradually explored viable opportunities due to the lack of sufficient assets/resources, which could assist them in determining which areas of specialisation to focus on. In the meantime, they monitored the manifestation of opportunities with potential to enhance SP competitiveness.

Within the context of the 'specialists' category, SPs are strategically positioned to play a critical role in innovation strategies for smart specialisation (S3). This strategy concept capitalises on national and regional assets, strengths, and potential, concentrating on a select number of growth-promoting thematic priority areas (Jacobsen et al., 2022). However, S3 is not confined merely to research and innovation; it extends to non-scientific innovations such as social innovation, public sector innovation, and service innovation. Therefore, a natural synergy arises between innovation strategies for smart specialisation and place-based economic transformation agendas.

S3 signifies a dynamic and evolutionary process underpinned by an entrepreneurial discovery process, where governments facilitate partnerships across the quadruple helix arrangements—comprising public entities, knowledge institutions, businesses, and civil society. The S3 directive mandates the involvement of all stakeholders within a territory in the strategy's planning and execution. This provides SPs with a unique opportunity and

responsibility to shape the future of their home region or country (Nauwelaers et al., 2014). For example, in Thailand, SPs are frequently managed by the government. This management approach facilitates the integration of S3 strategies with broader SP policies, thereby complementing other policy areas, such as industrial and educational strategies (Jacobsen et al., 2022). The synergy between these strategic approaches allows SPs to not only influence regional innovation clusters through the S3 strategy but also recognise and capitalise on emergent opportunities, thereby enhancing their competitiveness.

However, the survey did not disclose the number, nor the attributes of the SP samples utilised in this study. In the subsequent chapter, we will shed light on the application of these strategies, particularly in the context of the three SPs that serve as case studies in our research.

The European Investment Bank (2010) summarises that strong engagement from business organisations during the early phases of a park's development can bolster the public-private partnership, propelling the SP towards economic sustainability. To formulate a sustainable SP strategy, the public-private partnership model considers the following factors:

- During the positioning of the SP, it is crucial to identify emerging trends, research platforms, and competencies that need fostering and development to guarantee sustainability.
- Research platforms could leverage the historical manufacturing prowess and competitive advantages of the regional industry.
- Exclusive public investments in research are insufficient. A suite of innovation support services—including networking, marketing support, technology development and transfer, financing, education and training, Intellectual Property Rights (IPR) assistance, and the industrial commercialisation of R&D—is necessary.
- SPs must not only retain the benefits of research and innovation but also proactively engage in technology transfer to enhance their competitiveness.
- Long-term research support and associated services are pivotal for the competitive positioning of SPs.

Koh et al. (2005) carried out an analysis of three successful SPs—Silicon Valley, Cambridge Science Park, and Hsinchu Science Park. This research provided valuable insights, particularly for the performance of the Singapore Science Park between 1980 to 2000, a period that coincides with the criteria used for our case study selection (refer to Table 3.2). The study underscored the common Asian strategy of using government-led initiatives to establish SPs. This approach involves significant public investment in state-of-the-art R&D infrastructure with the intent of drawing foreign investment, attracting multinational corporations, and stimulating high-tech economic growth within the country.

Considering these challenges, merely enhancing infrastructure quality is not an effective strategy to attract companies to new SPs, particularly when considering the excess

of infrastructure across Asia. Knowledge spillovers have been identified as a more significant draw for potential tenants. As such, SP development could focus on nurturing an environment that promotes knowledge spillovers and encourages agglomeration effects. This could be realised through cluster-oriented approaches. The aim is to create an ecosystem where organisations across different sectors can combine their capabilities, thus driving innovative solutions. Concentrating on achieving a critical mass within SPs or IC development could be a key strategy for ensuring the sustainability of these parks.

2.1.6 Empirical studies of science park performance

SPs across the world are different entities in terms of the age of SP, the number of SP companies of various sizes, and the objectives of SP establishment (Poonjan and Tanner, 2020). Some parks, for example, offer incentives and business services to tenants, while others may not. Additionally, the location of the park is a significant factor, as some countries choose to build SPs in rural areas to distribute economic prosperity into these local regions (Albahari, 2015). Yet, despite these differences, much of the research on SPs has gauged their performance by comparing the outcomes of companies located within and outside of these parks. Below, I highlight some of this research from the academic literature, which examines SP performance globally in relation to various factors.

Löfsten and Lindelöf (2002) focused their study on technology companies in Sweden, using employment growth, sales growth, profitability, location motivations, and facilities management as indicators. Their results showed that SPs were significantly more likely to establish a link with a local university than off-park companies, likely due to their strategic location. This could suggest that SP companies already have formal ties to universities, and the strategic location of SPs amplifies these relationships. Conversely, they found no significant difference between on- and off-park companies concerning patents and new product launches.

Díez-Vial and Fernández-Olmos (2015) on the other hand, evaluated SPs in Spain as hubs for knowledge exchange and innovation promotion. They used the percentage of sales generated by new products as an indicator of success, while the company's R&D expenditure represented its innovation intensity. Their findings suggested that companies that entered into cooperative agreements with universities and other research institutions were more capable of leveraging knowledge externalities to enhance their innovation and knowledge-sharing capacity than companies operating outside the park. This was possible due to shared routines and procedures, which facilitated easy identification and collaboration with universities through both formal mechanisms and informal encounters and meetings, which are crucial within the park.

Consequently, the chances of developing innovative products are increased when companies can share knowledge with other companies investing in R&D. These findings support the notion that SPs function as intermediaries, enabling access to valuable resources

through a triple helix system of collaboration that involves knowledge production, knowledge use, and policy and governance actors. In terms of knowledge spillover from HEIs, these results are in line with Fukugawa's (2006) findings, which showed that two-thirds of Japanese SPs are home to HEIs or have established a partnership with them. His results indicate that R&D-intensive startups are more likely to engage in joint research with university academics and scientists.

Yang et al., (2009) investigated the R&D productivity of tenants in Hsinchu Science Park, Taiwan. Their findings revealed significantly higher R&D productivity outputs from park tenants than off-park companies. This efficiency stems from the government policies supporting the R&D efforts of SP companies, strategic location, clustering effect, and networking. The study asserts that this success originates from the rigorous tenant selection process within the Park. As such, only high-potential companies are selected to join the Park. Hsinchu SP, backed by policy measures, cluster effect, and technological externality, has drawn numerous high-tech companies to apply for admission. However, due to space limitations, the Park cannot accommodate all companies, leading to the admittance of only prominent companies with a higher number of patents.

In a study of 170 companies situated in Catalan Science and Technology Parks in Spain, Arauzo-Carod et al., (2018) explored whether the SP location impacts company performance. Utilising sales growth and the number of employees as indicators, their findings showed that tenant companies had a slightly higher increase in sales relative to employee growth. The study also discovered that companies with low absorptive capacity demonstrated less growth in their innovation performance. Conversely, companies with a medium-high absorptive capacity were better positioned to exploit opportunities from SPs. Hence, the authors recommended that managers should make careful decisions about entering an SP, considering company readiness and convenience, as well as the potential to access resources, secure finance, and improve innovation capability.

Cadorin et al.(2021) explored measures of park performance. They divided the concept of SP success into two categories: (1) successful SP tenants, and (2) successful innovation and technology transfer. The findings indicated that while universities do not influence successful tenancies, they significantly impact successful innovation and technology transfer (such as the number of patents and collaborative projects between a company and a local university). However, talent characteristics, including creativity, cognitive skills to generate new ideas and knowledge, communication and business skills, and scientific expertise, were not significant for successful innovation and technology transfer but were critical for successful SP tenants. The authors confirmed that collaboration with stakeholders, government, and universities is crucial for fostering innovation activities and enhancing technology transfer processes, while talented individuals working in SP companies are the main drivers of performance improvement.

Despite the predominance of studies highlighting the superior performance of SP companies over off-park counterparts, some studies have challenged the positive impact of SPs on tenant companies. For instance, Liberati et al., (2016) investigated the effects of SPs on tenant performance in Italian SPs, focusing on production performance (such as services provided, knowledge spill-overs, and product processing), profitability performance and financial conditions (such as income profile), investment propensity (the ratio between investment and total sales), and innovative capacity (the number of patents). The results revealed no robust evidence that affiliated companies performed better in terms of patents or investments. Similarly, Shearmur and Doloreux (2000) found no correlation between the establishment of SPs and employment growth in a study of 17 Canadian SPs. They concluded that SPs did not contribute significantly to regional industries, especially in terms of high-tech employment in the manufacturing and service sectors.

The empirical study of Radosevic and Myrzakhmet (2009) on the role of technoparks in Kazakhstan revealed that companies within the parks were not more innovative than those outside. The intensity and frequency of their external links, particularly joint development and material procurement, surpassed their internal links. Companies chose to relocate to technoparks due to lower rent and image enhancement. However, the study showed challenging access to finance and technology for business growth. In terms of innovation promotion and economic diversification, the services provided to tenant companies were insufficient for their development. Nonetheless, Kazakh technoparks appear to be effective at fostering business incubation.

The effectiveness and success of SPs remain controversial topics in academia. SPs are policy instruments focused on stimulating the growth of innovative companies (Löfsten and Lindelöf, 2002) and the economy. Various potential factors affect the success of SPs, including SP characteristics, ownership, and the physical and managerial services provided for park residents (Fukugawa, 2006).

However, SPs have diverse purposes and missions and are located in different areas, such as rural and developed areas. The performance of SP companies relies not only on internal support and external resources but also on strategies, experiences, and absorptive capacity (Díez-Vial and Fernández-Olmos, 2015) as well as the ability to create and maintain relationships with strategic partners (Yan, 2019).

Interestingly, in line with the consensus reached during the IASP workshop held at Manchester SP in 2010, leading IASP members collaborated to develop performance measurement tools for assessing SP performance. They argued that park success should be appraised holistically by various stakeholders intrinsic to each SP, such as educational institutions, city or regional authorities (Rowe, 2013).

It can summarise that SPs vary greatly in terms of age, size, objectives, and the range of services they offer to tenants. Location plays a significant role, with some countries opting

to establish SPs in rural areas to encourage economic prosperity. Studies examining the performance of SPs often compare the outcomes of companies within these parks to those outside. Findings indicate that SP companies are more likely to establish relationships with local universities, leverage knowledge externalities for innovation, and exhibit higher R&D productivity, largely due to government support and strategic location.

However, these successes depend on factors such as the company's absorptive capacity, readiness, potential to access resources, and its capability to secure finance and enhance innovation. While universities influence innovation and technology transfer within SPs, the talents and skills of individuals working in these companies are key to performance improvement. Contrarily, some studies challenge the positive impact of SPs, finding no robust evidence of superior performance in SP companies regarding patents, investments, and employment growth. As such, SP effectiveness and success remain controversial. Their performance hinges not only on internal support and external resources, but also on strategies, experiences, and the ability to create and maintain strategic partnerships. Hence, measuring SP success requires a holistic appraisal involving various stakeholders intrinsic to each park.

2.1.7 The success factors of a science park

Despite the numerous benefits attributed to SPs (Yan, 2020), robust methodologies to evaluate their performance are lacking. Such evaluations could describe their results, identify potential areas for improvement, and ensure the continued relevance of these parks as the main mechanism of government policy (Poonjan and Tanner, 2020, Phan et al., 2005). As highlighted by Dabrowska (2016), there is an absence of standard criteria that would facilitate the comparison of these parks (de Faria et al., 2019). Furthermore, a clear system that aids in understanding the evolving nature of SPs and their associated companies is missing, making it challenging to assess their performance effectively.

An abundance of academic literature pointed out that a pragmatic approach to assessing the performance of SPs involves comparing the performance of SP companies and outside ones (Löfsten and Lindelöf, 2002, Yang et al., 2009, Radosevic and Myrzakhmet, 2009, Díez-Vial and Montoro-Sánchez, 2016, Díez-Vial and Fernández-Olmos, 2015, Liberati et al., 2016), utilising indicators such as the number of jobs, turnover, innovation and R&D, company survival rates, and so on. However, such comparative studies between in and off-SP companies do not present a comprehensive view of the value of SPs. These results are difficult to apply broadly, as they are largely focused on individual SPs.

Additionally, numerous factors can influence these findings, such as the SP’s age (Albahari et al., 2018a) and objectives, the nature of stakeholders involved, the location of the SP, and its contributions to the development of the surrounding region. Furthermore, SPs do not solely involve themselves with technology-based companies within their boundary (Hansson et al., 2005). Rather, they engage with a range of stakeholders (Yan, 2019, Entringer

and Da Silva, 2020), both internal and external, and are established with diverse goals and objectives (Cadorin et al., 2019).

Indeed, the concepts of success or failure could be assessed in accordance with set goals and objectives. Assessing an SP against its short- and long-term goals can offer a clear depiction of its current standing and its path towards sustainability (Wasim, 2014). Understanding the elements that can strengthen the planning, management, and operation of SPs is vital for boosting their performance and ultimately securing their success.

The UKSPA categorised the performance of SPs into two areas: economic performance, and innovation and technology commercialisation performance of SP companies.

- **Economic performance** indicators encompass job growth, turnover, revenue, and access to finance among the companies.
- **Innovation and technology commercialisation performance** is evaluated by new products or services launched, patent applications, the proportion of scientists and engineers, and the intensity of investment in R&D (UK Science Park Association, 2003).

Yan et al. (2018) suggested assessing SP performance from two angles: SP company performance and overall SP performance. Company success, marked by sales growth, number of high-tech skilled employees, patents (Phan et al., 2016, Arauzo-Carod et al., 2018, Squicciarini, 2009) and R&D expenditure (Albahari et al., 2018a), can mirror the overall SP success and contribute to the park's reputation.

Alternatively, SP performance evaluation considers factors like SP's age, an increase in the number of tenants and employees, successful technology transfer processes, increased collaboration between SP companies and local R&D institutions (Kharabsheh, 2012, Vásquez-Urriago et al., 2016), success in obtaining funding for R&D projects, an increase in innovation activities, and park management (Albahari et al., 2013b).

Albahari et al.(2018a) posited that an older SP could better understand tenants' needs, accumulate and share knowledge, and build critical mass by aggregating essential strategic partners. This correlation between SP age and positive impacts on tenants suggests that time plays a vital role in cultivating mutual trust between park management and tenant companies. Yang and Lee (2021) supported this idea, finding that older, larger parks typically exhibited superior human quality and reduced R&D misallocation. However, Albahari (2015) observed that older parks could become saturated and might neglect learning or updating new processes, making them vulnerable to businesses.

Conversely, Lecluyse et al.(2019) found that larger management structures yielded better company outcomes, arguing that SPs create environments conducive to innovation, expand entrepreneurs' networks, facilitate technology transfer, and enhance the reputations

of SP companies. Interestingly, their study also revealed that SPs in less developed areas often outperformed those in more developed regions.

Tsai and Chang (2016) determined three crucial elements to the success of HsinChu Science Park: fostering a favourable business climate for SP companies, universities, and research institutions, provision of R&D funding to stimulate industry-academia collaboration, and government investment in infrastructures such as information networks, national technical standards for certification, and other public services.

Guadix et al.(2016) pinpointed crucial variables that contribute to the success of Spanish SPs. These include 'Revenue of the SP companies', reflecting the intellectual resource and collaborative potential within an SP, and 'Expenditure on R+D+i', representing the level of investment in research and development. These factors serve as key indicators for evaluating the performance of an SP.

In summary, there is no universally agreed-upon framework for evaluating SP performance due to its diverse nature and unique characteristics. The establishment of SPs in various regions corresponds to differing goals and objectives, all aimed at fostering economic growth across a range of technology businesses of different clusters and sizes. Our study will utilise key indicators proposed in the academic literature and apply these to individual case studies. We will assess their success relative to the goals and objectives of the SP establishment.

Despite some scholarly scepticism about the efficacy of SPs —exemplified by Bakouros et al., (2002), who found no research collaborations between universities and SP-based companies across three Greek SPs—most studies predominantly affirm the myriad benefits of SPs. These benefits extend to both technological enterprises and the regional economy, offering a range of direct and indirect advantages.SPs offer vital physical and managerial services for these businesses, playing an intermediary role (Díez-Vial and Montoro-Sánchez, 2016) that allows them to connect key players, promote technological and business knowledge, enhance products and processes, and access financial support to mitigate the risks and costs associated with innovation processes. Fulfilling this role can present challenges to both SPs and technology businesses, as it requires efficient access to services and the development of absorptive capacity. In the following section, we will explore the importance of developing ICs and the role of SPs in implementing a cluster-oriented strategy to ensure their long-term sustainability and success.

2.2 Innovation clusters

At present, SPs are assuming increasingly critical roles in supporting, providing services to, and interacting with a variety of organisations and technology businesses. The concepts of SPs and clusters share numerous parallels, particularly in their objectives and functions to foster innovation and entrepreneurship. Several studies have employed the idea of clustering alongside the formulation of SP strategies (Yan, 2019). Porter (1998b) amplified that clusters could enhance business competitiveness through productivity, innovation, and the creation of new businesses. Both developed and developing nations show interest in evolving their innovation ecosystems under the cluster concept.

This approach, therefore, serves as a widely adopted guide for government entities and policymakers, aiming to stimulate the growth of innovative companies and reinforce competitiveness for high-tech products/services (Fromhold-Eisebith and Eisebith, 2005, Intarakumnerd and Vang, 2006, Saraceni et al., 2015). Numerous cluster studies concur that this approach aids in facilitating connections and providing innovative incentives for accelerating product development through R&D institutions or SPs (Den Hertog et al., 2001).

2.2.1 Understanding clusters and innovation clusters: Definitions and Key Features

Michael Porter defined as *"Clusters are geographic concentrations of interconnected companies and institutions in a particular field. Clusters encompass an array of linked industries and other entities important to competition. They include, for example, suppliers of specialized inputs such as components, machinery, and services, and providers of specialized infrastructure. Clusters also often extend downstream to channels and customers and laterally to manufacturers of complementary products and companies in industries related by skills, technologies, or common inputs. Finally, many clusters include government and other institutions- such as universities, standards-setting agencies, think tanks, vocational training providers, and trade associations-that provide specialized training, education, information, research, and technical support" (Porter, 1998a, p.78).*

In his other work, Porter (1998b) indicated clusters as geographically concentrated networks of interconnected companies and institutions within a specific field. The catalysts for the emergence and development of clusters include geographical proximity among businesses, fostering collaborative and interactive learning, and engendering positive spillover effects for the involved parties. Such benefits draw like-minded companies and actors interested in interactive learning to join the cluster.

However, the definition of ICs varies amongst scholars. Porter (2003) characterises ICs as technology-economic networks formed by regular collaboration between enterprises and associated organisations, emphasising geographical or technological proximity to foster collaboration. Esmaeilpoorarabi et al. (2018) underline highlighting the significance of places — such as SPs and research centres — in stimulating knowledge and innovation-based

activities. They argue that modern ICs extend beyond mere spaces; they represent vibrant venues for living, creating, and networking.

Wang et al. (2017) view an IC as an evolved stage of an industrial cluster, a technical economic supply network composed of innovative companies sharing a common technology or talent pool. Yim (2014) further broadens the definition of an IC as a network of innovation actors and locations actively engaging, competing, and collaborating in innovation processes to generate economic and technological value. Economically dynamic ICs emerge from active and interconnected collaboration networks between entrepreneurs, investors, educational and research institutions, small and large businesses, and government agencies (Shivakumar, 2021).

According to the study of NSTDA, an IC encompasses three principal elements. First, it refers to a collection of innovative companies in a specific industrial or technological sector, coupled with R&D facilities and researchers. These parties maintain robust links with the cluster and are augmented by related alliances, such as research institutes and universities. Second, the IC is defined by intensive interactions, knowledge and expertise exchanges among its key stakeholders. Sharing of facilities is also a common practice within these entities. Third, the agglomeration and proximity of these actors can yield significant benefits for IC members. The advantages span research collaborations, joint R&D investments, knowledge and technology transfer, creation of innovative businesses, and human resource development, amongst others (Science Park Strategy and Collboration Section, 2013).

In their definitions, various scholars have drawn attention to the central role of geographical and technological proximity in the emergence of clusters and ICs. Porter, for instance, posits that clusters are geographically concentrated networks of interconnected entities, fostered by geographic proximity and collaboration, and involving an array of linked industries essential for competition. Furthermore, Porter identifies ICs as technology-economic networks formed through regular collaboration amongst enterprises and related organisations. This view aligns with that of other researchers who underscore the importance of locations such as SPs in stimulating knowledge and innovation activities. The NSTDA offers the description of ICs as collections of innovative companies linked with R&D facilities and researchers; venues of intense interaction, knowledge exchange, and shared facilities; and sources of significant benefits derived from the agglomeration and proximity of cluster members.

2.2.2 Conceptualising the formation and development of innovation clusters

Fromhold-Eisebith and Eisebith (2005) differentiate between two modes of IC creation: top-down and bottom-up approaches. The top-down method typically arises from overarching public interests and policy objectives targeting economic development. This approach offers a robust analytical and conceptual base and can often be initiated by a single key actor at a high political level, formally integrating it into regional administrative systems.

Government programmes set national priorities, determine future aims, and dictate the inclusion of participants. Essentially, this approach encapsulates the government-led cluster, wherein the composition of key players spans a range of businesses and organisations, targeted to be eligible for promotional and other forms of support.

Asian governments frequently take a proactive role in creating and nurturing clusters. In Japan, for instance, the government aims to build 'intellectual clusters', which are regional agglomerations of universities, public research and development organisations, relevant institutes, and knowledge-intensive core businesses. The central government supplies annual budgetary support with the objective to foster the interaction of original technical developments produced by public research bodies and universities, in an effort to meet business needs, thus stimulating the creation of an innovation ecosystem and new industries (Intarakumnerd and Vang, 2006).

Conversely, a bottom-up emergence represents an industry-led cluster. This approach comprises a focused group of active and practical players linked by pre-existing connections, forming a network of already affiliated businesses. This method enables pertinent actors to lead the resolution of collaborative issues, nurture their networks, and supervise the rules that guide specific collaborative domains (Shivakumar, 2021). The flexibility of membership exceeds that of its top-down counterpart. This approach finds common ground in High-Income nations, particularly those with market economies like the United States. Efficient clusters are usually the products of 'bottom-up' private sector activities, where governments primarily function as facilitators and enablers (Intarakumnerd and Vang, 2006).

As an industry-led cluster attracts resources, labour, and technology, IC costs rise. Each stage of IC development propels subsequent exponential growth. This organic evolution embodies business nature and norms. The next milestones in competitiveness growth enable participants to gain competitive advantages through their interaction with medium and small enterprises. The maturation of ICs signifies a groundbreaking step in enhancing global competitiveness, technology evolution, narrowly specialised product development, acquiring unique experiences, and providing high-quality personnel for continual industry growth and competitive advancement (KNIAZ et al., 2020).

2.2.3 Defining the characteristics of an innovation cluster

Numerous studies on ICs have sought to identify their fundamental attributes and key players. We can categorise the defining characteristics into three distinct sections:

- **Quality of Place**

The rise of digital disruption has driven a shift from a manufacturing-centric economy towards an innovation and knowledge-based one. ICs play an essential role in catering to the demands of knowledge industries and their workforce (Cooke, 2001). Esmaeilpoorarabi et al. (2018) examined the aspects of place quality contributing to the allure of ICs. Their research

suggested that core components of ICs include universities, R&D centres, and business districts situated within or near their boundaries. The quality of place is crucial in attracting these components and enhancing competitiveness among ICs (KNIAZ et al., 2020). Knowledge workers, who drive the knowledge-based economy, require conducive environments for creative work and comfortable living. These places could facilitate networking through state-of-the-art R&D infrastructure and enable access to social and business interactions (Sawasdee, 2021).

Esmaeilpoorarabi et al. (2018) identified five generic factors of place quality: context, form, function, ambience, and image. Context signifies the place's relevance to its urban surroundings. Form refers to the physical and social attributes that support the growth of knowledge industries and worker wellbeing, including essential infrastructure for both work and leisure. Function relates to IC operation, strategic planning, and targeted clusters. Ambience emphasises creating environments that enhance social vitality and interaction, such as social events. Image aims to establish a unique identity, making the IC distinctive and impressive. This can be summarised by the attributes of a place quality for IC development discussed above. It could be an SP that can cater to economic and place-based objectives, while ambience and image concentrate more on people-related objectives.

- **Interaction within the innovation clusters**

Dynamic interaction strategies within clusters necessitate flexibility to promote IC growth (Cooke, 2001). Such interactions could cultivate mutually beneficial, trustworthy, and cooperative relationships among universities, scientific organisations, technology companies, startups, etc. (Shivakumar, 2021). Moreover, IC management agencies ought to consider the shared interests of all stakeholders. As these bodies develop greater trust, they can alleviate stakeholders' concerns about the potential leakage of core knowledge by revising relevant laws, regulations, and rules (Wang et al., 2017).

Moreover, the Economist Intelligence Unit (2016) studied the life cycles of five innovation clusters in the United Kingdom, India, Estonia, Singapore, and the United States. They found networking to be a crucial attribute of successful ICs, specifically business collaboration and the exchange of ideas among skilled individuals. Efficient infrastructures that facilitate quick and cost-effective travel for meetings with suppliers, clients, financiers, and others are crucial. Hence, place quality and networking activities are interconnected.

Preissl's (2003) indicated that networks require consistent interaction, effort to maintain connections, and strong commitment from each member. Occasional ad hoc contacts can be sufficient to establish membership, thereby reducing costs and improving time management efficiency. Balanced relationships may lie dormant in a cluster environment and can be revitalised by events or new technologies.

- **Innovation services and incentives**

Given that ICs engage in advanced R&D activities, they cultivate an environment conducive to high-potential entrepreneurial enterprises, characterised by enhanced mobility of resources, including people, capital, and knowledge (Engel and del-Palacio, 2011). The empirical study of Varga et al. (2013) on ICs in the Republic of Serbia established the critical role of government support for ICs as tools in economic policy, contributing to innovative capacities essential for economic sustainability and the survival of member entities. Such support often manifests as financial assistance aimed at fostering R&D activities and stimulating commerce.

Moreover, the growth of knowledge capital within these clusters can be fuelled by private and financial funding, encompassing seed capital, angel investors, venture capital, and government incentives (Herliana, 2015). The provision of financial and economic mechanisms is recognised as one of the pivotal features of successful ICs. Governments and relevant units encourage IC development through inter-budgetary subsidies, incorporation of cluster development activities into federal programmes, tax exemptions, and income tax incentives (Veselovsky et al., 2015).

2.2.4 Benefits of an innovation cluster

The distinctiveness of ICs lies in their unique system of relationships that not only concentrate on trade activities but also on empowering entities through the absorption of novel knowledge from academic and research institutes, which serve as essential cluster members. Porter (2003) asserted that the value generated by sharing knowledge throughout the entire IC far surpasses the benefit derived from information exchange amongst individual enterprises. Aside from the above-mentioned merits, ICs offer key benefits across the following dimensions:

- The congregation of diverse organisations specialising in innovation allows for the sharing of innovation resources. This sharing encompasses tangible assets - such as advanced equipment, infrastructure, transaction costs, networking activities, training - and intangible assets like knowledge spillovers, tacit and explicit knowledge sharing, and relationship building, leading to mutual trust (Kowalski, 2014, Wang et al., 2017, O'Dwyer et al., 2015). Other benefits include both competition and cooperation (Preissl, 2003, Mazur et al., 2016).
- Efficiently operating ICs attract corporations interested in similar fields with a propensity for collaboration. These corporations actively participate in interactive learning and mutual benefit identification (Intarakumnerd and Vang, 2006, Engel and del-Palacio, 2011). This congregation of independent companies often outperforms isolated entities in effectiveness and productivity (Ketels, 2004, Ylinenpää, 2001). They can carry out specialised internal operations and standardisation (Mazur et al., 2016), thus reducing innovation and

other transaction costs, enhancing competitive capabilities, and fostering business growth potential.

- Small businesses, as part of regional and local ICs, receive support for their unique business niches. They can access capital for industrial enterprises, gain access to other resources, and benefit from a dynamic exchange of ideas and knowledge transfer from scientists to entrepreneurs (Mazur et al., 2016).
- The operation of ICs often involves public-private partnerships. These partnerships create an organisational structure providing financial and policy incentives for businesses, universities, and research institutions with the goal of collaborative advancement in the development, production, and commercialisation of cutting-edge technology (Shivakumar, 2021).
- The local economies also gain from IC structures through increased employment, wage and profit growth, and intensified entrepreneurial activity. Cluster structures spur economic growth for the region as a whole, not solely for cluster members, thereby enhancing overall population welfare, propelling regional scientific and technical progress (Muro and Katz, 2011), and reinforcing the subsequent phase of the innovation system (Mazur et al., 2016).
- ICs add value through knowledge sharing between technology companies and their affiliates. These knowledge-sharing activities, nurtured by the industrial, value, and knowledge chains, generate considerably more value than individual enterprises achieve through knowledge utilisation. Ultimately, the value generated by knowledge sharing across the entire IC exceeds the value created by knowledge sharing within a single business. This synergy effect, the concept that "1 + 1 > 2," was highlighted by Porter (2003).

The study by Wang et al. (2017) affirms that the independent innovation power of a cluster is significantly enhanced, and the competitiveness of a cluster considerably surpasses that of enterprises not within a cluster. They attributed this success primarily to inter-company knowledge-sharing within the cluster, which helps members surmount hurdles faced in the innovation process and bolsters the development of the IC economy.

In conclusion, ICs serve as unique ecosystems of interconnected relationships that focus on trade activities and enhancing knowledge acquisition from academic and research institutions. They generate superior value through comprehensive knowledge sharing compared to the benefits of information sharing among individual enterprises. ICs are an aggregation of diverse organisations, sharing both tangible and intangible innovation resources, leading to mutual trust and cooperation. Efficiently functioning ICs draw corporations with similar interests, fostering interactive learning, mutual benefits, and improved productivity. Small businesses within ICs gain access to capital, resources, and an active exchange of ideas, benefiting from their unique business niches. ICs often involve public-private partnerships, offering financial and policy incentives for businesses, universities,

and research institutions to collaboratively advance in technology development, production, and commercialisation. Additionally, ICs contribute to local economic growth through increased employment, wage and profit growth, and entrepreneurial activity.

2.2.5 The life cycle of an innovation cluster

The empirical study by Yim (2014) on 'The Development of ICs in Region: Experience of Gwanggyo Technovalley in Korea' segmented the lifecycle of ICs into four stages: Pre-cluster, Emerging-cluster, Expanding-cluster, and Restructuring-cluster. This classification aligns with Sozinova et al.'s (2017) study focusing on the development of ICs in Russia. According to these studies, the lifecycle of ICs can be partitioned into five stages:

- **Agglomeration/ Pre-cluster step:** This initial stage sees the establishment of a few member companies and other actors, with constraints on linkages and networks within the region.
- **Emerging cluster step:** In this phase, companies begin to forge connections, link themselves, and create networks with other beneficial alliances, recognising the pursuit of opportunities and shared interests.
- **Developing cluster:** The appearance or involvement of new participants in similar or related activities in the region marks this stage. Connections between these new actors begin to emerge, and this cooperation is maintained through both formal and informal structures. Commonly, regional and activity-related identifiers such as names and websites become apparent.
- **Mature cluster/ Expanding-cluster step:** This stage is characterised by a critical mass of actors, linked to other clusters, activities, and regions. There exists an internal dynamic as new enterprises form through joint ventures.
- **Transformation/ Restructuring-cluster step:** Triggered by constant changes in markets, technologies, processes, and clusters, this stage requires the generation of new ideas and adaptations to changing conditions to ensure the cluster's survival, sustainability, and prevent stagnation and decay. The cluster might evolve into one or more other clusters, focusing on different activities or altering how products and services are offered. Yim (2014) emphasised that when clusters reach their saturation points or maximum capacity, they have three options: rejuvenation, stagnation, or dissolution.

It is clear that the requirements and concerns of the actors will vary depending on the cluster's stage of development, necessitating appropriate adaptations in cluster regulations (Arthurs et al., 2009). In a more comprehensive study, Klimova et al., (2016) provided a detailed description of the functions and phenomena of each stage (see Table 2.1) as follows:

Table 2. 1: The functions and phenomena of innovation cluster's life cycle

Stages	Action
1. Identification stage	• To define the type of partners for potential clusters • To identify a network of connections, internal functions, and operational systems • To propose initial planning of the possible conditions for cooperation
2. Initiative stage	• To generate common ideas, connecting with mutual trusts regarding the reliability and anticipation of partners actions • The crisis of trust is realised in this stage
3. Innovative development stage	• To support communication through arranging basic activities based on the responsibility of members • The first jointed project has been commenced • The level of trust increases due to the jointed projects and the development of social capital • Market activities intensify • Supervision and monitoring are required • The development of the new competencies is indispensable for the network's activity
4. Maturity stage	• Need to focus on working out new approaches to keeping the strategic and competitive advantage of the cluster • Positive external effects increase, and relationships between cluster participants are strengthened by implementing the planned jointed projects and ongoing operations. • The growing level of trust enables the development of new products through the implementation of standards and an internal certification system. • The importance of technology and the reformulation or reorientation of the plans are required
5. Transformation stage	• Innovative systems are based mainly on knowledge transfer and initiate through direct contact between individual people The higher the level of knowledge, the higher the level of trust. • The purpose of the development of social capital is for driving and shaping the wheel of cluster. • There is a risk that a lack of transformation efforts will cause a cluster to stagnate and fade away.

Source: Adapted from (Klimova et al., 2016)

In conclusion, the lifecycle of ICs, as depicted by empirical studies by Yim (2014) and Sozinova et al. (2017), consists of five stages: Agglomeration/Pre-cluster, Emerging cluster, Developing cluster, Mature cluster/Expanding-cluster, and Transformation/Restructuring-cluster. Each stage signifies various milestones such as the initial establishment of companies, the formation of beneficial alliances, the emergence of new participants, the creation of a critical mass of actors, and finally, the transformation or restructuring influenced by market, technology, and process changes. This lifecycle requires adaptive cluster regulations and is subject to the cluster's saturation point, it then could rejuvenate, stagnate, or dissolve.

2.2.6 Proximity is fundamental in the development of an innovation cluster

Proximity plays a pivotal role in the evolution of ICs. A majority of studies on ICs underline the significance of proximity, asserting that it stimulates engagement among actors within ICs and facilitates the creation of a vibrant business milieu. SPs, as beyond real estate, function to develop and promote interaction through proximity between actors and industrial activity and ultimately innovation (Ng et al., 2020b). It can be said that SPs are crucial places to stimulate IC development. Engel and del-Palacio (2011) underscored that proximity efficiently fosters linkages. According to Díez-Vial and Montoro-Sánchez (2016), geographical proximity enables easier and more localised exchange of tacit knowledge among members and neighbouring R&D institutions (Giuliani, 2005). The empirical research by Engel (2015) in Silicon Valley posited that startups derive significant benefits from their location within the IC, given that proximity to resources, investors, and other components facilitates speedy trial and learning cycles essential for evolving a resilient and scalable enterprise.

Proximity can potentially transform riskier business strategies into competitive advantages owing to reduced transaction costs (Ng et al., 2020b) and the enhanced flexibility offered by clusters to adapt strategies and resources. According to Shivakumar (2021), proximity provides several advantages in IC development:

- Physical proximity allows companies, entrepreneurs, investors, academic staff, and scientific institution researchers to collaborate and innovate.
- Organisational proximity benefitss specialist workforces and equipment from local businesses, colleges, and other research institutions, thereby enabling modern technology users to save costs by clustering operations near similar facilities.
- Spatial proximity engenders build between the multiple actors scattered across different agencies to fund, research, develop, scale up, and bring innovative products and services to market. This led to the development of trust and reciprocity needed for cooperation.

In conclusion, the value of proximity extends across physical, organisational, and spatial dimensions, each contributing to the holistic growth of ICs. Physical proximity fosters a fertile ground for collaboration and innovation among various stakeholders, including companies, entrepreneurs, investors, academic staff, and researchers. Organisational proximity avails specialist workforces and equipment, presenting cost-saving opportunities for

modern technology users by enabling clustering near similar facilities. Spatial proximity nurtures trust and reciprocity among multiple actors involved in the multifaceted processes of innovation, from funding and research to scaling up and market delivery. Therefore, effectively leveraging proximity can catalyse the growth of ICs, converting potential risks into competitive advantages.

2.2.7 Success factors of an innovation cluster

Before discussing on the success factors of ICs, it is essential to identify why ICs sometimes fail. Shivakumar's (2021) study highlighted some primary obstacles to IC development. Firstly, certain actors may contribute less to a group due to concerns over others capitalising on their efforts or not meeting the expected commitment (Mazur et al., 2016), coupled with the ambiguity surrounding intellectual property during industry collaboration.

Secondly, collaboration can potentially lead to information asymmetry. For instance, startups may be reluctant to share complete information about new technologies and business confidentiality with potential investors. Lastly, some cluster members may overuse shared resources, such as funds or specialised equipment, and power imbalances may surface where certain entities control vital resources. For example, state-owned companies might have preferential access to scarce capital resources over private entrepreneurs. Nevertheless, the success of IC development varies across low-income and high-income countries, c depending on the type of IC formation (see Section 2.2.2) and the level of IC development (see Section 2.2.6).

The literature review on successful ICs has pinpointed several contributing factors, including high-quality localisation, specialised workforce, effective knowledge management, accessible technological resources and market capabilities, innovative environment/culture, and venture capital (Yim, 2014, O'Dwyer et al., 2015, Engel and del-Palacio, 2011). Of these, localisation factors, such as favourable natural conditions, transportation, and amenities that enhance work-life quality, have been recognised as the most crucial (Yim, 2014, O'Dwyer et al., 2015).

While Wang,Lv and Duan (2017) have argued that knowledge management and tacit knowledge, which aid businesses in overcoming obstacles through interaction and sharing, are key to creating strong companies that help propel ICs successfully. They concur with Preissl's (2003) study that the critical factors are knowledge circulation, interaction, and accessibility to advanced technological know-how, as opposed to geographical proximity without efficient communication or interaction.

Arthurs et al.(2009) conducted a study on indicators to support IC policy in Canadian clusters, and found that a successful IC needs to exhibit certain distinguishing features:

- Stakeholders need to continually refine management practices and policies.
- Policymakers and IC managers need to fully understand innovation pathways and cluster dynamics to craft and implement effective policy interventions and strategies.
- All participants consistently receive government support, especially for producing innovative goods and services.

The empirical study by Jacobsen et al. (2022) empirical study centred on applying S3 (see Section 2.1.5) to assist in devising SP innovation strategies for the Prince of Songkla University Science Park in Thailand to develop three specific clusters: biomedical, rubber and seafood. Findings from surveys and interviews with local businesses and regional authorities suggested that regional policy needs to improve actor coordination to promote collaboration within and beyond the region, particularly in university-industry relationships. Furthermore, SPs were found to play three key roles in S3 implementation.

Firstly, SPs can consolidate fragmented local networks, foster linkages and related diversity between sectors where a critical mass already exists and prepare to engage with extra-regional actors to tackle outdated local specialisations. Secondly, SPs should align their internal assets with existing regional resources. Lastly, SPs need to build competencies and skills in the three clusters. These findings underscore that developing R&D infrastructure and other facilities in SPs, as well as fostering collaboration among anchor players, are paramount to IC development.

According to Ylinenpää (2001), sustainable ICs require strategic development and performance indicators that accurately reflect the cluster's performance. Two IC member groups, permanent and temporary members, necessitate different evaluation approaches. Table 2.2 details the approach for developing a sustainable IC.

Table 2. 2: The development of long-lasting innovation cluster approaches

	Permanent member attraction	**Temporary member attraction**
1. Main target group	- Existing tenant companies - Existing network both local and international organisations - Multinational and large companies - Related R&D agencies and the researchers in the national research centres	- Startups and other technology companies in order to be a pipeline for the permanent one - Researchers from other R&D agencies - Academic staff from S&T universities - New international partners
2. Key drivers	- Government – as the leading driver for offering cluster-specific programmes and innovation services and incentivising.	

	- SP management team - as the bridging agent for allocating state-defined offerings to members.	
3. Roles of SP in the ICs	- Customisation of R&D space as needs - Assignment an account manager to support tenant's requirements based on individual cluster - Facilitating to access services and incentives for specific clusters - Referring them to international network and programmes	- Providing Flexible and functional premises, such as co-working space, virtual space rental
	- Creating opportunities to engage members to get to know through social events or R&D activities - Linking prospect members to collaborate together - Providing specific laboratories for each cluster and advanced equipment which is unaffordable for members - Advertising and educating members to use R&D facilities, other services provided especially for members	
4. General success factors	- The number of new members, networking events/ seminars arrangement - The percentage of occupied space of permanent and temporary members - The number of members who used those R&D facilities	
5. Critical success factors	- Establishment of value-added services for each cluster - Assessment of engagement in R&D activities based on each cluster, such as SP tenants with other ones and SP tenants with universities - The viability of collaboration further steps	- The percentage of engagement in networking activities on a regular basis
	- Member satisfaction to improve cluster performance and listen to common problems/ interests	

Source: Adapted from (Ylinenpää "Science parks clusters and regional development", 2001)

Wang et al., (2017) concluded that IC success hinges on two main elements: knowledge-sharing flow and government support. Additional contributing factors include quality localisation, worker knowledge, strategic operation and continuous development, accessibility to R&D resources and financial backing from both public and private sectors, and appropriate government intervention.

2.3. Conclusion

This chapter presents a comprehensive review of literature related to the roles of SPs in developing ICs. Although the impact of SPs has been extensively researched by comparing the performance of companies within and outside of SPs, evaluating the success of SPs in adding value to resident companies is challenging due to their unique identities. Given that SPs are vital to driving innovative businesses, governments often leverage them as intervention tools to provide incentives and facilities to technology businesses. Meanwhile, academic institutions rely on SPs as a conduit for transferring in-house knowledge to commercialisation, bridging academia and industry. Moreover, companies located within SPs take advantage of the offerings and networking opportunities provided by SPs to accelerate their innovation processes.

A review of the literature reveals that the success or failure of SP tenants does not reflect the effectiveness of the SP itself, as individual tenants vary in their capacity to engage with associated networks. Innovations are increasingly seen as collaborative rather than solitary endeavours, involving multiple organisations and a broad spectrum of companies. SPs, such as TSP, SRP, and HKSTP, are tailoring their strategies towards specialisation and clustering. An IC, being a network of innovative actors and locations, engages with various entities in innovation processes to generate economic and technological values. The development of ICs necessitates the support of SPs in providing R&D infrastructure, innovation services, and gathering stakeholders to cultivate a dynamic innovation ecosystem. Concurrently, the operation mechanisms of ICs enhance the functionality and sustainability of SPs by fostering networking and engagement with stakeholders.

While previous studies offer extensive insights into the impact of SPs on stakeholders and IC development in developed countries, there is a relative dearth of literature exploring the roles of SPs in supporting IC development, particularly in developing countries. This study endeavours to fill this research gap by examining the roles of SPs in bolstering IC development, focusing on three aspects: provision of R&D infrastructure, innovation services, and fostering engagement among anchor actors.

From the literature review, we acquired a comprehensive understanding of the roles SPs play in contributing to stakeholder dynamics, as well as the strategies supportive of IC development. This insight was instrumental in focusing the scope of our research and in shaping our research design. Table 2 elucidates the scope of the three pertinent factors and their definitions.

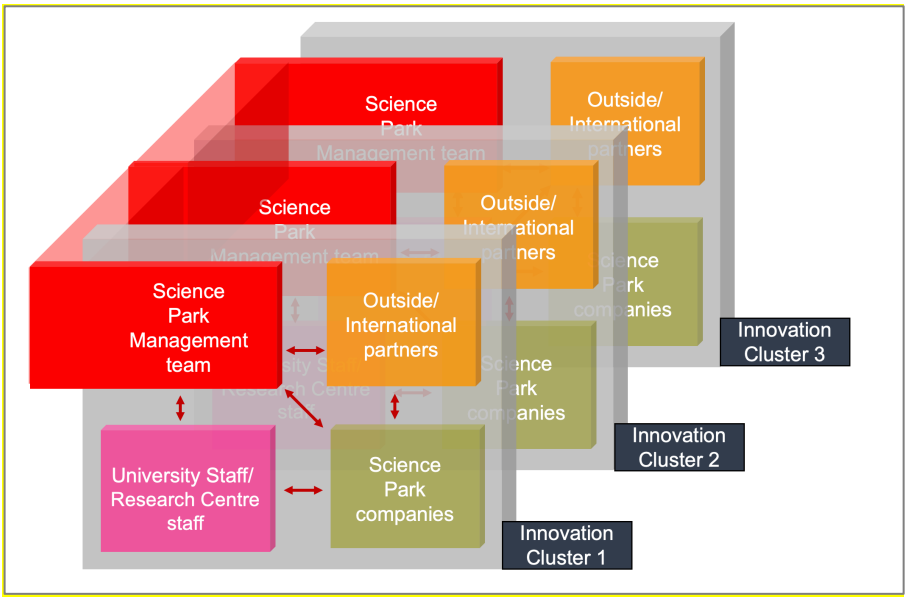
Table 2. 3: The scope of descriptions of the three key factors for this research

Typologies	Definition	References
R&D infrastructure	• Physical infrastructure for R&D that builds for doing R&D activities and provides a high-quality communication platform, laboratories, advanced equipment for R&D, testing lab, as well as providing quality of life, such as accommodation and healthcare	• Cheng *et al.*(2014) • What is a research park (2019) • (Katz and Wagner, 2014) • (Esmaeilpoorarabi et al., 2018)
Innovation Services	• These include financial support, funding, R&D services that government supports for tech companies • The purposes of services are to launch high-tech products/ services into markets, to reduce costs or the process of production, to advise the operation	• Bigliardwe*et al.*(2006) • Hansson,Husted and Vestergaard (2005) • Albaharwe*et al.*(2018b) • Siegel,Westhead and Wright (2003)
Building networks or engagement	• Building relationships between an SP tenant and other tenants within the SP • Building relationships between an SP tenant and nearby R&D institutions and HEIs • Building relationships between an SP tenant and external partners both local and international, such as tech companies international companies or agencies	• Díez-Vial and Montoro-Sánchez (2016) • Ketels (2004) • Siegel,Westhead and Wright (2003) • Ubeda,Ortiz-de-Urbina-Criado and Mora-Valentín (2019) • Fukugawa (2006)

Source: Author

We have also identified research gaps and formulated responses to all the posed research questions. A conceptual framework has been developed, as depicted in Figure 2.2. The diagram presents a conceptual framework for our study investigating the crucial role of SPs in supporting the development of ICs. At the heart of this framework is the SP Management Team, emphasising their critical role in managing the park's operations. Closely linked to the management team are the staff of universities and research centres, indicating a significant collaborative relationship. This partnership is fundamental in combining academic and cutting-edge research with practical innovation, crucial for knowledge-driven businesses.

Figure 2. 2: The conceptual framework of the study



Source: Author

The SP companies are portrayed as essential to the ecosystem, serving as the primary drivers of innovation and leveraging the support structure of the SP to propel their businesses forward. The framework also includes outside or international partners. These external collaborators encompass a range of business entities and academic institutions globally, introducing external expertise and viewpoints to the park's setting. Featured in the framework are various ICs, denoting different specialised sectors of innovation that the SP endorses. The connections between these distinct components imply the exchange of information, knowledge, R&D resources, and cooperative efforts, with the management team acting as the pivotal intermediary. These exchanges promote not only the internal operations of the SP but also its external partnerships and networks.

In summary, the framework presents a layered structure where the Science Park acts as a hub for innovation, with strong internal support and enriched by external collaborations, all contributing to the development of ICs.

Chapter 3:
Research Methodology

This chapter describes the research design and methodology utilised in our study, which implements the qualitative research method. Initially, we conducted a survey to select SPs from Europe and Asia as case studies. Additionally, we design our study in the form of semi-structured interviews to comprehend how SPs formulate their strategies to support the development of long-lasting ICs, and how they encourage their SP companies to engage with both local and international stakeholders. A multiple case study approach was chosen to examine the roles of SPs in the development and support of ICs for stakeholders and to discover commonalities and differences (Yin, 2018). These interviews also explored the extent to which SP companies and R&D institution staff rely on the contributions from SPs. The key themes and outcomes derived from this study will aid policymakers in considering the critical elements of strategies for SPs, particularly the TSP.

Further, this research incorporated the analysis of multiple public policy documents, official reports, online documents, and other relevant sources of information. This chapter is divided into five sections. Section 3.1 explains the research strategy and design, while section 3.2 presents the chosen research method. Section 3.3 focuses on data analysis, and ethical considerations and the conclusion are presented thereafter.

3.1 Research strategy and design

This study is designed to investigate the strategies and performance of SPs in developing long-lasting ICs. By comparing the TSP with two selected international SPs, the research aims to explore the differences in provided services and support, such as R&D infrastructure, services, and the establishment of networks with stakeholders to foster IC development. The findings of this research will contribute to determining key elements of TSP strategies for developing long-lasting ICs. Furthermore, the outcomes will provide valuable insights for other SPs, particularly those in developing countries, to shape their strategic development.

A questionnaire was employed to select two specific SPs, one from Asia and another from Europe, which met our criteria (refer to Table 3.1) for comparison with TSP. A multiple case study approach provided the opportunity to gain a profound understanding of a complex and dynamic phenomenon (Yin, 2018).

Following the selection of the two SPs, we conducted in-depth semi-structured interviews to investigate how these SPs manage and develop their clusters. The rationale behind choosing SPs from Europe and Asia was to investigate the differences in SP strategy, tenant profiles, methods of fostering interaction among SP companies with stakeholders (e.g.,

academic staff, external partners), and the ways they create a network amongst SP tenants and stakeholders.

The conceptual framework illustrated in Figure 2.2, as introduced in Chapter 2, is pivotal to our research, guiding the development and empirical analysis of concepts. It examines a system of interacting elements associated with the SP, both internal and external. Internal components comprise SP companies, the management team, researchers from adjacent research centres, and staff from nearby universities. In contrast, external elements include academic staff and R&D institution personnel from other universities or HEIs, along with local and international companies engaged with the SP.

This research is particularly focused on understanding the role of SPs in fostering the development of ICs. We examine how SPs assist tenants in building networks and enhancing their capability to liaise with key players such as staff at universities or R&D institutions within the SP system. Furthermore, we delve into the interactions among various elements and the collaborative efforts with external partners, including both local and international companies. These insights are crucial for optimising the roles of SPs, particularly in driving the long-lasting development of ICs.

The study is divided into three distinct phases (refer to Figure 3.2). The first phase is descriptive in nature and aims to provide accurate profiles or situational insights that respond to the 'how' aspect of our research question. Descriptive research can act as an extension of explanatory studies (Saunders et al., 2019). During this phase, we employ document-based study tools such as official reports, government publications, relevant academic literature, and interviews with both current and former members of the TSP management team. The outcome of this phase will address the first research question regarding TSP's operations, strategies, and particularly its approach towards cluster-based development. Moreover, it will help establish the criteria for the selection of other SPs as case studies.

The second phase, an exploratory study, begins with a broad focus, which gradually narrows as the research progresses (Saunders et al., 2019). In this phase, we deploy questionnaires to identify Asian and European SPs that bear similarity to the TSP context. By the end of this stage, we will have selected two specific SPs for comparative study alongside TSP.

The final phase of our study is both evaluative and explanatory. The objective is to assess the efficacy of operations within the three SPs. At specific points, we also aim to elucidate potential improvements that the SPs could implement to foster the growth of their clusters and assist SP companies in achieving their objectives, based on a comparative analysis of their strategies. Through interviews with SP tenants and R&D institution staff, we seek to comprehend the impact of the three factors delineated in Table 2.3, which the SPs provide in support of IC development. We investigate the experiences of tenants and R&D

institution staff concerning the use of R&D infrastructure and services, as well as their collaborative endeavours with other tenants, R&D institution staff, and external partners.

Moreover, we investigated the SP management teams regarding the strategies they employ to manage the Park and develop their ICs, the indicators they use to assess SP performance, and their specific actions in relation to the provision of R&D infrastructure, offering services, and establishing networks for individual clusters. The findings from this phase will address the question: *"How do science parks in developing countries manage research and development infrastructure, services, and networking in support of innovation cluster development?"* The answers will help us identify the key elements that the TSP strategy should focus on. In conclusion, our approach to addressing the research questions employs a blend of descriptive, explanatory, exploratory, and evaluative research.

3.2 Chosen research method

The study adopted a qualitative methodology, commencing with a survey to identify two additional SPs for comparison with the TSP. The selection criteria, delineated in Table 3.1, were established using TSP as a benchmark. The approach and methodology of this initial survey are expounded upon in Section 3.2.1. The IASP and the UKSPA websites served as the primary sources for compiling a list of SPs in Europe and Asia. SPs that met the established criteria were subsequently shortlisted. Invitations were extended to these SPs to participate in our study, accompanied by the distribution of a survey. Only respondents satisfying the selection criteria were considered for further engagement. Upon selection, these respondents were contacted to discuss the details of our study, the forthcoming steps concerning their participation, and the pertinent information they would need to provide to facilitate our research.

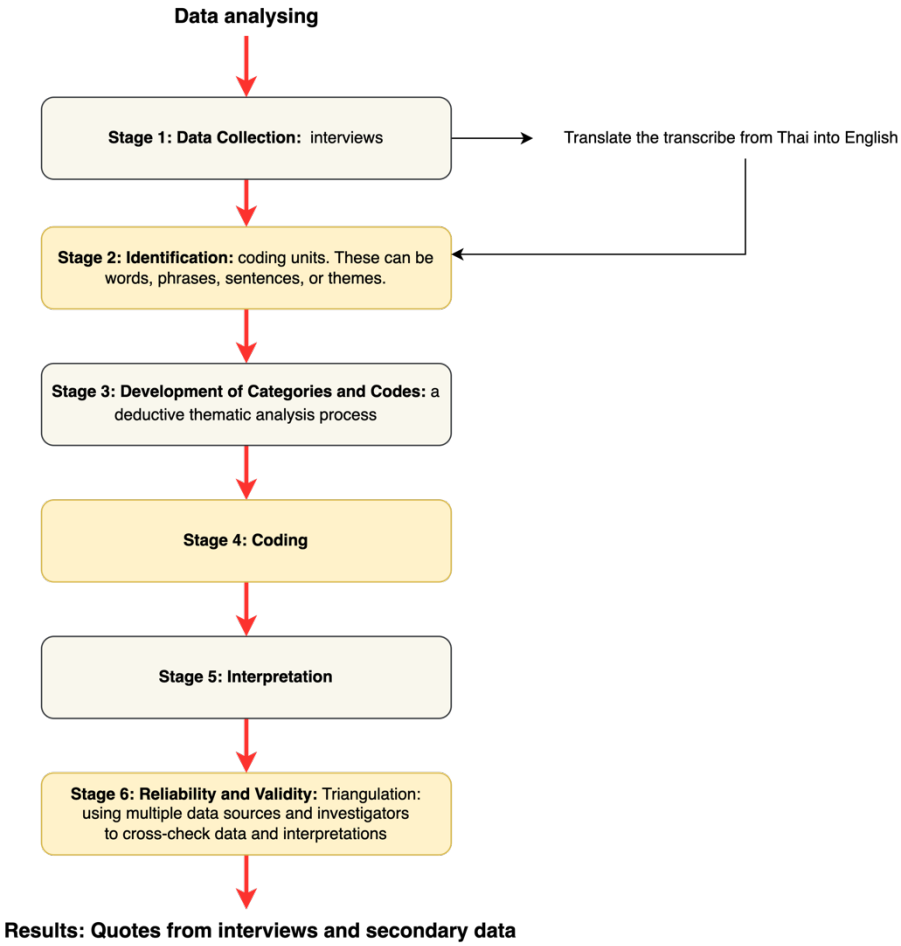
Table 3. 1:Key criteria for selecting particular science parks

Key criteria	Based line (TSP)
1. The period of establishment in 1980-2010	1. Established in 2002
2. At least one of focused clusters in food, agriculture, health and life sciences, and digital	2. Focused on four clusters, including food, agriculture, health and life sciences, and digital
3. To be occupied by tenants at least 80 companies (as of in 2021)	3. To be occupied by tenants more than 100 companies (as of in 2021)
4. To be created by public sector and managed by either government agencies or private sector	4. To be created and managed by Thai government
5. Close or adjacent to R&D organisations, universities, or HEIS	5. Close to two universities and four national research centres
6. The range of Technology Readiness Level (TRL) should be TRL 9 (commercialisation)	6. TSP tenants focused on TRL 9

Source: Author

The research work employed content analysis, an analytical technique that codes and categorises qualitative data for quantitative analysis. Within the qualitative methodology, content analysis serves as a tool specifically designed to identify the presence of particular words, themes, or concepts in qualitative data, predominantly textual content. Offering a flexible and nuanced method, it facilitates a deep understanding of complex issues and allows for a detailed interpretation of the contextual meanings embedded in the data (Bengtsson, 2016). The method is adaptable to the specific needs of a study, enabling not only the quantification of data — such as determining the frequency of certain themes — but also a comprehensive exploration of the nuances of meaning inherent in the textual material. This dual capacity for both qualitative interpretation and quantitative analysis makes content analysis a uniquely versatile tool in research (Saunders et al., 2019). Figure 3.1 presents n overview of the process of a qualitative content analysis.

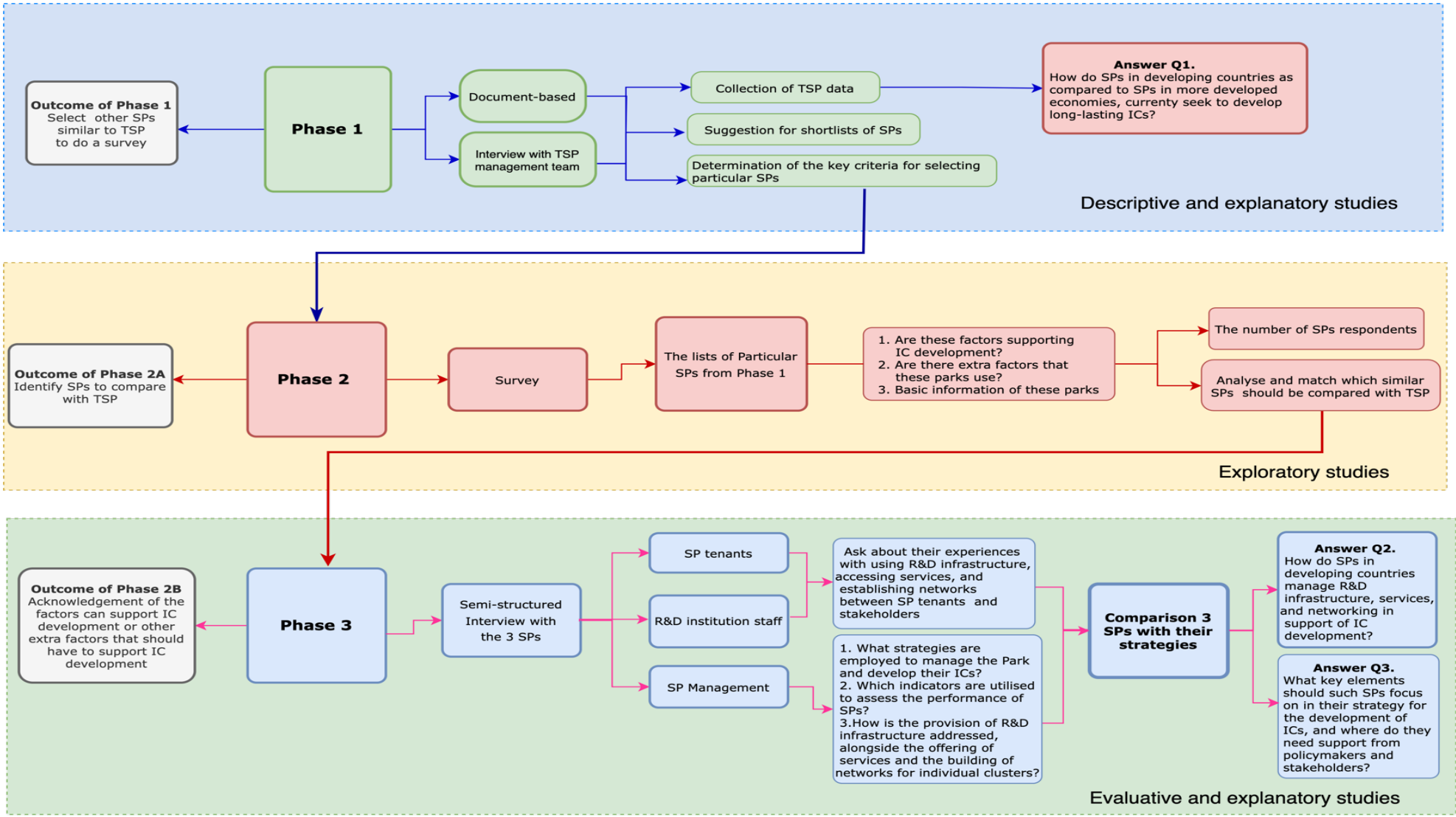
Figure 3. 1: An overview of the process of a qualitative content analysis of the study



Source: Author

The figure 3.1 presents a structured methodology for qualitative data analysis, commencing with data collection through interviews and including partial translation of these from Thai to English. The second phase involves identifying coding units such as words, phrases, sentences, or themes. This is followed by the development of categories and codes through a deductive thematic analysis process. Once the framework is established, the fourth phase, coding, systematically categorises the data. The subsequent interpretation phase analyses the coded data to extract meaningful insights. The final phase assesses the reliability and validity of the analysis using triangulation with multiple data sources and informants. The process culminates in the presentation of quotes from the interviews and secondary data, showcasing the results of the analytical procedure.

Figure 3. 2: Research methodology diagram



Source: Author

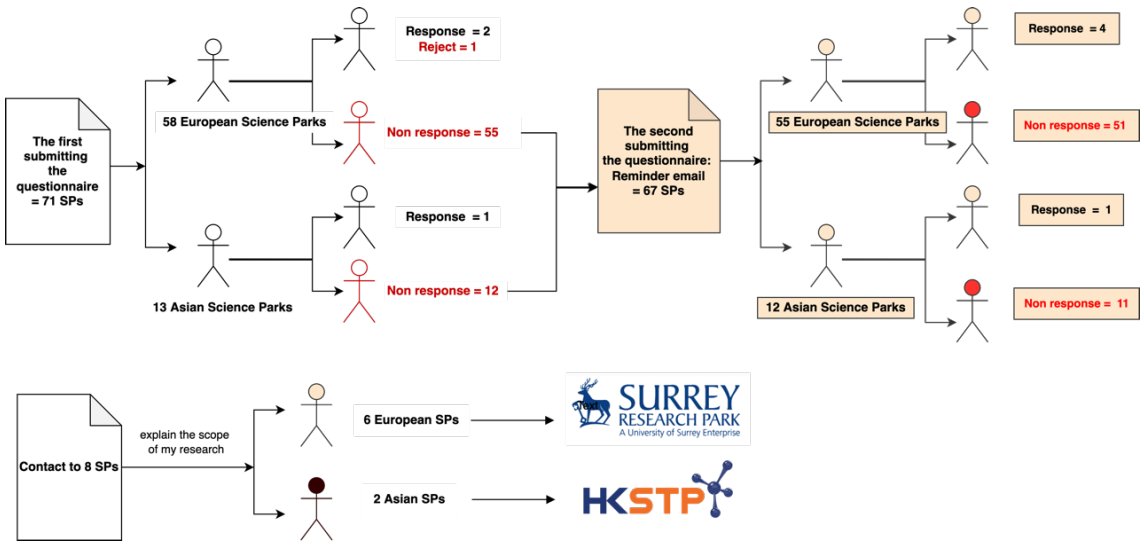
3.2.1 Survey for selecting science parks in Asia and Europe

Questionnaires are a commonly used data collection method within the survey approach. The strength of this method lies in its ability to collect responses from a large sample efficiently and consistently, as each respondent is asked to respond to the same set of questions. This method is generally used for descriptive or explanatory research (Saunders et al., 2019). Following the key selection criteria (refer to Table 3.2), we formulated ten questions to assess targeted SPs. These questions help us measure preliminary indicators such as the focus of SPs, the clusters they host, and the extent of formal and informal collaboration - categorised as Low (Up to 20 %), Medium (21% - 60%), High (Above 60%) between SP tenants and other tenants, SP tenants and nearby universities or research organisations, and SP tenants and other external companies or R&D organisations (as shown in Appendix 2).

We used QualtricsTM, a survey platform, to create, administer, and securely store our questionnaire data. The questionnaire was distributed to respondents online, who could access it either through a hyperlink on a web browser or by scanning a QR code.

In order to minimise misunderstanding, we undertook several steps to review and revise the draft questions. We first emailed the questionnaire to a member of Biocity Scotland's management and an R&D institution staff member specialising in IP and commercialisation at the University of Strathclyde. Their feedback was used to clarify and streamline the questionnaire. The revised questionnaire was then sent to the former and a pioneer director of TSP, who provided additional feedback. The final draft of the questionnaire was reviewed by the current director of TSP to ensure its effectiveness in identifying suitable SPs for our case studies. We anticipated that respondents would be at a level equivalent to that of an SP director or manager who could competently complete the questionnaire (Cadorin et al., 2019).

Figure 3. 3: The survey approach to science parks in Europe and Asia



Source: Author

We emailed the questionnaire to 58 European and 13 Asian SPs that met our criteria (See Figure 3.3). The first round of emails resulted in responses from three European and one Asian SPs. Follow-up emails sent to the non-responsive SPs elicited responses from an additional four European and one Asian SP. Despite the low response rate, a total of eight SPs expressed their interest in supporting our research. We then personally contacted these eight SPs to discuss the scope of our research.

After these interactions, we chose SRP and HKSTP as case studies for our research due to several reasons. Both parks are publicly established and managed; they focus on the same clusters as TSP, namely health and digital; they are in close proximity to universities and other R&D organisations engaged in joint R&D activities; and each park hosts more than 80 companies. In essence, both SRP and HKSTP met the criteria outlined in Table 3.1.

Upon selecting SRP and HKSTP, we conducted a preliminary study of these parks using government reports, official websites, and relevant literature. We then formulated specific sets of questions for semi-structured interviews for three types of participants: SP management team, SP tenants, and R&D institution staff.

3.2.2 Interview

For qualitative analysis, semi-structured and in-depth interviews were utilised to gather data. This method of data collection aids in understanding the 'what' and 'how', with a particular emphasis on the 'why' (Saunders et al., 2019). To answer our research questions of 'what' and 'how', we employed semi-structured interviews conducted either face-to-face or via internet-mediated platforms such as Zoom and Microsoft Teams.

These interviews were guided by a list of open-ended questions developed from a review of SP literature and IC development literature. To achieve data with high validity/credibility, these questions were composed carefully, including clarifying queries and probing questions from various angles. Furthermore, additional questions may have been asked to obtain deeper insight into unique phenomena in each SP.

The sequence of the questions may have varied depending on the participant and the context of the conversation to maintain a natural flow and ensure that interviewees felt comfortable responding. Not all questions may have been asked in every interview (Saunders et al., 2019). On the other hand, we may need to ask additional questions in order to obtain deeper information on distinct phenomena in each SP.

Data collected through interviews are often recorded via audio or video. These recordings are typically transcribed into written form, a process that is interpretative in nature (Bengtsson, 2016). This method of data collection proved essential for enabling repeatable analyses (Khan, 2014). The interviews were transcribed and summarised promptly, ideally no later than the day following each interview.

3.2.3 Selection of participants

As quoted from Howard Becker by Neuman *"Sampling is a major problem for any type of research. We can' t study every case of whatever we're interested in, nor should we want to. Every scientific enterprise tries to find out something that will apply to everything of a certain kind by studying a few examples, the results of the study being, as we say, generalizable."* Neuman cited from Howard Becker's quote (Neuman, 2013 p.246).

In qualitative research, selecting cases for detailed investigation allows us to apply what we learn from these cases to a broader range of cases. These samples aid in deepening our understanding of larger processes and relationships, highlighting critical circumstances (Neuman, 2013, Khan, 2014).

In-depth, semi-structured interviews were conducted from September 2021 to October 2022, with each interview lasting between 30 to 90 minutes. We engaged with three groups: (1) SP companies operating in the medical and health, food, and digital clusters; (2) the SP management team; and (3) partner institution staff who collaborate with SP residents in knowledge sharing, R&D collaboration, or tech business services.

We determined that the minimum number of SP tenants would constitute at least ten per cent of each Park. Therefore, approximately ten SP tenants were selected from SRP and TSP; however, for HKSTP, with more than 1,000 tenant companies, interviewing about 100 was impossible. We aimed to conduct interviews with the CEOs or management-level staff of these SP companies. In total, we conducted 53 interviews (see Table 3.3).

We engaged with SP tenants through various methods to invite them to participate in our research (see Table 3.3). For SRP, the management team assisted in reaching out to tenants in our target clusters via email. The marketing manager facilitated personal contact with the remaining tenants. We then gathered preliminary information about interested participants and confirmed the list of companies. Interviews were subsequently scheduled as either Zoom meetings or face-to-face interactions. We endeavoured to ensure that these interviewees were representative of the companies in the Park.

In contrast, the HKSTP management team was only able to assist in contacting a single SP tenant due to their job responsibilities. We resorted to snowball sampling to identify willing participants for our research. The first interview was conducted, and we were then referred to other potential participants. However, this method of sampling is prone to information bias as interviewees are likely to identify other potential participants similar to themselves, leading to homogeneity in the information gathered (Saunders et al., 2019).

We recognised the shortcomings of snowball sampling. In an attempt to counterbalance the risk of information bias, we made efforts to secure further participants through direct contact with other management teams closely affiliated with the tenants. Finally, we successfully interviewed 11 companies within HKSTP. With regard to TSP tenants, we

established contact through the facilitation of TSP management. We successfully completed interviews with ten tenants, with equal representation from the food and digital clusters. Given that these two clusters account for the majority of TSP tenants, we strived to represent a wide range of business sizes in our selection. Thus, we were successful in interviewing ten companies within TSP. A similar approach was employed for SRP, enabling us to interview ten SP tenants (as shown in Table 3.2).

Table 3. 2: Number of interviewed companies classified by each Science Park and cluster

Company	Name of SPs	Clusters	Scope of each cluster
1	Surrey Research Park	Digital	• **Health cluster** includes medical devices, life sciences, Biomedical, pharmaceutical, cosmeceutical, and well-being • **Digital cluster** consists of intelligent system, artificial intelligent, data science and analytics, IT, software, media & digital games, as well as enabling technologies such as digital, sensors or communication that allow the application of technology into various commercial areas. For example, agritech is expanding rapidly, yet it consists entirely of enabling technologies and robotics applied to the agricultural sector. • **Food cluster** includes functional food & ingredient, food safety & packaging • **Agriculture cluster** consists of seed, economic crops, industrial livestock, farming technology, and standard and supporting system
2	Surrey Research Park	Health	
3	Surrey Research Park	Digital - Space	
4	Surrey Research Park	Digital	
5	Surrey Research Park	Digital	
6	Surrey Research Park	Digital	
7	Surrey Research Park	Digital	
8	Surrey Research Park	Digital	
9	Surrey Research Park	Health	
10	Surrey Research Park	Digital and Health	
11	Thailand Science Park	Food	
12	Thailand Science Park	Health	
13	Thailand Science Park	Food	
14	Thailand Science Park	Food	
15	Thailand Science Park	Food & Agriculture	
16	Thailand Science Park	Digital and Health	
17	Thailand Science Park	Digital	
18	Thailand Science Park	Biochemicals	
19	Thailand Science Park	Digital	
20	Thailand Science Park	Food	
21	HK Science and Technology Park	Digital	
22	HK Science and Technology Park	Health	
23	HK Science and Technology Park	Digital	
24	HK Science and Technology Park	Digital	
25	HK Science and Technology Park	Digital	
26	HK Science and Technology Park	Digital and Health	
27	HK Science and Technology Park	Health	
28	HK Science and Technology Park	Digital	
29	HK Science and Technology Park	Health	
30	HK Science and Technology Park	Health	
31	HK Science and Technology Park	Health	

Source: Author and scope of each cluster is adapted from (Park, 2020, Thailand Science Park, 2020a)

In the selection of SP management teams across each park, our choices were informed by the nature of management in each respective park. We conveyed to our key contacts our particular interest in matters of strategy, park operations, and networking methods designed to foster cluster development. For both TSP and SRP, our interviews encompassed high-level management involved in these areas. In the case of HKSTP, we interviewed the team in charge of startup programmes, as well as a separate unit tasked with nurturing international networks. In total, we conducted interviews with 15 members of various SP management teams (as shown in Table 3.3). We also had the opportunity to visit the SRP over a three-day period, even participating as observers in a management team meeting in September 2021.

Table 3. 3: Number of interviewed Science Park management and research and development institution staff

No.	Organisations	Country	Group
1	Asian Institute of Technology	Thailand	Partner instituion staff
2	Medical School @ Thammasart University		
3	University of Hong Kong	Hong Kong	
4	Chinese University of Hong Kong		
5	Chinese University of Hong Kong		
6	University of Surrey	UK	
7	SETsquared @ SRP		
8	King Mongkut's University of Technology Thonburi	Thailand	SP management
9	Former TSP Director		
10	Former Director of Division		
11	Deputy Director of TSP		
12	Director of Marketing Division		
13	Key Account manager		
14	Senior officer		
15	Marketing officer		
16	Vice President, Promotions and Community Development for Startups	Hong Kong	SP management
17	Assistant Director, Business Development		
18	Assistant Director Greater Bay Area Commercial and Market Development		
19	Former senior officer, Promotions and Community Development for Startups		
20	CEO of SRP	UK	SP management
21	COO of SRP		
22	CMO of SRP		

Source: Author

For the selection of R&D institution staff or those employed within other R&D organisations, our choices were guided by their past collaborations with SP tenants and any existing relationships with SP management in the context of providing funding, sharing knowledge, and networking. At SRP, we interviewed staff from the University of Surrey and the SETsquared. In the case of HKSTP, we conducted interviews with staff from both the University of Hong Kong and the Chinese University of Hong Kong. For TSP, our interviewees included management from the Medical School, Thammasat University and Asian Institute of Technology, as shown in Table 3.3.

However, we were mindful that interview data are inherently subjective and may lack hard facts. To address these potential pitfalls, we ensured a wide range of corroborative evidence from diverse sources. We also develop an informal rapport with our interviewees, consciously avoiding an excess of interviewer-led questions. To lend credibility to the information we garnered, we supplied interviewees with relevant information prior to the interview, such as research objectives and participant information sheets (as shown in Appendix 1).

Moreover, we provided a list of semi-structured questions, which we believed would enhance validity and reliability. This list not only kept interviewees apprised of the information we sought, allowing them to prepare by compiling organisational documentation (Saunders et al., 2019), but also offered clarity on any ambiguous questions. These strategies were adopted to manage potential bias, enabling us to obtain a more objective picture.

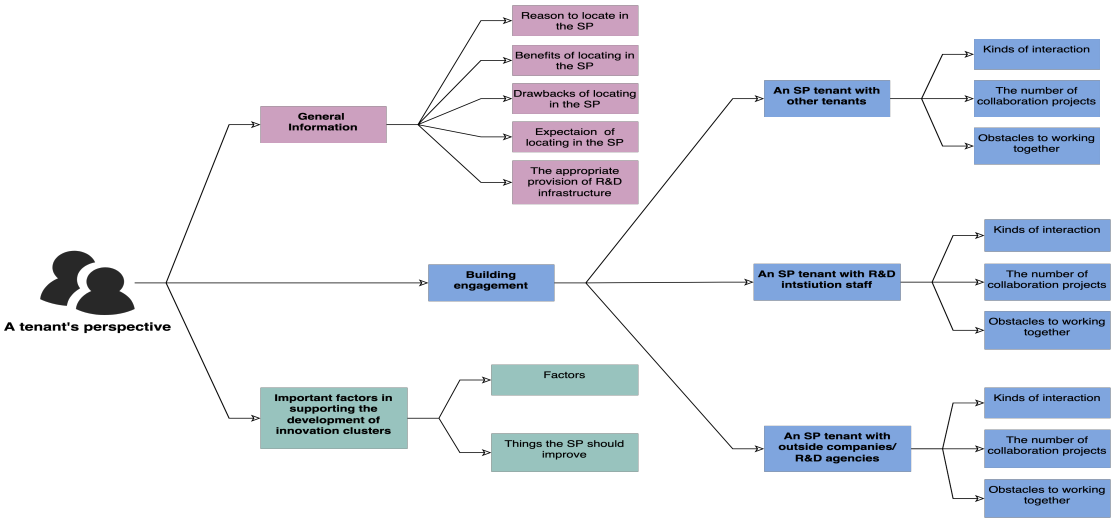
3.3 Data analysis

Following data collection, in-depth interviews with SP tenants from TSP, SRP, and HKSTP were analysed alongside the interview recordings and notes, using NVivo software, given that this group forms the largest portion of interviewees. NVivo is an effective tool for qualitative analysis, enabling researchers to manage vast data sets with precision and affording straightforward access to relevant resources (Jackson and Bazeley, 2019). Employing NVivo for data management enhances the rigour of the procedure and proves particularly beneficial for multiple case study methods (Qureshi, 2016b). Interviews were recorded and conversational notes were taken. The cases of SRP and HKSTP were conducted in English, whereas the TSP case was conducted in Thai, requiring translation into English prior to NVivo 12 analysis. Direct quotes were used to illustrate speech patterns in the data and convey our findings.

We asked SP tenants from three perspectives. Firstly, we enquired about the rationale, expectations, benefits, and drawbacks of their Park location, as well as the adequacy of the R&D infrastructure provision. Secondly, from a building engagement perspective, we investigated their engagement with other tenants, external companies or R&D agencies, and R&D institution staff concerning interaction types, collaboration obstacles, project collaborations, and the level of SP contribution towards establishing networks with such

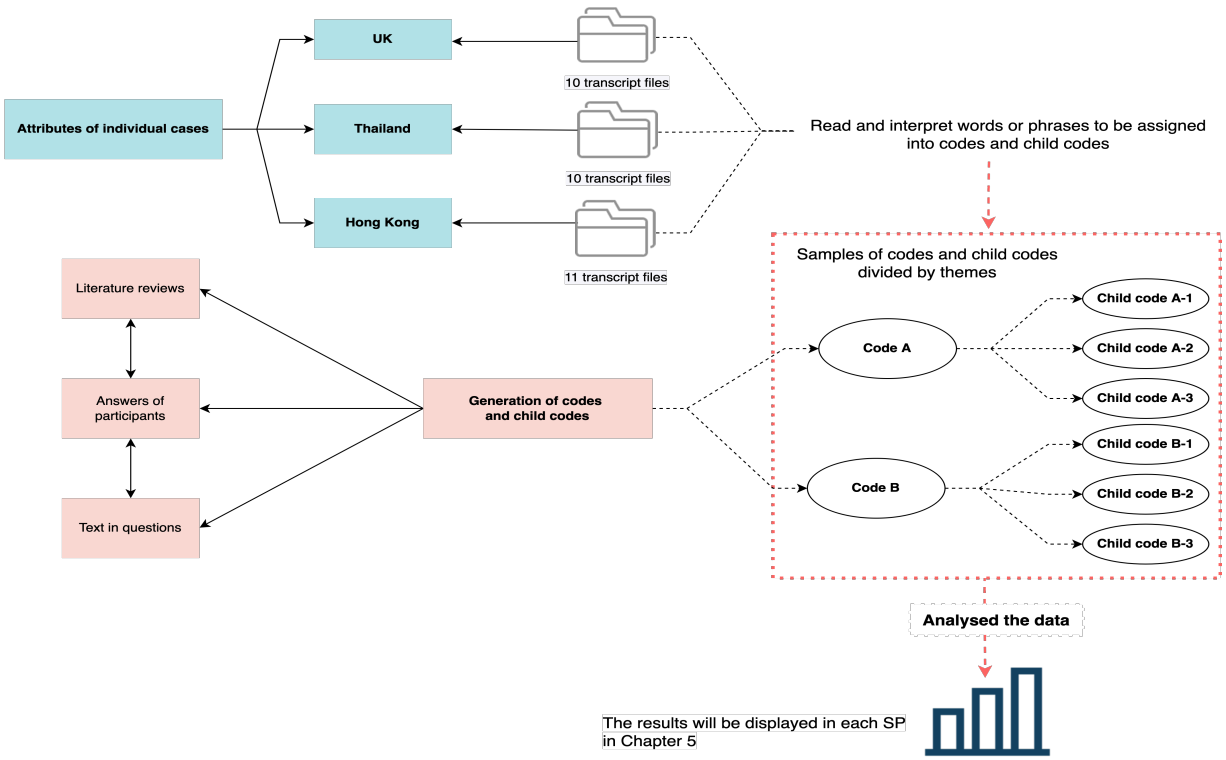
anchor players. Lastly, we allowed SP tenants to express their opinions fully with an open-ended question regarding the most critical factors and areas for SP improvement in fostering IC development within their own Park, thereby facilitating their success (see Figure 3.4).

Figure 3. 4: Model of tenant's analysis data



Source: Author

Figure 3. 5: Step of identification of the attributes and generation of codes to analyse the data



Source: Author

Figure 3.5 outlines the process of using NVivo 12 to analyse SP tenant data. Initially, we identified the attributes; an attribute refers to any feature or property of a source item or node impacting data analysis, such as age, group, and location (Qureshi, 2016a). In this study, the attributes would be the countries' names: the UK, Thailand, and Hong Kong. Secondly, we imported all transcripts from the recordings and notes into NVivo.

Table 3. 4: Examples of codes and child codes for the data analysis

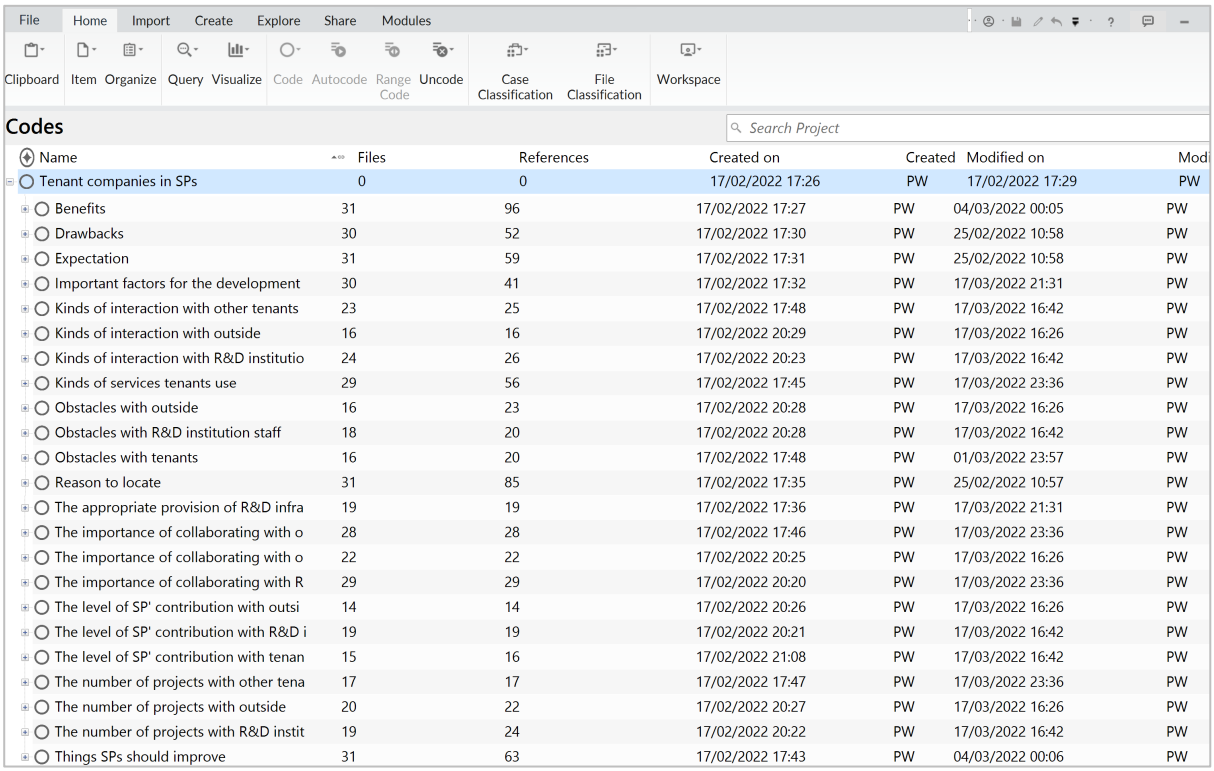
Themes	Codes	Child codes
The SP overviews	Reasons to located in the SPs	1. Access funding, services and facilities 2. Corporate image and reputation 3. Engagement with anchor players 4. Geographical proximity 5. Good location
	Benefits of locating in the SPs	1. Access funding, services and facilities 2. Corporate image and reputation 3. Engagement with anchor players 4. Geographical proximity 5. Good location
	Drawbacks of locating in the SPs	1. Expensive rent and high cost of living 2. Insufficient and discontinuous in building engagement 3. Reimbursement process takes a long time 4. SP operation 5. Traffic and transportation inconvenient
	The important of collaboration	1. Very important, 2. Important 3. Moderate, 4. Not important
Building networkings: **1. an SP tenant with other SP tenants** **2. an SP tenant with R&D institution staff** **3. an SP tenant with outside partners**	The level of SP's contribution to those collaborations	1. High, 2. Moderate 3. Low, 4. Necessary
	Kinds of interaction with those collaborations	1. Formal, 2. Informal, 3. Both
	Obstacles while interacting with other SP tenants	1. Asymmetric business benefits 2. Mutual trust-sharing information 3. Time limitation 4. Lack of IP clarity in collaboration
	Obstacles while interacting with R&D institution staff	1. Asymmetric business benefits 2. Delayed response and time limitation 3. Financial support and funding 4. The lack of business view 5. Lack of IP clarity in collaboration
	Obstacles while interacting with outside partners	1. Financial support and funding 2. Regulation and contact 3. The difference of business procedures 4. Business culture and language 5. Sharing information and finding the liked-mind person 6. Lack of IP clarity in collaboration 7. Time limitation

Source: Author

The third step involved code generation. A code is an abstract representation of an object or phenomenon, typically a word or short phrase, encapsulating the essence of a language-based or visual data subset. Code creation can arise from identifying repetitions and regularities in participants' ideas, and codes can also be generated from the text within questions (Jackson and Bazeley, 2019). Examples of codes and child codes are shown in Table 3.4.

Our research applied a deductive thematic analysis process, leveraging a pre-existing theoretical framework to guide the analysis. This process was initiated with a set of codes or themes extracted from pre-existing theories and literature review, which were subsequently used to interpret the raw data (Fereday and Muir-Cochrane, 2006). Consequently, we employed this methodology to clarify the roles of SPs in supporting the long-lasting growth of ICs, focusing on three key factors: provision of R&D infrastructure, delivery of innovation services, and fostering networks between SP tenants and stakeholders. As an integral part of this process, we reviewed the interview notes multiple times to ascertain the frequency and context of various aspects, attributing codes as relevant (refer to Figure 3.6).

Figure 3. 6: Codes developed during data analysis

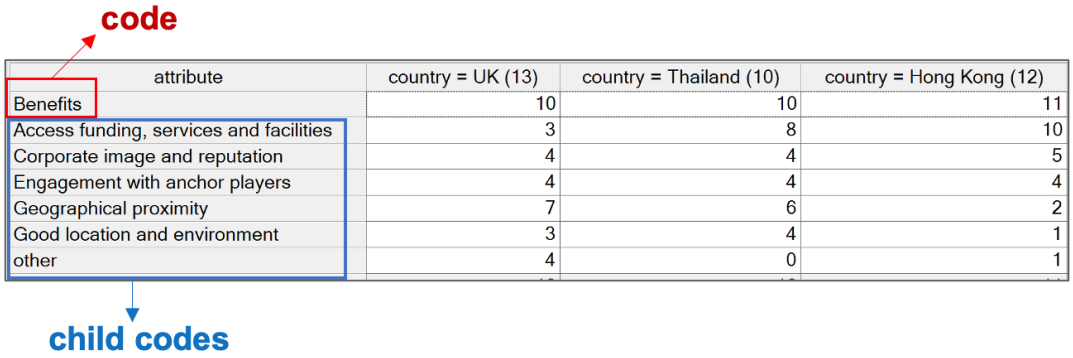


Name	Files	References	Created on	Created	Modified on	Mod
Tenant companies in SPs	0	0	17/02/2022 17:26	PW	17/02/2022 17:29	PW
Benefits	31	96	17/02/2022 17:27	PW	04/03/2022 00:05	PW
Drawbacks	30	52	17/02/2022 17:30	PW	25/02/2022 10:58	PW
Expectation	31	59	17/02/2022 17:31	PW	25/02/2022 10:58	PW
Important factors for the development	30	41	17/02/2022 17:32	PW	17/03/2022 21:31	PW
Kinds of interaction with other tenants	23	25	17/02/2022 17:48	PW	17/03/2022 16:42	PW
Kinds of interaction with outside	16	16	17/02/2022 20:29	PW	17/03/2022 16:26	PW
Kinds of interaction with R&D institutio	24	26	17/02/2022 20:23	PW	17/03/2022 16:42	PW
Kinds of services tenants use	29	56	17/02/2022 17:45	PW	17/03/2022 23:36	PW
Obstacles with outside	16	23	17/02/2022 20:28	PW	17/03/2022 16:26	PW
Obstacles with R&D institution staff	18	20	17/02/2022 20:28	PW	17/03/2022 16:42	PW
Obstacles with tenants	16	20	17/02/2022 17:48	PW	01/03/2022 23:57	PW
Reason to locate	31	85	17/02/2022 17:35	PW	25/02/2022 10:57	PW
The appropriate provision of R&D infra	19	19	17/02/2022 17:36	PW	17/03/2022 21:31	PW
The importance of collaborating with o	28	28	17/02/2022 17:46	PW	17/03/2022 23:36	PW
The importance of collaborating with o	22	22	17/02/2022 20:25	PW	17/03/2022 16:26	PW
The importance of collaborating with R	29	29	17/02/2022 20:20	PW	17/03/2022 23:36	PW
The level of SP' contribution with outsi	14	14	17/02/2022 20:26	PW	17/03/2022 16:26	PW
The level of SP' contribution with R&D i	19	19	17/02/2022 20:21	PW	17/03/2022 16:42	PW
The level of SP' contribution with tenan	15	16	17/02/2022 21:08	PW	17/03/2022 16:42	PW
The number of projects with other tena	17	17	17/02/2022 17:47	PW	17/03/2022 23:36	PW
The number of projects with outside	20	22	17/02/2022 20:27	PW	17/03/2022 16:26	PW
The number of projects with R&D instit	19	24	17/02/2022 20:22	PW	17/03/2022 16:42	PW
Things SPs should improve	31	63	17/02/2022 17:43	PW	04/03/2022 00:06	PW

Source: Author

Lastly, we analysed the completed coding using the crosstab function for each topic within each SP, as demonstrated in Figure 3.7. This approach enabled us to answer our research questions.

Figure 3. 7: An example of codes and child codes developed during data analysis



attribute	country = UK (13)	country = Thailand (10)	country = Hong Kong (12)
Benefits	10	10	11
Access funding, services and facilities	3	8	10
Corporate image and reputation	4	4	5
Engagement with anchor players	4	4	4
Geographical proximity	7	6	2
Good location and environment	3	4	1
other	4	0	1

Source: Author

Once the NVivo data analysis process was completed, the initial analytic task involved revisiting each SP to identify significant statements, comprising phrases, statements, or paragraphs that were directly pertinent. Analyses were conducted within individual cases to scrutinise phenomena and strategies and capture the essence of individual SP performance.

Subsequently, we utilised an across-case analytic strategy to examine all participants' experiences and define categories of significant phenomena to determine whether they employ similar or distinct strategies to achieve their objectives. The analysis might identify strategies employed by one SP and not by another, based on factors such as the country and cultural context, government innovation policies, the nature of tech businesses, etc. This study endeavours to identify practical practices that TSP could implement to support the long-term development of ICs (Ayres et al., 2003).

3.4 Ethical issues

Ethical considerations are crucial in all research, but particularly so in qualitative research due to the nature of the engagement with participants' lives (Punch, 2013). Participation in research should always be voluntary, and the researcher must clearly communicate all components of the study to the participants. In this light, we ensured that all participants were fully aware of their rights and briefed about the research study (Neuman, 2013). All participants received the participant information sheet and consent form via email prior to their participation. Informed consent was obtained from all participants before the interviews, either verbally or in writing, with permission to record the interview. We will keep the names and organisation names of all participants confidential in order to encourage open and honest discussion.

3.5 Conclusion

This chapter describes our research design and methodologies, rationalising our choice of research strategy and the deployment of a questionnaire as our initial mode of data collection. This methodology facilitated the selection of our case studies of SPs: SRP, HKSTP and TSP. We engaged in detailed, semi-structured interviews with three principal stakeholder groups: the SP tenants, the R&D institution staff, and the SP management team. The tenants and R&D staff furnished valuable insights into IC development, gleaned from their hands-on experiences within the SPs, while the management team provided a strategic perspective on IC support.

In terms of data analysis, we utilised NVivo, a proficient tool for managing data sets and offering easy access to resources. We performed individual case analyses to discern the unique phenomena and strategies that bolster IC development. After a thorough analysis of each of the three SPs, we carried out a cross-case examination to pinpoint notable phenomena that contribute to the realisation of their objectives. Ultimately, the goal of this research is to uncover practical strategies that the TSP could adopt to promote the long-lasting development of ICs.

Chapter 4:
Empirical Case Studies:
Thailand Science Park, Hong Kong Science and Technology Park, and Surrey Research Park

This chapter provides an overview of TSP, HKSTP, and SRP. Each of these parks embodies a unique confluence of strategic vision, geographical context, and developmental trajectory, justifying a comprehensive study. The objective of this chapter is to outline the histories and foundational objectives of each SP, along with their strategic approaches and the diverse mechanisms through which they foster innovation and research.

Additionally, the chapter examines the provision of innovation services and R&D infrastructure within these SPs. It highlights how building effective networks with stakeholders, which vary across each park, is crucial. Furthermore, it introduces a set of indicators used to evaluate the performance of these SPs. These indicators present measures of success and insights into areas of strength and potential improvement. The evaluation covers a range of metrics, from innovation outputs to economic impact, with the aim of presenting a holistic view of the effectiveness and influence of these SPs. Ultimately, the aim of this chapter is to deepen the understanding of how Science Parks operate and thrive in different contexts and how they can support their tenants.

This chapter is divided into three main sections, each shedding light on the holistic management of SPs and stakeholder engagement. Section 4.1 provides an overview of the TSP, showcasing it as one of the prominent SP successes in developing countries. Section 4.2 presents an overview of the HKSTP, also known as the centre of the innovation hub for potential startups worldwide. This is evidenced by the 14 unicorn startups based in the Park. Finally, Section 4.3 discusses the SRP, representing the Park in developed countries. This Park is unique in terms of management and is also one of the oldest SPs in the UK.

4.1 Thailand Science Park

4.1.1 The overview of science park in Thailand

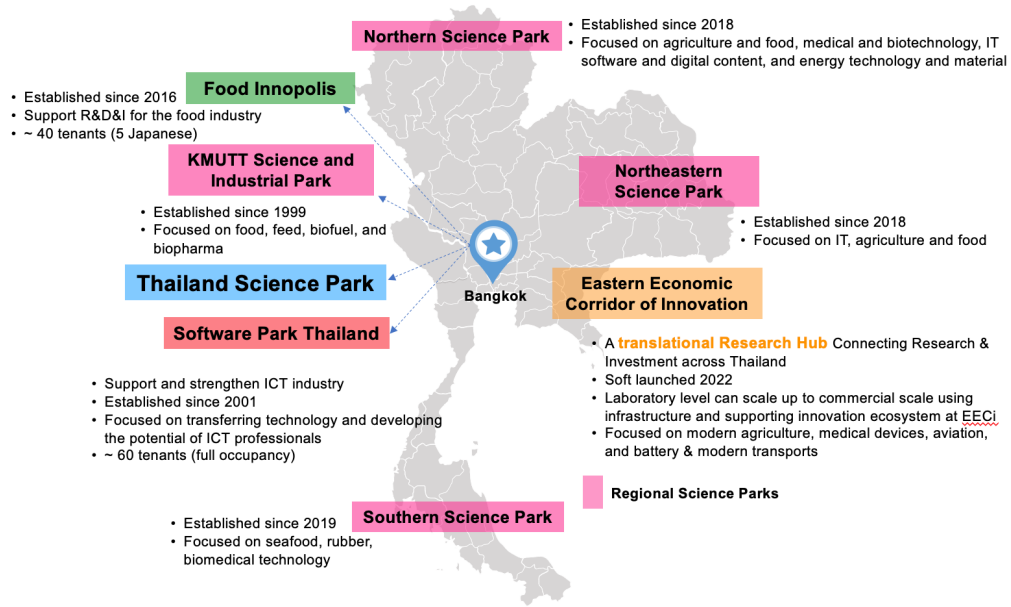
SPs in Thailand are governed by the Ministry of Higher Education, Science, Research, and Innovation (MHESI) and are supervised by two government agencies. First NSTDA oversees TSP, Software Park Thailand, Food Innopolis, and the Eastern Economic Corridor of Innovation (EECi). Second, the Office of the Permanent Secretary, MHESI, manages regional SPs throughout Thailand (Tantanasiriwong, 2016). These regional SPs are administered by universities (see Figure 4.1).

The first university industrial park, KMUTT Science and Industrial Park, was established in 1999 and is governed by King Mongkut's University of Technology Thonburi

(KMUTT). This Park emphasises the food, feed, biofuel, and biopharma industries (KMUTT Science and Industrial Park, 2020). Subsequently, other regional SPs were established, such as Science and Technology Park Chiang Mai University (STeP) in 2018, focusing on sectors such as agriculture and food, medical biotechnology, IT software and digital content, energy technology and materials (STeP, 2019). The Southern Thailand Science Park (STSP), established in 2019 under the supervision of Prince of Songkla University, prioritises rubber, seafood, palm oil, and biomedical technology industries (Jacobsen et al., 2022). The Northeastern Science Park, also known as Khon Kaen University Science Park (SPKKU), was founded in 2018 and focuses on food, agriculture, and IT sectors (Saksart, 2022).

Each regional SP collaborates with universities in their respective regions to assist local startups and industries, serving as the main platforms for IP management, technology transfer from universities to the private sector, Technology & Innovation Business Incubation, and engineering and technology consultancy. These SPs provide R&D infrastructure and facilities, such as R&D and co-working spaces, pilot plants, testing and laboratories (Phisansupong, 2014, Boonaneksap, 2022).

Figure 4. 1: Overview of science parks and regional science parks in Thailand by region and focus areas



Source: Author

A member of the KMUTT SP management team expressed that regional SPs operate on a project-by-project basis and frequently collaborate with research centres within TSP. However, interactions with TSP tenants have remained limited. This is primarily due to the difficulties in identifying mutually beneficial relationships between the technology companies in their network and TSP tenants, as the latter tend to engage in research at a higher level.

Regional SPs often forge strong relationships under the shared oversight of the same agency, underpinned by a commitment to shared Key Performance Indicators (KPIs) and co-creation of strategies. Consequently, regional SPs have numerous opportunities for coordinating joint activities, sharing knowledge, and identifying mutual interests among themselves. In contrast, TSP, which falls under the management of NSTDA, pursues different strategic objectives (Boonaneksap, 2022).

4.1.1.1 History of the first science park establishment in Thailand

The first SP in Thailand, known as TSP, was established in 2002 on an 80-acre site. This space is divided into four main zones:

(a) the NSTDA and its five research centres, alongside the Technology Management Centre (TMC);

(b) an incubation space for emerging enterprises;

(c) a rental space designated for technology-based companies; and

(d) leased plots where companies can construct their own R&D centres.

As a component of the TMC, TSP is responsible for administering infrastructure and promoting rental spaces for R&D activities among targeted companies (National Science and Technology Development Agency, 2020c). In addition to these functions, the TSP management team is also charged with fostering a conducive innovation ecosystem and enhancing interactions between companies and researchers within these centres.

The TSP team's role is not merely that of a landlord. One SP management member commented, *"We aim to attract companies that we believe have the potential to collaborate with researchers or are capable of leveraging applied research for commercialisation, maximising the use of the R&D infrastructure and facilities we provide. We believe that these types of tenants will contribute to our sustainability* (Wongthawethong, 2020)."

The government made a substantial investment of ฿7,000[1] million in the establishment of TSP, with ฿4,000 million allocated for research-related infrastructure and the remaining ฿ 3,000 million for R&D equipment, facilities, and enhancing the quality of life within the park (Thailand Development Research Institute, 2015). The chosen location for TSP was on unused land owned by Thammasat University and the Asian Institute of Technology in Pathum Thani province, situated near Bangkok (Bunnag, 2020). Several factors contributed to this decision:

[1] As of 22 July 2022, accounting for inflation in Thailand and using the current exchange rate (1 pound = 43.94 baht), the construction costs translate to £92 million, while the expenditure for R&D equipment and facilities amounts to £68 million.

- Geographical Advantage: The location of TSP offers convenient access to Don Muang International Airport, multiple industrial parks, and HEIs, facilitating R&D activities and travel.
- Expansion Opportunities: The availability of ample land provides the potential for future expansion of TSP's facilities and activities.
- Special Economic Zone: The area surrounding TSP was designated as a special economic zone, incentivising the development of a knowledge-based economy through tax privileges and other innovation packages offering by Board of Investment Thailand (BOI).
- Access to Knowledge: The proximity of TSP to academic staff and researchers allows entrepreneurs easier access to the knowledge and expertise available within the HEIs.
- Shared R&D Resources: The presence of various R&D organisations around TSP enables the sharing of R&D resources and encourages collaboration and cooperation.
- Knowledge Transfer: Policymakers envisioned that the close proximity between TSP and universities would foster the sharing of tangible and intangible resources. This closeness was expected to stimulate technology transfer activities and facilitate the emergence of new industries through the transfer of knowledge from universities or academic spin-offs (Minguillo and Thelwall, 2015).

Thailand's establishment of its first SP faced some delays compared to other Asian countries. The location of TSP in Pathum Thani province offers strategic advantages, including proximity to airports, industrial parks, and HEIs. This facilitates R&D activities, knowledge transfer, and the sharing of resources among regional SPs. Policymakers believed that the close proximity between TSP and universities would promote technology transfer and the emergence of new industries through the exchange of knowledge and resources.

4.1.1.2 Vision and mission of Thailand Science Park

The vision of TSP is to establish itself as a leading platform in Southeast Asia, enabling knowledge-based entrepreneurs and businesses to start, grow, and thrive. TSP's mission is to foster a dynamic S&T community composed of successful companies, promising enterprises, innovative entrepreneurs, and public institutions. It aims to strongly support the community in their R&D and business endeavours while promoting cooperation among universities, public agencies, and industries (Thailand Science Park, 2022e, p.1).

According to the TSP website (Thailand Science Park, 2022e), TSP was established with five key objectives and four goals:

- To function as a fully integrated R&D hub.
- To encourage cooperation among R&D institutes, public agencies, and industries, including regional and international SPs.
- To facilitate the transfer of R&D knowledge from the laboratory to commercialisation by acting as a connecting provider.

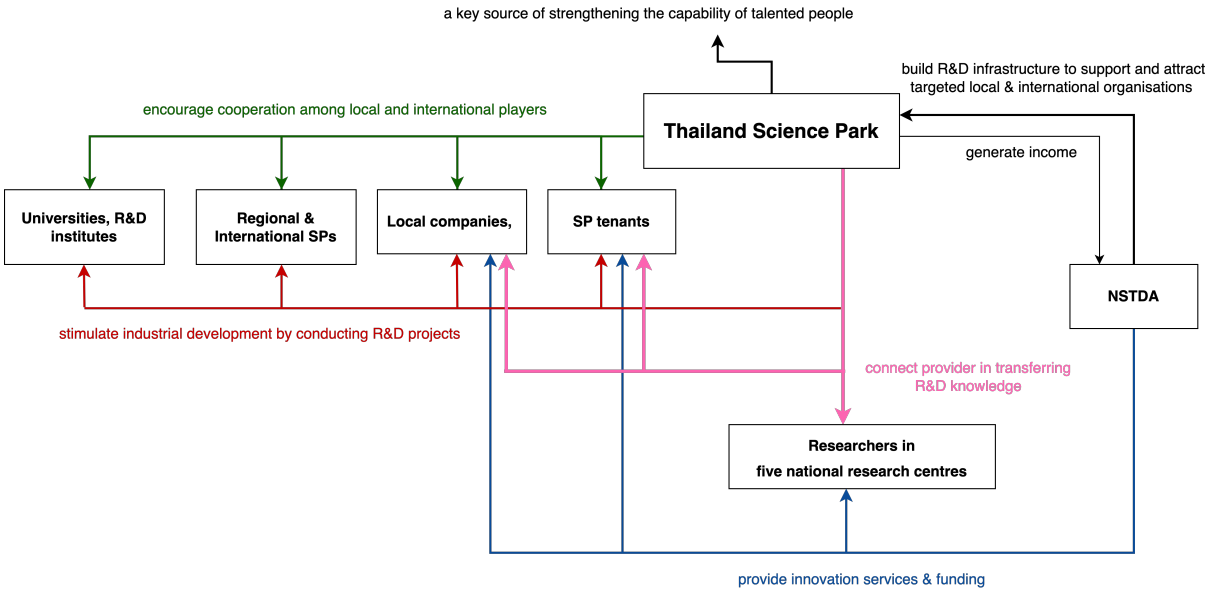
- To stimulate industrial development by conducting private sector R&D projects.
- To strengthen the capabilities of talented individuals.

TSP has four specific goals it aims to achieve:

- Driving TSP companies to expand into overseas markets.
- Engaging regional and international partners to support potential SP tenants.
- Attracting foreign corporations to establish a presence or conduct research within TSP.
- Enhancing the innovation ecosystem and creating business opportunities.

An examination of TSP's objectives and goals reveals a clear alignment between them. TSP focuses on creating an integrated R&D environment, fostering cooperation, promoting the commercialisation of SP tenants, stimulating industrial development, and strengthening talent. These objectives directly correspond to TSP's goals of attracting foreign corporations, engaging partners, driving international growth for TSP companies, and enhancing the innovation ecosystem. This vision showcases TSP's commitment to innovation, growth, and collaborative advancement.

Figure 4. 2: Stakeholders & delivered value propositions of the Thailand Science Park

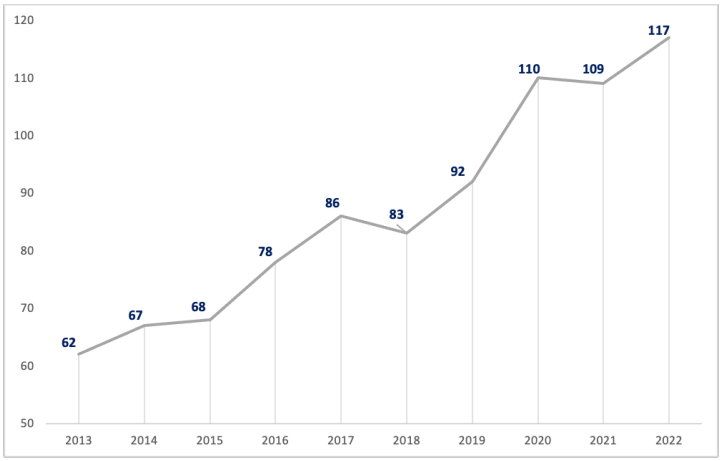


source: Author

TSP interacts with a wide range of stakeholders (see Figure 4.2). The government assigned NSTDA the responsibility of supervising TSP. Within NSTDA, the TMC plays a significant role by providing innovation service programs and funding to both internal and external tech businesses and research centres that collaborate with the private sector. It is evident that TSP plays a crucial part in strengthening the capabilities of talented individuals in the fields of science and innovation. Simultaneously, TSP aims to generate income through rental space for NSTDA. The Park actively fosters collaboration opportunities between its

tenants and stakeholders, establishing networks among universities, tech companies, and other SPs at the local, regional, and international levels to cater to the needs of diverse SP tenants, ranging from SMEs to large corporations. Moreover, TSP endeavours to facilitate the development of R&D research from lab to commercial scale by transferring knowledge from research centres to SP tenants and other local companies that serve as potential future pipelines.

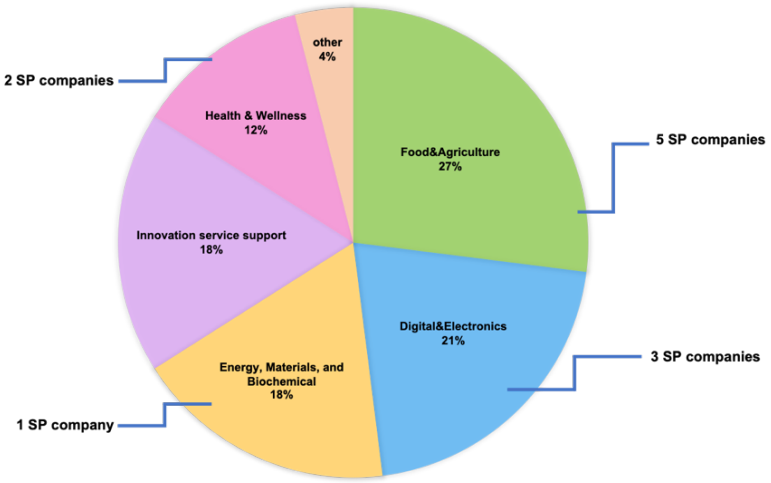
Figure 4. 3: Thailand Science Park companies from 2013 to 2022



Source: Adapted from (Tongsri, 2022)

Figure 4.3 illustrates the number of SP companies over the past ten years. Despite the impact of the Covid-19 pandemic, TSP has successfully maintained a stable tenant population. As of 2022, TSP is home to 117 technology companies, with nearly 40 per cent of them being international entities. The highest number of international companies are from Japan, followed by Germany, the United States, Spain, and Australia, among others. TSP currently boasts an occupancy rate of 87 per cent (Tongsri, 2022). SP companies are categorized into four major clusters, along with innovation service support. In the case of TSP, ten SP companies were interviewed. Notably, one company operates within both the digital and health clusters, while another company is involved in the food and agriculture clusters; hence, we have counted these two companies in both clusters (see Figure 4.4).

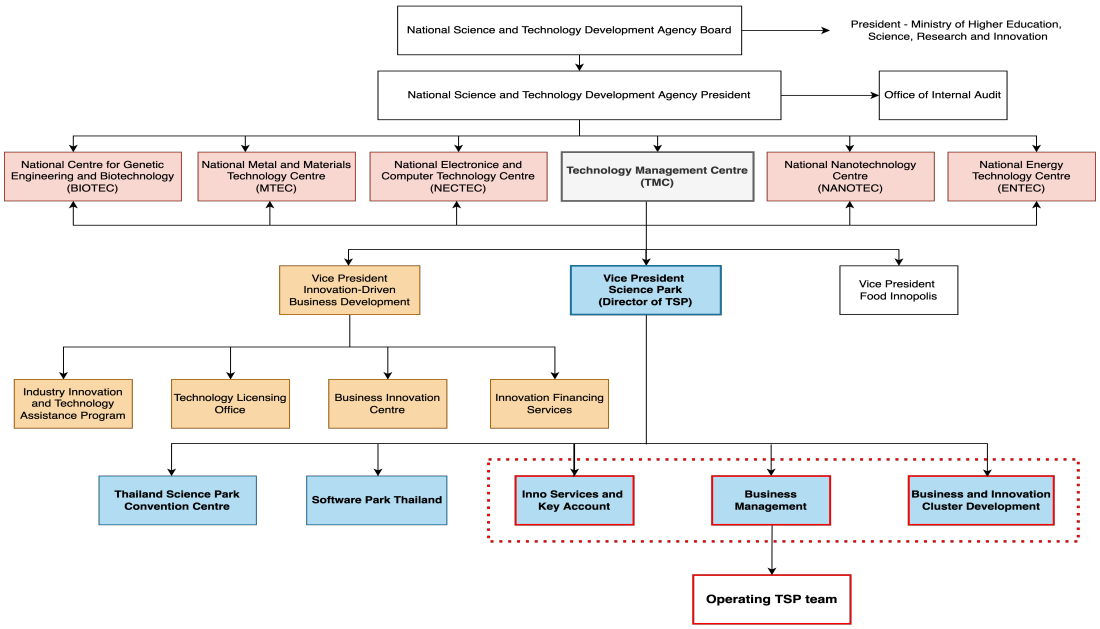
Figure 4. 4: The Number of interviewed companies of Thailand Science Park classified by Clusters



Source: Author and (Thailand Science Park, 2022d)

Figure 4.5 presents a partial organisational chart of NSTDA related to TSP, depicting the physical location that accommodates NSTDA, five national research centres, and the TMC. Each research centre is led by its own director. The TMC, an organisational unit within NSTDA, not only manages TSP but also administers various incentives and financial support programmes for technology companies. These programmes encompass Technology Licensing, Industry Innovation and Technology Assistance Programmes, Business Innovation Centre, and Innovation Financing Services. The position of TSP Director is held by the Vice President of SP, who also oversees Software Park Thailand.

Figure 4. 5: Organisation chart related to Thailand Science Park management



Source: Adapted from NSTDA organisation chart, effective date: October1, 2020

TSP operates as a division within NSTDA, led by the TSP Director and consisting of three primary divisions. The Division of Business Management assumes responsibility for engineering, building management, and administrative oversight, including budget and cost control, as well as lease management. The other two divisions play pivotal roles in fostering the development of ICs within the Park.

The Division of Business and Innovation Cluster is tasked with nurturing the cluster's growth by establishing new networks to attract R&D investments. They focus on connecting stakeholders to enhance the capabilities and competitiveness of TSP tenants, while also working towards building brand awareness and enhancing the reputation of TSP. This division manages a wide range of activities, employing a 'many-to-many' approach to expand the network through formal and informal means such as knowledge sharing and business matching (Bunnag, 2020, Anusardsittikit, 2021).

On the other hand, the Division of Inno Service and Key Account Management is dedicated to attracting companies to the Park and facilitating TSP tenants' access to NSTDA's services. They also support TSP tenants in bringing innovative products or services to the market. This team engages with participants who have shown a heightened interest in collaboration or research, nurturing these emerging relationships at a more personalised, 'one-on-one' level. These divisions work in synergy to create a conducive environment for innovation and collaboration within TSP, enabling the growth and success of its tenants (Wongthawethong, 2020).

4.1.2 Strategic evolution and current objectives of the Thailand Science Park

The TSP's development has been categorised into three distinct phases. From 2002 to 2014, the initial phase of the strategic development plan aimed to establish a critical mass in R&D and foster a vibrant innovation ecosystem within the Park. Due to TSP's rural location, attracting prominent technology-intensive companies, both domestically and internationally, to conduct research was a significant challenge.

As explained by Bunnag (2020) TSP adopted two primary strategies to overcome this obstacle: first, relocating the initial three national research centres to TSP, and second, providing government incentives and privileges to international companies undertaking R&D within the Park.

The construction of R&D infrastructure, business facilities, and premises for the first three national research centres, namely NECTEC, BIOTEC, and MTEC, was undertaken by NSTDA. This is intended not only to attract international technology businesses but also to invite local firms interested in creating links with international companies to expand their business opportunities. TSP embraced an open approach, allowing technology businesses from various clusters to join under relatively flexible entry conditions. The initial group of SP

tenants comprised small companies recommended by researchers, thereby reducing transaction costs for research projects and facilitating knowledge access.

However, despite TSP's success in attracting a diverse array of both leading and local companies to become Park members, interactions amongst these companies and researchers were limited. This was attributable to the heterogeneous nature of the clusters and technologies present, leading to difficulties in identifying shared interests, thereby making the establishment of networking opportunities through seminars and events a significant challenge for TSP.

The second strategy focused on offering incentives and privileges to international companies conducting business at TSP, including tax exemptions and additional benefits for skilled foreign workers. The first multinational tenants, including Air Products, TUV SUD, Ecolab, and Zoetis, played a crucial role in convincing local businesses to establish their operations within the Park (Wongthaweethong, 2020).

Although the presence of researchers attracted large corporations and MNCs to the Park, smaller companies chose TSP due to access to financial support and service programmes that assisted them in the initial stages (Nilsuk, 2007). Nonetheless, the SP management team faced administrative challenges like debt collection and lease agreements due to a lack of rigorous entry criteria. As a result, the SP management did not have time for network building between tenants and researchers. Additionally, Researchers' KPIs, the number of published papers and patents, did not align with the goals of TSP, as they did not conduct industry-targeted research (Bunnag, 2020).

According to an interview with the second TSP director (2004-2017), the second phase strategy was designed to enhance industry competitiveness by establishing food and auto clusters. TSP began to steer the Park towards specific clusters, including digital clusters. This approach was considered due to the majority of TSP companies belonging to the food and electronics industries, the ability of researchers to assist members, the access to a broad range of services and benefits offered by Food Innopolis to the food industries, and the capacity of TSP's strategic partners to help these clusters grow.

In 2018, the third TSP director adjusted the focus clusters to encompass health and wellness, digital technology, food, and agriculture. This decision relied on the National Strategy 2018 - 2037. However, the automotive cluster was not prioritised due to challenges associated with identifying mutual benefits among its members. The Thai auto parts manufacturers, who provided components to foreign assemblers, found themselves at a disadvantage. They generally opted for suppliers offering the lowest minimum wages, making it potentially challenging for Thailand to compete with its neighbours (Wanasathop, 2021). To achieve these cluster developments, TSP is currently in its third phase (2018-2024), further developing the four clusters via three strategies: 1) Going international, 2) Building a science and technology

business platform, and 3) Creating a knowledge hub (Wanasathop, 2021, Anusardsittikit, 2021).

The first strategy seeks to expand TSP's connections from existing networks to others, particularly at the international level. For example, TSP hosted Health Tech Thailand 2021, a medical and health technology innovation showcase. This international event attracted like-minded individuals and businesses, fostering mutual interests. The second strategy aims to build a science and technology business platform to facilitate each cluster's members, providing one-stop services from idea conception to market. TSP is piloting this through the launch of a health innovation platform. The third strategy, "Creating a knowledge hub", intends to enhance the capabilities of talented individuals and is aligned with the strategic objectives of TSP.

These strategies are projected to enhance TSP's objectives in terms of promoting cooperation among local and international stakeholders, stimulating the growth of the health industry through collaborative R&D projects, and increasing access to various services of the NSTDA. They will also support the financial sustenance of the Park by generating income (Anusardsittikit, 2021).

In its third phase (2018-2024), TSP focuses on developing four targeted clusters - health and wellness, digital technology, food, and agriculture - utilising three strategic objectives: 1) expanding international connections, 2) building a science and technology business platform, and 3) creating a knowledge hub. One of the primary benefits of SPs is that they enable businesses to leverage the ability of a pool of skilled individuals to share and transmit knowledge (Etzkowitz and Zhou, 2018), a notion that aligns with TSP's strategic objectives.

TSP, for example, hosted the international event Health Tech Thailand 2021, attracting innovative minds in the medical and health technology sectors, fostering connections and mutual interests. Furthermore, TSP is piloting a health innovation platform to provide members of each cluster with one-stop services from concept to market. The third strategy, creating a knowledge hub, aims to strengthen the capabilities of talented individuals, thereby supporting the broader objectives of TSP to foster cooperation among local and international stakeholders, stimulate industry growth through collaborative R&D projects, and broaden access to NSTDA's services. These strategies not only contribute to achieving TSP's objectives but also generate income, thereby ensuring TSP's financial sustainability (Wanasathop, 2021, Anusardsittikit, 2021).

4.1.3 Innovation services for Thailand Science Park companies

TSP is situated within a special economic zone, where tech companies based in the Park can receive privileges and incentives from the BOI. The BOI offers a corporate income tax exemption for eight years, supplemented by a 50% corporate income tax reduction for five years following the end of the tax exemption period. Moreover, it provides work permits for

foreign specialists and researchers and an exemption from import duties on machinery and equipment used in the R&D process. Additional incentives include those from the Revenue Department, which include a corporate tax exemption of up to 200 per cent for R&D and accelerated depreciation allowances for machinery utilised in R&D (The Office of the Board of Investment, 2017, Thailand Science Park, 2022b).

TMC, an organisational unit, manages innovation services and provides financial programme support for tech companies within and outside the Park. As regards R&D support, the Innovation and Technology Assistance Programme (ITAP) offers technical experts from universities and R&D agencies to assist businesses in identifying technical solutions and ensuring successful design and implementation. The ITAP covers support ranging from product design and development to process improvement and Digital Transformation, reimbursing expert expenses of up to 50 per cent of project cost, to a maximum of ฿400,000[2]. Additionally, the Technology Licensing Office (TLO) manages the patenting and licensing of the intellectual property of all researchers in the research centre to businesses interested in commercialising their research findings.

For financial support, the Company Directed Technology Development Program (CD) provides low-interest loans to industrial operators to develop new products, improve manufacturing processes, setup or improve a laboratory, conduct reverse engineering, and commercialise research breakthroughs. The CD provides loans covering up to 75 per cent of the total project value, to a maximum of ฿30 million[3] for a duration of up to seven years (Technology Management Centre, 2020). SP companies are eligible for a fast track for budget approval for the construction of a laboratory in TSP (Anusardsittikit, 2021).

Moreover, the Thai government promotes local innovative products or services by introducing the Thai Innovation Registration criteria. NSTDA will certify products or services as the R&D output of a Thai research institute, educational institution, or private company, providing a testing certificate that meets the standard. These items will be registered in the Thai Innovation database for eight years, and government agencies can procure them through special procurement (Thailand Science Park, 2022a).

In terms of funding, NSTDA offers the Research Gap Fund Programme, a one-year initiative aimed at encouraging tech companies to utilise university research to develop further on a commercial scale. This programme is targeted at local small tech businesses, with each

[2] Approximately £9,100 for the ITAP. This figure is based on the currency conversion as of 22 July 2022, accounting for inflation in Thailand and using the current exchange rate (1 pound = 43.94 baht).
[3] Approximately £683,000 for the CD Programme. Calculated using the same exchange rate and inflation data as previously stated.

project receiving up to ฿800,000[4] for the digital cluster and ฿1.5 million[5] for clusters that the government prioritises, such as health, food, agriculture, bio-economy, etc., provided the private sector invests at least 25 per cent of the project cost (National Science and Technology Development Agency, 2020b). However, the programme is limited to around 20–30 projects annually.

The Thai government has created a dynamic and diversified funding system for research and development, composed of nine different organisations. Each organisation supports innovation across various sectors and manages funds based on the strategic goals of their respective clusters within the national strategy, enhancing the country's competitiveness. Key examples include the National Innovation Agency (NIA) and the Program Management Unit for Competitiveness (PMUC). The NIA provides research funding to enhance technological capabilities and promote innovation in strategic and potential emerging industries at regional, national, and international levels. The PMUC offers research funding with the specific aim of enhancing the country's competitive capabilities, encouraging collaboration between the public and private sectors domestically and internationally, and ensuring the potential for commercialisation of research outputs (Chulabhorn Research Institute, 2022).

In 2020, NSTDA established Nastda Holding Company Limited to serve as an investment vehicle to further support the utilisation of advanced technology businesses and scale up research, technology, and innovation in Thailand. The invested companies will benefit from the linkage of various NSTDA supporting mechanisms, partners, and networks to strengthen product/process development and company growth. It focuses on modern agriculture, future food, health and wellness, energy, environment, advanced materials, and service platforms (Nastda Holding Company Limited, 2021).

In fact, NSTDA provides services and funding for businesses of diverse sizes, including startup vouchers for startups. However, as this case study focuses on TSP, we did not discuss startups in the Park as another division handles that aspect. We have therefore described only the programmes in which SP companies can participate.

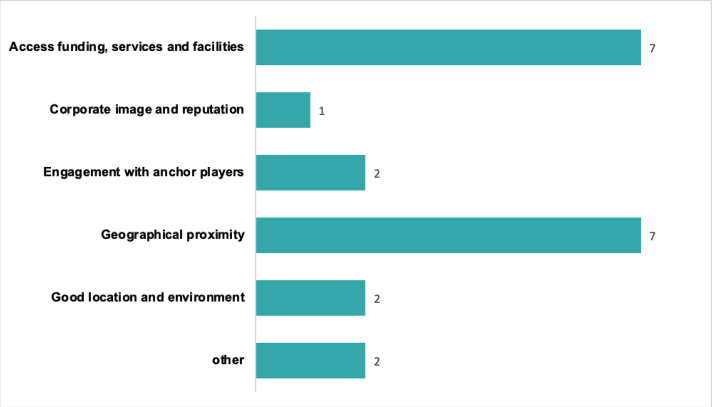
In addition to business and financial service support, NSTDA established the national quality infrastructure, such as the Electrical and electronic products testing centre (PTEC), a centre for testing, calibration, inspection, and certification of electrical and electronic products for domestic, import and export sales. NSTDA also has the Characterisation and Testing Service Centre (NCTC), a centre providing testing and analysis services to meet international standards such as Microscopy, Thermal Analysis, and sample preparation to serve

[4] Approximately £18,200 for the digital cluster. Calculated using the same exchange rate and inflation data as previously stated.
[5] Approximately £34,000 for other clusters. Calculated using the same exchange rate and inflation data as previously stated.

researchers and tech companies (National Science and Technology Development Agency, 2020a).

Based on interviews conducted with SP companies, it was found that one of the primary reasons for conducting business in TSP is the ability to access innovation services and financial support, proximity to national research centres and like-minded companies (see Figure 4.6). These companies stated that R&D infrastructure and services for tech businesses in TSP enable them to initiate businesses faster and potentially save on the cost of building their own R&D centre or laboratories.

Figure 4. 6: Reasons of companies that chose to locate in the Thailand Science Park



Source: Author

"*When establishing our facilities in a new country, as a multinational corporation, we wanted to be in a location with a lot of the basic R&D infrastructure we would need to set up our R&D lab and pilot manufacturing facility* (Company 12)."

"*We chose TSP due to R&D infrastructure and NSTDA's services. We got a loan from CD to build our R&D centre in TSP. Then, we joined ITAP, they provided an expert to help us with process improvement. When we worked on a project with the university, we also got money from the Research Gap Fund. Our product was able to be added to the Thai Innovation database. This helped us approach government organisations easily. We would say government agencies have become our most significant customer base.* (Company 15)."

"*We are a food company from Japan. Our CEO chose TSP due to the profiles of the food company in the Park. He found several food companies we worked with as suppliers or co-research projects located in TSP. So, it would be great to build an R&D centre in TSP. We used ITAP and testing services from NCTC. However, NCTC could not support and help us with testing, whereas other universities could do and more facilitate* (Company 20)."

Although TSP does not offer extensive funding for tech businesses, its comprehensive suite of hard and soft services effectively attracts tech companies, particularly those that are small and locally based. Furthermore, TSP leverages the talent of researchers in its five

national research centres to draw the attention of major and international companies, attracting them to establish a presence within the Park.

Pursuant to the second strategic direction, TSP has developed an S&T business platform designed to facilitate each cluster's operations. TSP began by piloting a health innovation platform, which aims to provide members with convenient access to a variety of services that were previously scattered across multiple government agencies. Services related to the health cluster from both the public and private sectors, as well as those from SP companies, are pooled onto this single platform. This model enhances the engagement of SP tenants, and by allowing them to benefit from this streamlined approach, it amplifies their satisfaction with being part of the Park.

4.1.4 Building network between a Thailand Science Park company and stakeholders

The team at TSP not only oversees infrastructure operations but also seeks out companies to lease R&D spaces. Their main goal is to cultivate a vibrant innovation ecosystem that attracts targeted companies. As part of this strategy, the SP management endeavours to create opportunities for tenant interaction with stakeholders. For instance, one such initiative is a 'cluster visit', an activity conducted in collaboration with the Federation of Thai Industries. This initiative facilitates visits by entrepreneurs from specific clusters to TSP and SP tenants (Supmak, 2022). These activities not only increase the future tenant population of the Park but also aid SP companies in finding new partners. Moreover, SP companies are welcome to participate in activities arranged by the national research centres.

- **Building networking between a Thailand Science Park company and other co-located companies**

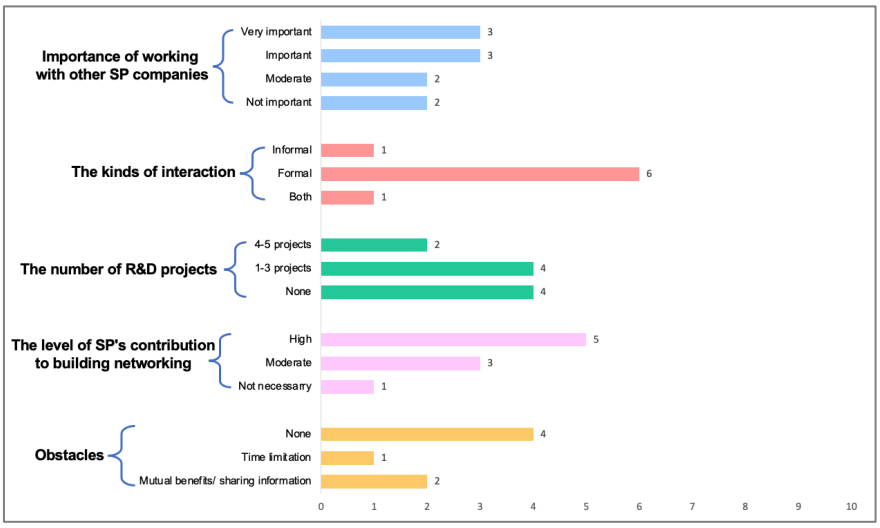
TSP fosters tenant relationships through social events and dedicated account management. The Tenant Club, a bi-monthly internal event, provides an opportunity for SP companies to connect and become more acquainted with each other and also serves as an avenue to introduce new companies that have joined the Park. Furthermore, TSP management regularly communicates new developments within TSP or collects feedback from the tenants. A staff who is responsible for arranging this activity stated that the majority of attendees at these events are usually local tenants. This often comprises individuals who have either attended previous gatherings or have been selected by the management to participate. Their regular participation tends to foster close collaborations, as repeated interactions help to cultivate trust. Over time, this trust can serve as the foundation for initiating joint projects.

However, persuading larger or international corporations to engage in these activities remains a substantial challenge (Supmak, 2022). Typically, SP tenants establish connections with others through the facilitation of an account manager. Each account manager provides support to approximately 20 SP companies, which are organised based on clusters and areas of expertise. These account managers guide the companies in utilising NSTDA services and

meeting their unique needs. For instance, they may assist in finding other R&D organisations to support their research endeavours (Wongthawethong, 2020, Anusardsittikit, 2021).

Figure 4.7 illustrates interactions between a tenant and other tenants. These relationships tend to be formalised by joining the Tenant Club and coordinating with their account manager. Six out of ten companies have collaborative projects with other tenants in areas such as product testing and improvement, and supplier relationships. Tenants express satisfaction with SP's contributions. However, some have noted constraints related to time and avenues for information sharing or identifying mutual benefits.

Figure 4. 7: Networking building between a Thailand Science Park company and other co-located companies



Source: Author

"*We have four projects with four companies in TSP. We knew them through the Tenant Club; some companies had worked with us before moving in. Being in TSP enables us to work faster, so we can walk to meet them. We found that it took a long time for commercialisation because the food companies in TSP are big names in Thailand, so there are many procedures, unlike a small one* (Company 11)."

"*It is very important because our business model is B2B, so we rely on collaborating with partners to co-develop products. We knew other tenants through our account manager, and she connected us with others she felt might be interested in utilising our technology. It is usually formal as we have a meeting to discuss at our facility. We had one R&D project and two discussions with SP companies that never materialised into any projects. It is the usual obstacle we would face with clients, such as budget and cost and aligning objectives* (Company 12)."

"*Very important because we can work with other tenants who work on enzymes, and it could be beneficial to work with them. It has primarily been through our account manager, and there is no obstacle. Thanks to the Tenant club, which is helpful, we could get more information that helps us develop our products better* (Company 13)."

"*It is difficult to discuss any projects with the tenants because they may be our competitors, and it could lead to the theft of our ideas or services* (Company 19)."

In summary, TSP fosters relationships amongst its tenants through internal activities such as The Tenant Club, but most notably through the role of the account manager. Account managers serve as proactive intermediaries, assisting SP companies in navigating their relationships within the Park.

- **Building networking between a Thailand Science Park company and Research and Development institutions nearby**

In the context of TSP, our focus lies on the collaborations between the five research centres within the Park and two HEIs (TU and AIT) located nearby. This is intended to forge networks between tenants and proximate R&D organisations. A top-down management strategy utilising MOUs helped foster relationships between TSP and the two universities. As the health cluster in the Park was developed, an MOU was signed between NSTDA and TU's medical school. The health cluster manager states, *"The MOU facilitates establishing mutual intentions and objectives, simplifying basic procedures like clinical trials. It also serves as the basis for legal contracts, reducing transaction costs and time for further development"* (Thongkamwitoon, 2022).

On the other hand, management at TU, who also oversees the medical school and Thammasat Hospital, has expressed mixed feelings. *"After signing the MOU, we have had several meetings with researchers. However, TU Hospital's policy focuses on technological use to enhance hospital efficiency and facilitate patient care. We need IT developers more than researchers. The researchers tend to do more than we require. While we understand their need to create new knowledge to meet their KPIs, our limited, project-based budget makes it challenging to identify mutual interests. Interestingly, the cluster manager has not mentioned tech companies in the Park. We suspect that these companies would be more likely to meet our needs than researchers. The roles and distinctions between NSTDA and TSP remain unclear to us"* (Junthong, 2022).

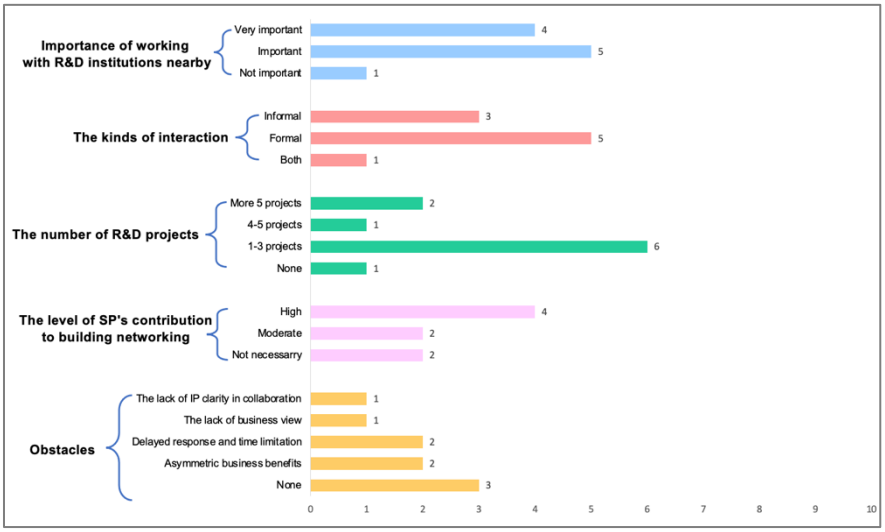
In contrast, AIT has had long-standing research collaborations with SP tenants. They have also maintained a strong relationship with Siam Cement Public Company Limited[6] (SCG) and have collaborated on various projects. AIT has also partnered with NSTDA and NECTEC on six projects from 2013 to 2021. An MOU provided a framework for this collaboration. *"We have organised seminars or workshops together. We believe that more formal gatherings*

[6] SCG was established in 1913, regarded as the first group of tenants. They built "SCG Living Tech Technology Center" on the land of TSP. The center focus on R&D in construction materials and living solution technology to response to the "Better Habitat Solutions". They have developed prototype house called "The NEST" (The Next Eco-Sustainable Technology for Home) which has integrated technology and system to be a Smart Living, Eco Living, and Living Care in harmonisation to accommodate the ever-changing trend of every family members for their happiness, comfort, safety, energy saving and environmental friendly.

could be beneficial. It would be great to organise a theme-based workshop catering to most tech companies on both sides" (Anwar, 2022).

Working closely with researchers in the Park is one of the main reasons why large and foreign companies are located in TSP. Before moving in, most companies has established good relationships and collaborated with the researchers. They do this to reduce transaction costs and conduct research faster and more efficiently. However, the presence of national research centres is a double-edged sword for SP companies. The researchers in TSP prioritise their own research to achieve their commitments for patents or publications, and also to transfer their research for commercial purposes. This can create an overlap between the research conducted by national research centres and SP tenants. In other words, these researchers may be both business partners and competitors, making it difficult to develop strong internal relationships between SP companies and researchers. For example Kongyoung (2021) revealed that digital-related tenants had weak ties with NECTEC researchers. This weak linkage was attributed to the overlapping nature of their research work, which often resulted in competition rather than collaboration.

Figure 4. 8.: Network building between a Thailand Science Park company and nearby R&D institutions



Source: Author

As depicted in Figure 4.8, collaborations with nearby R&D institutions are vital for the firms at TSP, with seven out of ten companies collaborating with researchers within the Park, and some even collaborating with researchers and academic staff from nearby institutions. The account manager typically oversees these interactions, but a few SP companies maintain personal contact with researchers. The primary form of collaboration is through co-research projects. SP companies enjoy working with TSP researchers, largely due to their stronger business view compared to traditional academic staff. However, these collaborations face some challenges such as delayed responses from academic staff, a lack of clarity regarding intellectual property rights, and perceived uneven distribution of business benefits.

In essence, SP tenants predominantly collaborate with researchers from the research centres within the Park, especially BIOTEC, NANOTEC, and MTEC, mainly through testing and co-research projects. However, these collaborations sometimes falter due to the failure of researchers to meet business needs, delays caused by rigorous procedures and contracts, and the obligation of researchers to focus on their own research. Regardless, SP companies hold the view that NSTDA researchers have greater business comprehension than conventional academic staff.

"*We have one project with TU and one testing project with MTEC. We have our own connection, and they respond quite late* (Company 14)."

"*We work on educational software, such as e-learning and MOOK. TU is the primary client, and we knew TU before moving into the Park. We do not have any projects with NECTEC because research units in NECTEC do research and business similar to ours. We would say research from this centre overlaps with IT companies in TSP* (Company 17)."

"*We have several projects with BIOTEC and NANOTEC. We contact them directly and through the SP management team. We would say researchers work as professionals but with more rigorous agreements and contracts than university work. Universities are more flexible about licensing IPs and patents. TSP contributes significantly; when we reach out to our account manager, he seeks the right person to facilitate and arrange the meeting. Accessing the right researchers to support our research in each centre is convenient* (Company 15)."

"We have one co-research project with NANOTEC. One SP company introduced us to the researchers. From our perspective, we think the KPIs of researchers mismatch with business needs, and it is not easy to find mutual benefits. Even though the project was already done, it did not meet our expectations (Company 16)."

"*We have one project with BIOTEC. We would say researchers try to do more advanced work, but this is not practical for the market. We need them to improve our technology for scale-up. We need TSP to find and match the demand of tenants and KPIs of researchers so that companies acknowledge and find mutual benefits* (Company 20)."

Interestingly, based on the interviews conducted with representatives of both HEIs, it was observed that these institutions had not leveraged their proximity to TSP to access its facilities and knowledge resources. TU expressed uncertainty regarding the roles of NSTDA and TSP and was not aware that numerous tech companies within TSP could contribute to the university and hospital projects. AIT, on the other hand, has a clearer understanding of TSP's role and suggests more frequent organisation of events or workshops involving TSP, structured around specific clusters.

- **Building networking between a Thailand Science Park company and outside partners**

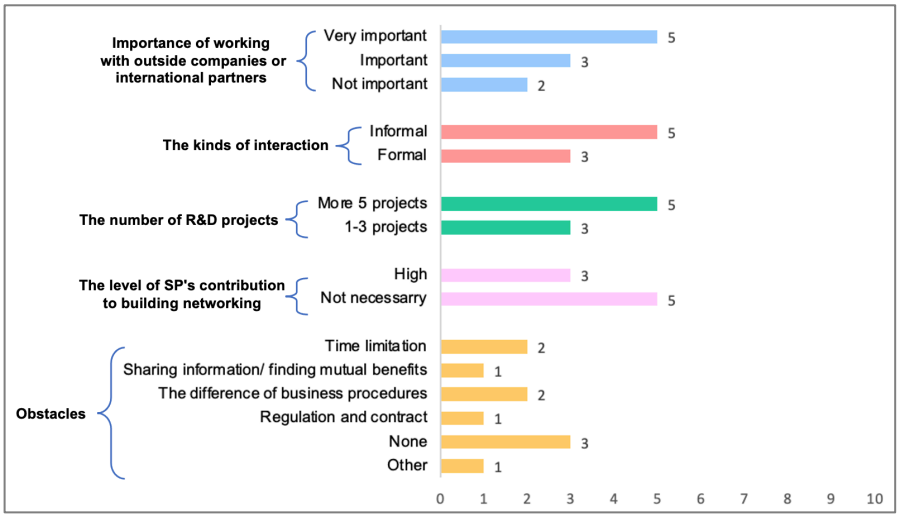
In the process of establishing relationships with external partners, most participants emphasised engagement with local and international universities. This is because SP companies are primarily local SMEs or an R&D unit tasked with supporting their headquarters. The findings of network building with external entities are illustrated in Figure 4.9. Eight out of ten companies are more inclined to engage external partners in joint research projects rather than commercialisation. They have projects with both local and international universities. Most companies leverage personal relationships; hence, they require less assistance from TSP than for other relationship-building endeavours. However, identifying mutual benefits, navigating different business procedures, and understanding regulations pose challenges for this network.

"*We have more than 20 projects with universities in Japan, Taiwan, the UK, etc. The obstacles might be time limitations and contracting matters, as always, but we understand that is necessary, so just accept. We do not need TSP to facilitate building outside networks because we have our connections* (Company 18)."

"*Our company just signed an MOU with Kasetsart University to conduct joint projects about molecular cooking. Thanks to the Food Innopolis that introduced us to this university, we now have no problems working with them* (Company 20)."

"*Before the pandemic, we did a lot with other universities, more than ten projects. We do not need any help from TSP because our colleagues have good relationships with these universities. Travelling to them is only one obstacle because the Park is quite far from the city centre* (Company 14)."

Figure 4. 9: Networking building between a Thailand Science Park company and external partners



Source: Author

"*We worked on many projects with universities and other R&D agencies across Thailand, and it was a formal interaction through seminars. Our company tried to find the potential research from universities to scale up because the government encouraged the private sector to take university research to market and funded each project. We found that individual universities have different procedures and processes, and we need to take time to learn their processes and waste time preparing documents for each project with each university. We would say our company is ready to expand overseas. We need TSP to draw international partners or funding organisations to the Park. That is very helpful* (Company 15)."

In summary, establishing networks with external stakeholders is important, especially with local and international universities and other R&D organisations across Thailand, for testing and funding. SP companies tend to rely on personal connections for this type of networking, and thus, the TSP team's facilitation is not typically required. With their own relationships, they encounter fewer obstacles when embarking on joint projects. However, some companies highlighted that the main problems are time constraints and the differing procedures required to engage with these universities. It is observed that the propensity of most SP companies is to collaborate with external partners rather than undertake commercialisation or business expansion overseas.

In conclusion, SP tenants are satisfied with TSP's contribution to the establishment of relationships with stakeholders. Account managers play a vital role in creating links and aiding them with research. In particular, local SP tenants, who have less experience, require more support to help them access R&D and business services and introduce them to SP members. Upon reviewing TSP's strategies, it is found that these are capable of supporting and meeting tenant needs in terms of building networks with stakeholders.

4.1.5 The appropriate provision of Research and Development infrastructure from the perspective of Thailand Science Park tenants

TSP provides 300,000 sq.m. of built-up space dedicated to tech businesses, consisting of two buildings designed for conducting research or delivering services, and pilot plants tailored for companies requiring a scaling-up process before commercialisation. These pilot plants are engineered to accommodate the installation of large production machinery. Furthermore, TSP offers leasehold land furnished with public utilities to businesses necessitating the construction of their own research buildings (Thailand Science Park, 2022c). The R&D infrastructure is one of TSP's strengths, as reflected by the main reasons tech businesses elect to establish themselves in the Park (see Figure 4.5).

As TSP has shifted focus towards a cluster development approach, it has sought to find partners to broaden networks and address any gaps for cluster members. For instance, TSP collaborated with the Digital Economy Promotion Agency (DEPA) to launch the TDX Centre on campus. This initiative aims to nurture SMEs and startups in developing prototypes through 3D printing to bridge the design process and prototyping gap. This Centre will expedite

the translation of ideas to market, and small businesses can access equipment that would otherwise be unaffordable (Saengsurathum, 2022). This Centre could potentially support the health and digital clusters. Currently nearing full capacity, TSP is planning to develop additional infrastructure to accommodate more tech businesses. The operational plan is in the process of detailing and estimating the budget required for the construction of new buildings.

From the interviews conducted, it was found that nine out of ten SP tenants are satisfied with the R&D infrastructure. They contended that the infrastructure is well-suited to cutting-edge technology and research. Additionally, they appreciate the opportunity to utilise the equipment in the research centres. However, Company 13 expressed that the R&D infrastructure is not appropriate for the food sector due to a lack of basic equipment and testing capabilities; hence, they have to conduct these activities at universities.

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TSP is now almost full capacity and plans to develop infrastructure to accommodate tech businesses. The operational plan is currently in the process of planning and estimating the budget for the construction of buildings. This Centre could potentially support the health and digital clusters. Currently nearing full capacity, TSP is planning to develop additional infrastructure to accommodate more tech businesses. The operational plan is in the process of detailing and estimating the budget required for the construction of new buildings.

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4.1.6 Indicators of successful Thailand Science Park performance

TSP's success is gauged through three critical areas: investment, impact, and income, utilising six indicators: investment and expenditure of SP companies, revenue from R&D activities, the number of employees, R&D projects, the innovation ecosystem, and tenant company satisfaction (Thailand Science Park, 2020b, Bunnag, 2020), as shown Table 4.1.

Table 4. 1: Indicators of Thailand Science Park performance

Indicators	Details
1. Investment and Expenditure of TSP companies	• Total investment in fixed-assets and equipment • Total R&D expenditure • Total other science and technology related to expenditure
2. Revenue from R&D activities	• Revenue generated inside TSP: • Tenant companies earn revenue from; testing and analysis testing services, conducting formula, pilot scale productions, and product selling • Revenue generated outside TSP, called ***'Impact value'*** • Tenant companies earn revenue from; OEM services, product selling revenue deriving from researching TSP, process improvement to reduce cost-production, Product enhancements to boost sales
3. Number of employees	• The number of employees of tenant company, working in the areas of R&D, Design and Engineering, RDDE • The number of employees of tenant company, working non-RDDE as a supporter for RDDE
4. R&D projects	• In-house projects • Joint projects with the research centres in TSP • Contract-in and contract-out
5. Tenant company satisfaction	• The support or contribution of TSP in terms of tenant companies' research activities • The support or contribution of TSP in terms of tenant companies' the business development
6. Innovation ecosystem (These are questions that get asked of tenants on a scale of 1-5)	• Atmosphere and surrounding encourage R&D creativity • Atmosphere and surroundings facilitate collaboration between organisations • Located in TSP encourage serendipitous collaboration • New technical knowledge and business idea are always shared • Taking part in the knowledge sharing activities above, leads to concrete new development projects/ business deals • Formal/ informal networking via TSP activities created are enough • Formal/ informal networking via TSP activities created are useful • Important physical infrastructure useful • Ease of technical services accessibility • Ease of financial services accessibility

Source: Adapted from TSP performance annual report in 2020

Additionally, the development of ICs is assessed via supplemental indicators that correspond to TSP's three primary strategies. However, most of these indicators are numerical assessments, including the number of new international partners, platform user satisfaction levels (expected to be at least 85 per cent), and seminar participant numbers (Wanasathop, 2021, Anusardsittikit, 2021), as shown Table 4.2.

Table 4. 2: The description of the indicators used in the strategy assessment Phase 3

Strategy	indicators
Go international	• The number of new international partners • The number of projects in which a local business collaborates with an international partner. Both completed deals and projects that are in the pipeline have been counted. • The number of marketing activities co-create with the partners.
Build science and technology business platform	• Launching health and wellness business pilot platform • The number of increased key players can contribute to expanding the health cluster in order to fill this platform along the innovation value chain more effectively. • The number of increased services or centres benefit to the cluster. • The number of people consume this platform and their satisfaction at least 85 per cent • TSP can generate revenue
Create knowledge hub	• The number of trainings, seminars, events arrange in the Park • The number of people participate in each activity • TSP can generate revenue

Source: Author and the TSP strategy from 2022 to 2024 report

In summary, the performance of TSP is gauged through three key areas: investment, impact, and income. These areas are quantified using six indicators: investment and expenditure of SP companies, revenue from R&D activities, the number of employees, R&D projects, the innovation ecosystem, and tenant company satisfaction. Detailed measures of these indicators include the total investment in fixed assets and equipment, R&D expenditure, income from R&D activities inside and outside TSP, the number of tenant company employees in R&D and support roles, in-house and joint R&D projects, and tenant satisfaction with TSP support for research and business development.

The innovation ecosystem's health is also evaluated through the extent of R&D creativity and collaboration, knowledge sharing, networking via TSP activities, and the ease of access to technical and financial services. Additional indicators are used to assess the development of ICs, including the number of new international partners, user satisfaction levels with the platform, and event participation. These comprehensive measures, mostly numerical assessments, provide a broad overview of TSP's performance and its success in fostering the innovation ecosystem.

The TSP serves as a symbolic representation of a successful SP in developing countries. The Park has endeavoured to adopt the established SP model prevalent in developed nations such as the United States and the United Kingdom. Considering the diverse contexts of government bodies and the constraints imposed by limited budgets for fostering innovation, alongside an emerging culture of innovative entrepreneurship, the trajectory of economic development, driven by innovation, is comparatively slow and marked by

inconsistency. Support mechanisms in R&D, as well as financial programmes for technology companies, are found lacking when compared with those in other countries. In the forthcoming section, we will explore the HKSTP, acclaimed as one of the most successful SPs in nurturing startups.

4.2 Hong Kong Science and Technology Park

4.2.1 The Overview of History of Hong Kong Science and Technology Park

HKSTP is a hub for translational research and product development aimed at commercialisation in local and overseas markets. It was established in 2002, under the management of the Hong Kong Science and Technology Parks Corporation (HKSTPC), a body incorporated by the Hong Kong government (Hong Kong Science and Technology Parks Corporation, 2022a). This 22-hectare waterfront SP is situated on the edge of Tolo Harbour at Pak Shek Kok, marking the boundary between the Sha Tin District and the Tai Po District (All Architecture Design's, 2015). The government has allocated substantial funding to HKSTPC, spending approximately HK$3 billion[7] on the construction of R&D infrastructure and facilities.

The remaining HK$7 billion[8] is utilised to strengthen tenants and startups (Hong Kong Government, 2020). The Park is envisioned as an R&D campus where high-potential entrepreneurs and businesses of all sizes can flourish. Since its inception, HKSTP has promoted innovation and sustainable development through clustering, aiming to attract high-tech companies and talent to the Park with a focus on five clusters: IT & telecommunications, electronics, biotechnology, green technology, and precision engineering (Sharif et al., 2013).

The development of the Park was divided into three phases. The first phase, completed in 2004, focused on building infrastructure and facilities to support information communication technologies. It included the installation of a conference and communication system, recreational facilities, and serviced residences. HKSTP constructed buildings for medium-sized businesses and four for large companies, with the remaining space utilised by restaurants, an exhibition centre, serviced apartments, and a recreational area (Architectural Services Department, 2022). The success of the first phase resulted in HKSTPC signing lease agreements with sixteen companies, bringing the occupancy rate up to 55 per cent (Xinhua News Agency, 2002).

Phase two was completed in 2007. This phase intended to house applied research and development facilities (Lau, 2021), including those for biotechnology (Anthony Tan, 2012), precision engineering, and electronics. Additional facilities such as an auditorium and

[7] As of 14 September 2022, accounting for inflation in Hong Kong and using the current exchange rate (1 pound = 9.05 Hong Kong dollars (HK$)), the construction costs for R&D infrastructure and facilities amount to approximately £330 million

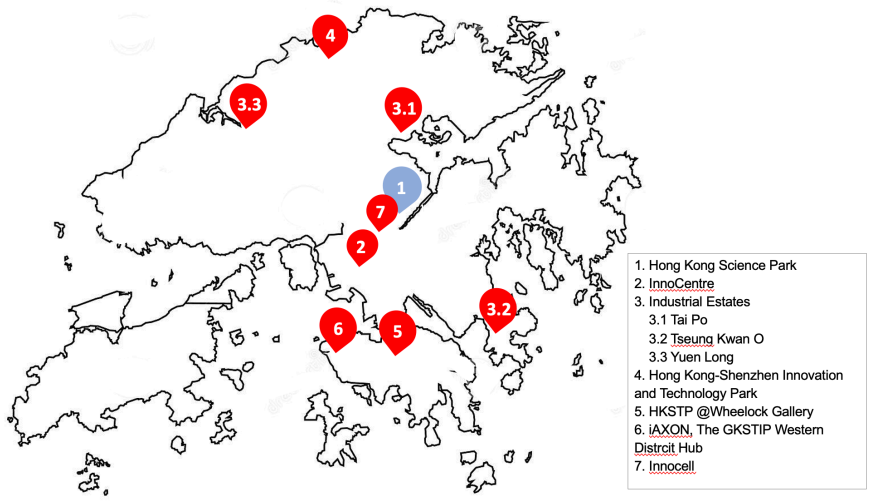
[8] Approximately £770 million for financial support and services to strengthen tenants and startups. Calculated using the same exchange rate and inflation data as previously stated.

conference room were provided for hosting visiting groups, alongside exhibition spaces and a sports club (Building Journal Hongkong China, 2007). In this phase, over 400 companies, 32 per cent of which were foreign, established a presence in the HKSTP (Anthony Tan, 2012).

Phase three took place in 2014 with a focus on sustainable development and energy conservation. This phase provided additional laboratories, advanced equipment, rental spaces, and communal areas for SP members to socialise and engage. It also facilitated comprehensive Incubation Programmes and offered opportunities to access extensive networks of international investors and partners. HKSTP constructed an Innovation Showcase to display the latest inventions from partner companies within the Park. Visitors from around the world can learn about the journey of innovation and cooperation from this showcase. At this stage, the Park could accommodate over 600 companies, all of which can benefit from comprehensive programmes supporting startups and other SP companies (Anthony Tan, 2012, Hong Kong Science and Technology Parks Corporation, 2014).

HKSTP has constructed a variety of areas to nurture and accelerate entrepreneurial growth seamlessly from early to mature stages (Hong Kong Science and Technology Park Corporation, 2021), across seven campuses in Hong Kong (see Figure 4.10)

Figure 4. 10: The location of the Hong Kong Science and Technology Park and its campuses



Source: Adapted from Hong Kong Science and Technology Park Corporation, (2021)

1. **Hong Kong Science Park** he largest R&D base in Hong Kong, supports SP tenants' R&D activities by providing state-of-the-art R&D equipment, software platforms, and a pool of R&D experts. They also encourage R&D personnel exchange, investor matching, business development, and commercialisation, engendering a vibrant SP environment.

2. **Innocentre** was established in 2006 to support fintech, digital commerce, and advanced innovation in AI, blockchain, cybersecurity, and data analytics (Chan, 2021). The property provides infrastructure, facilities, and rental space for tenants involved in such activities. Located in a downtown hub at Kowloon Tong, approximately 14 km away from

HKSTP, it offers pre-incubation and soft-landing support for startups qualified in the incubation programmes.

3. **Industrial Estates**, basecamps for re-industrialisation through smart manufacturing, are managed by HKSTPC with the objective to bridge the commercial gap from lab-scale to industry-grade commercialisation. HKSTPC supervises three industrial estates to support different usage purposes across various industries (Hong Kong Government, 2020) as follows:

3.1 **Tai Po Industrial Estate,** spanning a total of 75 hectares, is the closest to HKSTP, just 350 meters away. Primarily occupied by manufacturers in food processing, this industrial estate was fully taken up by SP tenants in advanced manufacturing and mask production after the refurbishment of the Precision Manufacturing Centre of HKSTP was completed in 2017.

3.2 **Tseung Kwan O Industrial Estate,** covering 75 hectares of land, is approximately 25 km from HKSTP. Focused on ICT and multimedia industries, it is primarily occupied by ICT operators. It serves as a Data Technology Hub and home to the Advanced Manufacturing Centre, providing intelligent production facilities for advanced products or processes on demand (Hong Kong Science and Technology Parks Corporation, 2022e, Hong Kong Government, 2020).

3.3 **Yuen Long Industrial Estate,** spanning 67 hectares, is the furthest from HKSTP, around 31 km away. It caters to a wide range of industries, from pharmaceutical and biomedical production to logistics services and petrochemical plants (Hong Kong Science and Technology Parks Corporation, 2022a).

4. **Hong Kong-Shenzhen Innovation and Technology Park** a cross-border R&D base, is four times the size of HKSTP. As a wholly owned subsidiary of HKSTP, the Park is responsible for constructing world-class R&D infrastructure and is expected to attract leading companies, R&D institutions, HEIs, and talent from around the world, creating unprecedented space and opportunity for innovation and technology industries in Hong Kong and the Greater Bay Area (GBA). It not only provides an ecosystem for innovation to thrive but also offers access to the supply chain, manufacturing capabilities, and talent pool across the border. It is strategically important for R&D companies worldwide wanting to leverage their innovation advantages for faster access to the mainland market. The Park is currently under construction, with the first phase expected to launch in 2024.

5. **Hong Kong Science and Technology Park @Wheelock Gallery**, a downtown hub for entrepreneurs, is a shared office/event space open only to members and invited guests, located in the city centre's financial district. Space usage is reservation-based and it doesn't serve as a regular office for startups (Chan, 2021). It provides incubation and early-stage startups the opportunity to interact with stakeholders through investment and business matching, technology knowledge transfer and exchange, as well as mentoring and networking.

6. **Hong Kong Science and Technology Park Corporation Western District Hub** (iAXON^{TM}) is an incubation centre for university spin-offs, jointly set up by HKSTP and the University of Hong Kong (HKU). It provides incubation support for deep-tech startups spun off from the university. Additionally, iAXONTM hosts startups formed by HKU students, faculty, and alumni who are conducting research at HKU and wish to market their research.

7. **Innocell** opened in 2021 and located adjacent to the HKSTP, is a co-creation space designed for innovation and technology professionals. It offers shared working spaces for lease to small and medium-sized companies and startups in the Park (Legislative Council Panel on Commerce and Industry, 2021). It also serves as a residential building and offers discounts to HKSTP members (Company 29).

4.2.1.1 Vision and mission of Hong Kong Science and Technology Park

The vision of HKSTP is *"to create a vibrant innovation and technology ecosystem to deliver social and economic benefits to Hong Kong and the region, and to build a future abundant with innovation opportunities for the younger generations"* (Hong Kong Science and Technology Parks Corporation, 2022f ,p.1). Commemorating HKSTP's 20th anniversary, a new vision was launched to capitalise on developing the Greater Bay Area, thereby maximising innovation opportunities for successful business translation (Hong Kong Science and Technology Parks Corporation, 2021b). Their mission emphasises nurturing startups and SP companies towards growth (Hong Kong and Technology Parks Corporation, 2022).

The five objectives of HKSTP's establishment are as follows (Liu, 2021, Chan, 2021):

1. Supporting tech startups and enterprises on their journey for innovation and growth.
2. Fostering the development of innovation and technology in Hong Kong.
3. Serving as a testbed for new technological developments.
4. Stimulating professional exchange, investor matching, and business development.
5. Supporting commercialisation through the well-developed infrastructure of innovation.

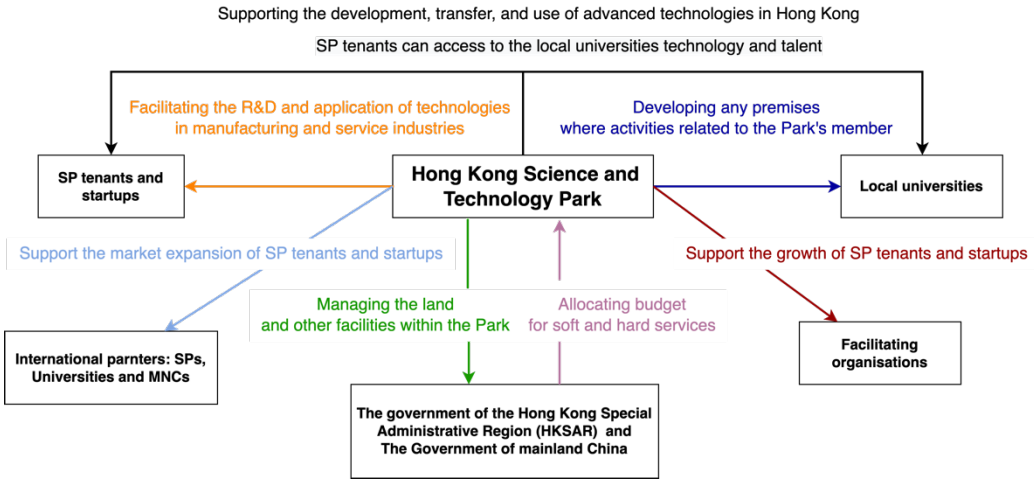
Furthermore, HKSTP has set five specific goals (Hong Kong Science & Technology Parks Corporation, 2022):

1. To drive Proof of Concept and adoptions in overseas markets and cross-border commerce;
2. To engage with regional partners, to scale businesses and expand networks;
3. To attract top-notch tech startups and entrepreneurs to be members;
4. To strengthen the innovation system;
5. To enhance business opportunities for SP members.

There is a clear harmony between the objectives and goals of HKSTP. The objectives, centred around enabling technology application, promoting the proliferation and transfer of

advanced technologies, facilitating suitable premises for pertinent activities, and overseeing the park's facilities, correspond well with the goals. The goals endeavour to catalyse technology adoption in global markets, collaborate with regional partners for scalability, attract leading-edge startups, enhance the innovation ecosystem, and expand business opportunities.

Figure 4. 11: Stakeholders & delivered value propositions of the Hong Kong Science and Technology Park



Source: Author

According to this list of objectives, HKSTP interacts with a range of stakeholders (see Figure 4.11), playing a crucial role in both local and international development. The Park was established to facilitate the application of R&D technologies in the manufacturing and services industries. The presence of three industrial estates supporting different technologies accelerates the introduction of innovative products to the market. There are 950 technology companies at HKSTP, of which local and non-local companies account for 79 per cent and 21 per cent respectively. Besides large companies, over 610 small and medium-sized businesses operate within the Park (Legislative Council Panel on Commerce and Industry, 2021). Multinational corporations represent 23 different countries. Notably, HKSTP hosts three unicorn startups: SenseTime, Lalamove, and SmartMore (Hong Kong Science & Technology Parks Corporation, 2022).

HKSTP also fosters an innovation ecosystem to support the development, transfer, and use of advanced technologies in Hong Kong. This is achieved through collaboration with multiple research-intensive universities, thus enabling SP companies to access cutting-edge knowledge and talented individuals. To support the growth and market expansion of SP tenants and startups, the Park liaises with facilitating organisations and international partners, such as leading international universities and multinational corporations. Additionally, HKSTP has received substantial support from the local government in terms of budgetary provision to bolster both soft and hard services to SP members and in harvesting HKSAR-provided funding

programmes. The innovation strategies of HKSAR are intertwined with China's economic policy, bolstering early-stage businesses.

4.2.2 Hong Kong Science and Technology Park's Strategy

Currently, HKSTP boasts an occupancy rate of approximately 90 per cent (Chan, 2021). Based on its developmental trajectory since its inception, HKSTP's strategy can be characterised as cluster-oriented, demonstrating a top-down model where innovation is promoted through cluster-based development. The government has earmarked HK$10 billion[9] for the InnoHK[10] for the InnoHK initiative, which is intended to provide financial support and facilitate the construction of research centres within the Park.

The first two targeted clusters are Artificial Intelligence and Robotics (AIR) and Biomedical Technology, referred to as AIR@InnoHK and Health@InnoHK, respectively. InnoHK's cluster-based approach has attracted leading universities, research organisations, and technology companies both locally and internationally to conduct collaborative research in Hong Kong (INNOHK, 2022). In addition to these two clusters, HKSTP focuses on materials and precision engineering, and green technology (See Figure 4.12). However, this research predominantly investigates the Artificial Intelligence and Robotics (AIR) and Biomedical Technology clusters. Among the 11 SP companies interviewed, three operate within the Digital and Health clusters and have thus been counted within both.

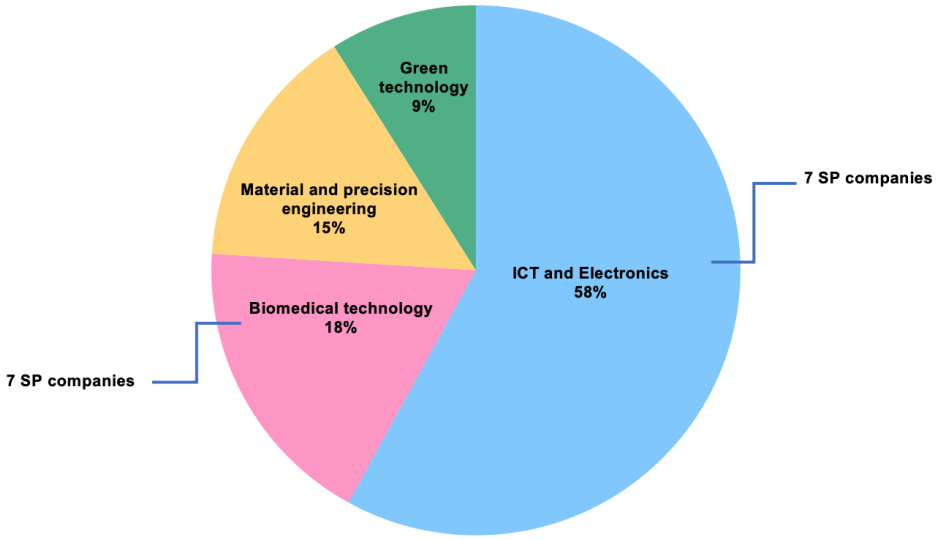
In 2021, HKSTP introduced a new SP platform to accelerate the development of the AIR cluster. This platform offered three core services: infrastructure, virtual lab, and data services, aiming to support the cluster's development and stimulate commercial adoption, especially in the areas of smart cities, big data, IoT and sensors. The Biomedical cluster encompasses health and well-being, pharmaceuticals, and medical devices, providing necessary medical data or lab results for biomedical businesses (Chan, 2021). HKSTP also established the Biobank and Biomedical Informatics Platform as a centralised system to collect, process, store, and share high-quality biospecimens, thereby facilitating biomedical R&D under ISO accreditation (Hong Kong Science and Technology Parks Corporation, 2022a).

[9] Approximately £1.1 billion for the InnoHK. Calculated using the same exchange rate and inflation data as previously stated.

[10] InnoHK is the flagship innovation and technology of the Hong Kong government. It aims to bring together top minds from universities and scientific research institutions around the world for research collaboration.

https://www.innohk.gov.hk/

Figure 4. 12: The Number of Interviewed Companies of Hong Kong Science and Technology Park companies classified by clusters



Source: Legislative Council Panel on Commerce and Industry (2021) and author

Interestingly, HKSTP stands apart from TSP and other SPs in Asia. These SPs conduct their own research and employ R&D specialists who work on self-directed R&D projects, as well as co-projects with SP companies. This can result in them being partners or competitors of the SP companies, leading occasionally to disputes over confidentiality and weakened relationships (Chan, 2021). In contrast, HKSTP offers advanced equipment and R&D centres that support company use, as well as expertise across a range of fields through outsourcing and partnerships with universities.

Beyond the cluster-oriented strategy, HKSTP employs several additional strategies to achieve its strategic objectives:

- Utilising existing support mechanisms to attract potential technology businesses to the Park, thereby strengthening the innovation ecosystem,
- Identifying strategic partnerships regionally and internationally to bolster the development of clusters,
- Leveraging opportunities to expand business growth in alignment with the innovation policy of mainland China,
- Increasing and transferring startup density in HKSTP to a new SP in Shenzhen, to foster innovative connections.

4.2.3 Innovation Services for Hong Kong Science and Technology Park Members

The Hong Kong Special Administrative Region (HKSAR) government provides a budget to HKSTP, which is then allocated to SP members. These members can utilise the services offered at every stage, from idea conception to market introduction. Over 50 per cent

of SP companies are startups benefiting from the incubation programme (Chan, 2021). The programme is divided into two main streams, designed according to the expertise of the startups and their areas of focus (Lai, 2017): INCU-BIO and INCUBATION Programmes.

- **INCU-BIO -** a four-year programme concentrating on biomedical technology and health. Managed by the Biomedical Technology cluster, this programme supports the development of biomedical startups by facilitating connections with stakeholders and providing regulatory support. INCU-BIO startups also have access to cutting-edge equipment, co-working spaces, and lab services. Notably, they can receive financial support of up to HK$6,000,000[11]. Besides these provisions, they can benefit from the BMT ecosystem, gaining more business opportunities with like-minded partners and investors, and leveraging professional services and coaching to pave the way to commercial success.
- **INCUBATION -** The INCUBATION Programme is a three-year scheme focused on aiding deep tech startups in the areas of ICT, electronics, green technology, and precision engineering. Participants of this programme can receive financial aid of up to HK$ 1,290,000[12], secure their own office spaces, and gain access to R&D equipment or even lab services across the campus.

"After three months of joining the programme, one-third of the funding will be transferred to the company. Two-thirds of the money will be subject to strict guidelines. For example, one-third will be used to cover the rental payment, so you cannot take the money out. The last one is reimbursement-based, such as exhibition attendance or training (Company 23)."

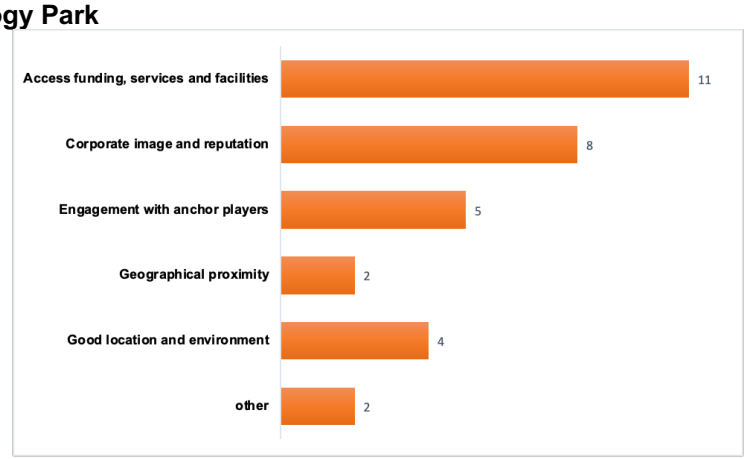
Directly providing funding to technology companies is a key strength of HKSTP in attracting entrepreneurs to establish their businesses there. This point is supported by all participating companies, which cited funding, services, and R&D facilities as the primary motivations for their presence in the park (see Figure 4.13).

However, HKSTP maintains stringent criteria for accepting entrepreneurs into each programme. Every proposal admitted to the SP must include a detailed plan for the coming years. HKSTP's experts need to understand at least 50 per cent of the proposed work to ensure it pertains to R&D and that the projects are feasible within the time commitment. In addition to proposal preparation, they must detail the number of employees, their work experiences, and R&D expenditure, which must cover over 50 per cent of the total R&D cost to consider approval for participation in the Incubation Programme (Lai, 2017). Thus, it can be asserted that HKSTP requires a solid plan to minimise the risk of failure as much as possible (Chan, 2021).

[11] Approximately £662,983 for the INCU-BIO. Calculated using the same exchange rate and inflation data as previously stated.

[12] Approximately £142,000 for the Incubation Programme. Calculated using the same exchange rate and inflation data as previously stated.

Figure 4. 13: Reasons that companies chose to locate in the Hong Kong Science and Technology Park



Source: Author

The statement from Company 23, a startup specialising in smart city and IoT solutions, further attests to the rigour of the criteria for joining the Incubation Programme. *"The startup journey in HKSTP is not easy for the first approach. We needed to fill in the application and produce a business proposal and PowerPoint slides. Then, they would have a screening session at the first stage by reading over those documents, maybe over 100 applications, and screening until only 30 left in order to go to the second round of interviews. In this step, HKSTP would invite the shortlisted applicants to give a 15-minute presentation to the entire panel with the committee and the judges. HKSTP might invite some professors or specialists to review the technology parts of the applicants and provide some venture capital. In the final round, only eight to ten have opportunities to present 15-minute pitching."*

Company 28 stated that *"the rigorous criteria for selecting startups to join the INCU-BIO. They need people from top universities and require a lot of information."*

HKSTP has designed the Incubation programmes to leverage available hardware and software support across the Park, including other HKSTP partners, to nurture startups in their early stages. The funding provided by HKSTP can help startups maintain minimal operations.

However, startups will need to seek additional funding resources through numerous business events arranged on a cluster-theme basis, leading them to meet venture capitalists. HKSTP recognises that each cluster requires different support to drive startup success (Pun, 2021). By providing tailored offerings for each cluster-focused strategy, a HKSTP Management member claimed, "the survival rate of startups in the park is around 60-70 per cent. Given the success of our graduated startups, we can proudly say that HKSTP is one of the largest incubators in Asia" (Chan, 2021).

HKSTP also offers the "Ideation Programme" to transform ideas into innovations, particularly benefiting students and graduates. This one-year programme provides HK$100,000[13], access to co-working space, business training, and mentorship. Most applicants are students from universities that have a MOU with the Park (Hong Kong Science and Technology Parks Corporation, 2022d). Most applicants are students from the universities with MOUs with the Park.

Upon graduation from the Incubation Programmes, startups will either pass or fail. Those that fail must be terminated or relocated outside the park. If they pass, they are offered the Acceleration Programme, which provides more advanced resources and privileges for mid-stage companies (Chan, 2021).. This programme offers up to HK$4.8 million[14], in subsidies to cover company expenses, access to an extensive investor network for diversified funding sources, guidance on preparing financing materials, negotiation with investors, support for product testing and business expansion, and CEO coaching.

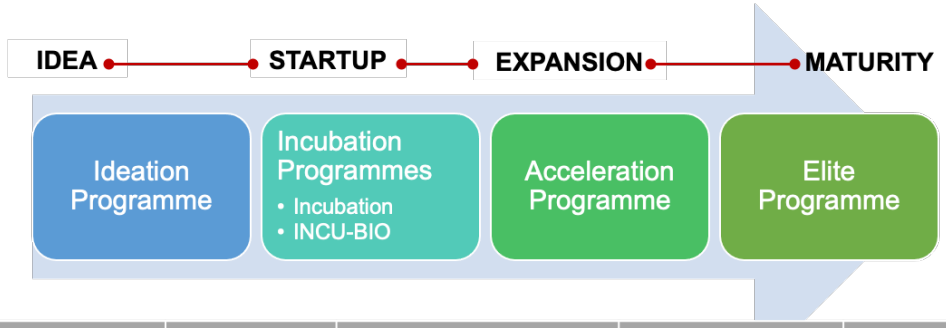
HKSTP provides the Elite Programme for mature-stage companies with strong growth potential looking to expand outside Hong Kong. To join this programme, demonstrate potential to become unicorns. The programme offers up to HK$21.5 million[15] in funding support for international business growth, and promotes product adoption in regional and international markets, business matching, and market exposure through PR activities (Hong Kong Science and Technology Parks Corporation, 2022b).

In addition to direct support programmes, HKSTP also acts as an intermediary to connect members with both HKSAR and overseas investors and Venture Capitalists (VCs). Additional government support programmes like the Innovation and Technology Fund and Research Talent Hub[16] (RTH) are available for SP companies. HKSTP's Corporate Venture Fund (CVF) is tasked with identifying potential projects, investing in some companies, or co-investing with investors or partners (Hong Kong Science and Technology Parks Corporation, 2022c, Hong Kong Government, 2020, Chan, 2021).

[13] Approximately £11,050 for the Ideation Programme. Calculated using the same exchange rate and inflation data as previously stated.
[14] Approximately £530,000 for the Acceleration Programme. Calculated using the same exchange rate and inflation data as previously stated.
[15] Approximately £2,375,000 for the Elite Programme. Calculated using the same exchange rate and inflation data as previously stated.
[16] Launched in July 2020, it aims to provide funding support for organisations/companies undertaking R&D projects to engage research talent to conduct R&D work. Each project may engage up to 4 research talent at any one time. The maximum engagement period for each research talent is 36 months in general.

https://www.itf.gov.hk/en/funding-programmes/nurturing-talent/research-talent-hub/research-talent-hub-for-itf-projects-rth-itf-/index.html

Figure 4. 14: Summary of business support programmes in Hong Kong Science and Technology Park



	Ideation	Incubation	Acceleration	Elite
Target/ Purpose	Students/ Entrepreneurs	- Startups working on **deep tech** research - Startups working on **biomedical technology**	- Scale ups in growth stage looking for international expansion	- Support companies having potential to be unicorns
Period	1 year	- 3 years - 4 years	N/A	N/A
Funding (cash, reimbursement, value worth)	HK$ 100,000 cash grant	- HK$ 1,290,000 - HK$ 6,000,000	HK$ 4,800,000	HK$ 21,500,000

Source: Adapted from Elements of a Science Park (Lau, 2021)

It is apparent that these kinds of funding are beneficial for SP members. Company 24 addressed that *"HKSTP provided a series of funding for startups. The famous funding programme from the government for HKSTP companies is to hire engineers who have graduated from university, whether a bachelor's or master's degree, will get 100 per cent reimbursement for every single month of the salary for three years. One company can recruit a maximum of four people at any one time."*

Although, RTH was used extensively, some HKSTP companies mentioned negatively about this programme.*"This program is the reimbursement way, so you have to apply for more than maybe 6 or 8 months to get the money back. If you cannot secure your survival, there is no use, no way to talk about the funding* (Company 29)*."*

"We had one staff member from this programme and paid the salary in advance for around 4 months. The drawbacks of this programme are that it takes so long to pay back (Company 21)*."*

"We are hiring one engineer, but this programme is really hard to manage, and there are many requirements. It takes a long time to reimburse. You have to wait for 6 months to file a paper to get reimbursed, but this reimbursement process can take up to a few months so that you get reimbursed for 6 months every 9 months (Company 26)*."*

In conclusion, there are two principal types of funding in Hong Kong. The first type is government funding, which is earmarked for HKSTP, other R&D agencies, and universities. This funding is part of the government's strategic approach to drive innovation and support

startups. With a substantial budget allocated to help these entities grow and expand their businesses on a global scale, the government significantly contributes to the innovation ecosystem. However, it should be noted that most government funding programmes operate on a reimbursement basis. As a result, it becomes essential for entrepreneurs to manage their cash flow prudently (Company 29).

The second type of funding comes from HKSTP's investment team. This team's role is to provide capital funding, creating opportunities for entrepreneurs to raise the necessary capital for their ventures (Pun, 2021). Additionally, they play a crucial part in sourcing further funding both locally and internationally from investors and venture capitalists. This dual approach to funding facilitates a dynamic and sustainable environment for startups, thereby fostering innovation and growth in Hong Kong's tech sector.

4.2.4 Building network between a Hong Kong Science and Technology Park company and stakeholders

- **Networking building between a Hong Kong Science and Technology Park company and other co-located companies**

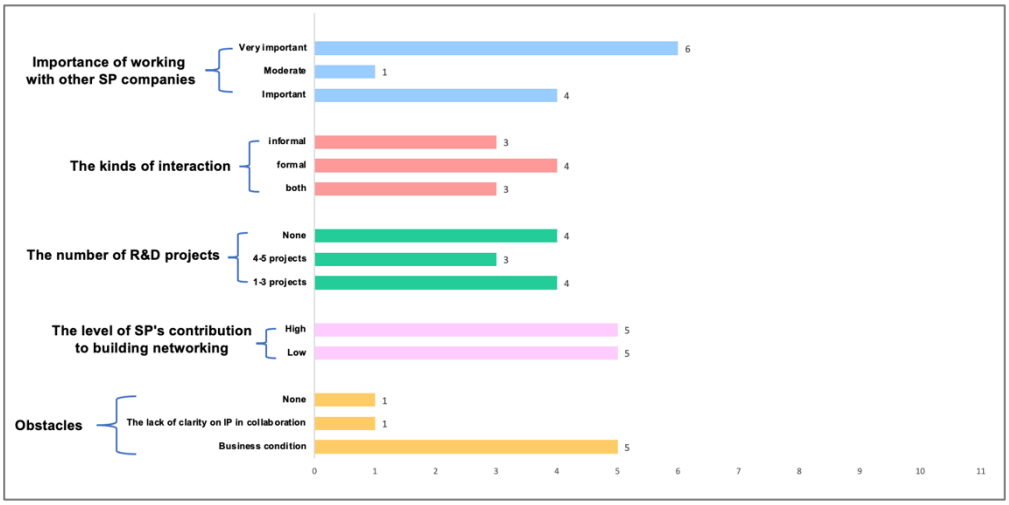
According to Pun (2021), a majority of SP tenants are startups specialising in digital and biomedical sectors, thus making it easier to identify common interests. Startups, by their nature, actively seek opportunities to expand their networks for growth and collaboration. Despite this, startups often face challenges, such as proving the reliability of their technologies and overcoming their lack of business experience. This often leads to difficulty in securing deals with more mature SP companies.

HKSTP plays a pivotal role in facilitating interactions among SP members. Considering the existence of several campuses and over 1,000 companies, HKSTP established a networking community known as 'SPARK' (Chan, 2021). SPARK acts as a vibrant community that unites all innovators across the campuses. As of 2022, the SPARK community boasts over 15,000 members (Hong Kong Science and Technology Parks Corporation, 2022a). Its mission is to help Hong Kong's innovation and technology community reach its full potential by facilitating connections and inspiration. This is achieved through various activities designed to encourage potential collaborations, broaden networks, and share ideas. Significantly, the number of SPARK members is one of the indicators used to evaluate SP's annual performance. It is obvious that the HKSTP pays attention to developing internal networks on campuses.

Figure 4.15 illustrates the eagerness of SP companies to collaborate with other startups or companies within the Park. These interactions are formed both formally (via account managers and public events) and informally (via internal exhibitions and direct approaches to other SP tenants). Seven out of 11 participants have engaged in collaborative projects, usually with industries/technologies that can aid in new product development.

However, obstacles such as asymmetric business benefits, cost, lack of business experience, and unclear intellectual property rights often hinder such collaborations. The level of SP contribution to these collaborations can vary. It's been observed that biotech-related companies, who generally maintain good relationships with their account managers, express greater satisfaction with SP facilitation.

Figure 4. 15: The relationships and building networking between a Hong Kong Science and Technology Park tenant and other co-located tenants



Source: Author

"It is very important because we definitely can connect with similar companies, so we just walk to their offices, and say we want to make these things happen. We have 2-3 projects for this year. We are currently doing with one team to do some of the AI software such collaborations. We started with informal interaction and transformed this party into formal partnerships like signing contracts. The main obstacle is that we have very little information about what company exists in the Park, so we don't have many opportunities to meet these companies. SP didn't hold such events or boost the communication between the tenants, so it is tough to begin the collaboration. We are also looking for other industries that can help us achieve new products. For example, we need to make sensors, but we are not familiar with that, and we need a partner. The obstacle when we worked together it just so common about cost. For the SP's contribution, we can say they didn't' do much on this part (Company 27)*."*

"It is important. Startup community is very closer before the Covid 19. We had Friday night, where startups will come and join in, drinking beer and talking. Recently, the situation improved. Most of the time, it is both when we faced the large corporate to speak formally in business. Informal interaction between startups because we can talk straightforwardly. We have four collaborative projects with startups. It is very efficient to communicate and very convenient because they are in the next building. We knew them somehow from an internal exhibition at the lobby. All startups have to walk through this way. People can take a look at

what we are doing. Eventually, we have a project with a startup work about thermal sensors, and they need our AI solution to the plugin. Price and cost are the most challenging.

I think the low extent that HKSTP facilitates with other startups. They do not have any events to expose what we are doing to other startups. I experienced only the mini exhibition at the lobby, and they organised some seminars and invited speakers. HKSTP has EDM to invite the startups to participate. That's it (Company 23)*."*

"It is very important because we cannot do innovative products to finish by ourselves. Normally, we have 4-5 projects per year. The obstacle is a patent issue. For biotech companies, the patent is the most important thing. If we co-develop something, it is very hard for us to justify who should own a patent.

I think the SP did it quite well in gathering. For example, monthly, they will ask all the tenant to come out have a wine tasting section to share the recent status. The HK team is quite self-initiative and very active to stimulate the collaboration and the ecosystem in the Park (Company 29)*."*

In conclusion, all interviewed companies recognised the importance of building relationships with other SP companies. They expressed a particular interest in cross-cluster collaborations to enhance product value. Interactions among SP companies often commence through informal activities such as dinner gatherings, internal exhibitions, and ceremonies, eventually evolving into formal partnerships. However, fostering relationships among over 1,000 companies presents a significant challenge, particularly during the COVID-19 pandemic when such interactions have been largely stopped for several years. The level of contribution from the SP towards facilitating these relationships varies and seems to depend on individual experiences and entrepreneurial cultures. For instance, startups and companies in the digital cluster are typically more inclined to participate in both HKSTP-organised and self-organised internal events.

Nevertheless, considering that most SP tenants are startups, certain challenges persist when it comes to collaboration. These include asymmetric business benefits, lack of business experience, and uncertainties surrounding intellectual property ownership. This suggests a need for more support structures to address these issues and enable more effective collaboration among SP companies.

- **Networking building between a Hong Kong Science and Technology Park tenant and external partners**

HKSTP has forged relationships and sought strategic partners overseas to create channels for members to share, exchange new knowledge, and maximise exposure for their innovative solutions. These partnerships also facilitate growth in areas of AI and their expansion into other clusters such as health and medical services. For instance, they have collaborated with the Hospital Authority to explore opportunities in developing smart hospital

solutions and improving the quality of medical services. They have also cooperated with public and private transportation sectors and the University of Hong Kong to utilise simulation technology (Hong Kong Science and Technology Parks Corporation, 2022a).

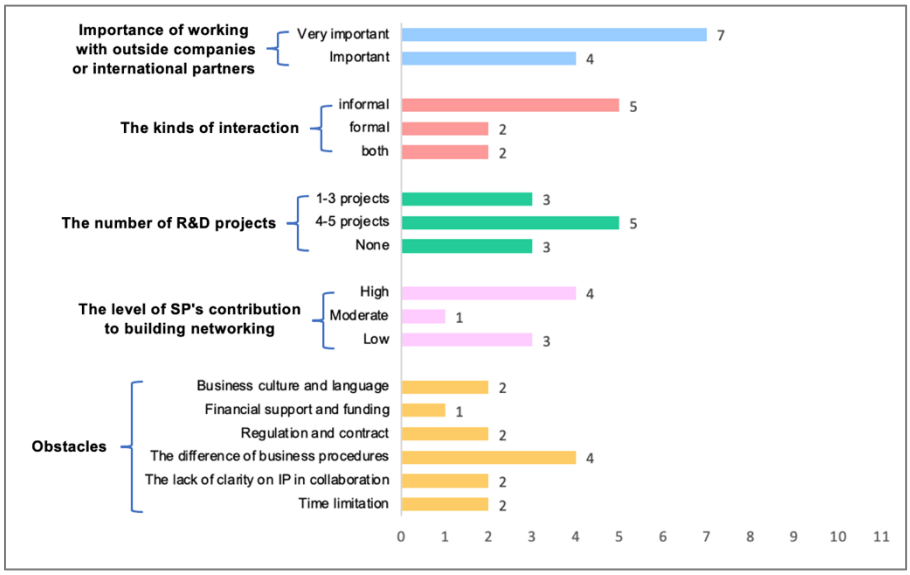
In 2019, HKSTP signed an MOU with NSTDA to enhance trade and investment relations in advanced technology areas. They have also organised events in conjunction with the Japan External Trade Organisation (JETRO) (Chan, 2021). Furthermore, to expand their global connections, HKSTP has led members to participate in international conferences and exhibitions, thereby creating opportunities and fostering connections in the global marketplace. Delegations from HKSTP have attended various major technology conferences across Europe and America (Hong Kong Science and Technology Parks Corporation, 2021a).

Their strategies include building partnerships with overseas corporations, landing consultancies, VCs, and channel sales to help technology companies expand in global markets. They have adopted a regional focus, targeting areas such as Thailand, Vietnam, and Singapore in Southeast Asia, and Germany, Austria, and Spain in the UK and Europe, in addition to mainland China (Hong Kong Science & Technology Parks Corporation, 2022).

The dynamics of relationship building and networking between SP companies and external or international partners are depicted in Figure 4.16. Findings from this study reveal that a majority of these companies, particularly startups, display a strong propensity to collaborate with external entities. However, the degree of contribution from the SP in facilitating these connections varies among the surveyed SP tenants. Four out of the eleven tenants express high satisfaction with the facilitative role played by the SP management in establishing connections with international partners. On the other hand, three out of the eleven tenants perceive the contribution of the SP as somewhat limited in aiding such network development.

However, significant obstacles to collaborations with international partners exist. These include differences in business culture and language, both of which can impact communication and business protocols. Different countries have unique business procedures, and preparing necessary documents or reports can be time-consuming. Moreover, some countries exhibit slower response times and provide limited incentives for foreign companies to conduct business there.

Figure 4. 16: The relationships and building networking between a Hong Kong Science and Technology Park company with external partners



Source: Author

The purpose of these collaborations extends beyond the mere execution of joint projects; companies also aim to broaden their global business footprint. Startups, in particular, prioritise engagement with the Greater Bay Area, leveraging the government's initiative to stimulate connectivity between Hong Kong and mainland China. Interestingly, the personal relationships or networks of senior executives within these companies often play a crucial role in establishing such partnerships. When engaging with external entities, the focus tends to be on outsourcing or collaborating with suppliers, as opposed to prioritising research and development endeavours.

The active engagement of eight companies in international ventures was highlighted from the interviews with participants. These ventures include clinical research collaborations with hospitals in Thailand and joint projects with the Tokyo government. Furthermore, one biomedical company has chosen to expand its presence by establishing a new operation in Bangkok.

"We chose to open another site in Bangkok as our headquarters of Southease Asia because BOI policy allows foreign companies to have business there, and we have research projects with three renowned hospitals there. Medical tourism is quite popular. The final list was Singapore, Malaysia, Thailand and Indonesia, and then we started thinking one by one. Singapore has a huge demand, but the market is quite conservative. People in Singapore use the service provided by the government. Therefore, most companies in Singapore mainly focus on Malaysian patients. Indonesia has the highest population and demand higher than these three countries. The problems are logistics as a biological sample needs to be delivered on time to the lab. There are so many islands. It is very hard for transportation. Another reason

is religion. We did a survey, and the results showed that it is not a good place for a small company to penetrate. Malaysia is good, but they do not like the Chinese very much, and their policy is quite strange. They asked us so much and need we promise, for example, how many taxes we will pay in the future (Company 29)."

"We want to expand our solution overseas. We have two projects in Macau and Tokyo. We were one of the overseas startups they admitted to the government project. We figured out an accelerator programme in Japan, and they welcome overseas startups to apply. We knew it from the website.It would be perfect if HKSTP would help us to build networking overseas. So far, they also share the news every week. I am thinking from the perspective of HKSTP. Most startups in the survival stage have to focus on how to survive in the local market first. We understand why they are not going to promote overseas expansion for startups. It would be great if HKSTP could help some potential startups with that (Company 23)."

"Hong Kong and China have different business systems. Hong Kong is more straightforward, whereas China requires stronger relationships to build trust. It takes time, and Hong Kong is more westernised (Company 31)*."*

In conclusion, the majority of companies acknowledge the significance of networking with external entities, particularly those on an international level. However, it poses a challenge for the Hong Kong HKSTP to establish international networks that meet the needs of SP companies. Although most companies that manage to expand internationally do so through personal relationships and self-initiated opportunities, they also seek assistance from the Park. Typically, the Park aids in enhancing their visibility through international conferences, exhibitions, and business matching with partners, showcasing the capabilities of SP tenants on a global scale. This, in turn, helps to bolster the reputation of the SP (European Investment Bank, 2010)

However, obstacles such as cultural and language differences, along with differing business practices in each country, make it a challenging endeavour for SP tenants aspiring to expand their businesses internationally. Interestingly, our findings regarding the contributions of SP management to SP tenants, particularly in the context of global exposure, do not align with the results of Chan and Lau's (2005) study, which concluded that startups in Hong HKSTP did not benefit from networking and clustering.

One possible explanation for this discrepancy might be that the HKSTP was relatively new and nascent when Chan and Lau's study was conducted. Albahari et al.'s (2018a) research posited that older SPs can better understand their tenants' needs, accumulate and share knowledge, and aggregate vital strategic partners to build critical mass. The age of an SP has a positive impact on its tenants. Time is crucial to develop and maintain mutual trust between park management and tenant companies. Consequently, the age of the Park may have a favourable influence on the outcomes of interactions between tenants. Therefore, our findings do not correspond to those of Chan and Lau's (2005) study.

- **Networking building between a Hong Kong Science and Technology Park company and nearby universities**

HKSTP has strong ties with six research universities in Hong Kong. They leverage the InnoHK programme to extend partnerships to leading international universities, working with local universities to facilitate important research and breakthroughs. This collaboration leads to involvement in the Park's commercialisation phase and opportunities for startups and tenants to participate in their projects (Pun, 2021).

The Chinese University of Hong Kong (CUHK), one of the six research universities, is located conveniently close to the HKSTP, about a 15-minute walk away. CUHK has a commendable reputation in the field of biomedical research. In 2021, we interviewed two staff members from the Pre-Incubation Centre (PI), a university body that nurtures students to become entrepreneurs and future startup founders. PI collaborates closely with HKSTP, particularly the Department of Incubation Programme Development.

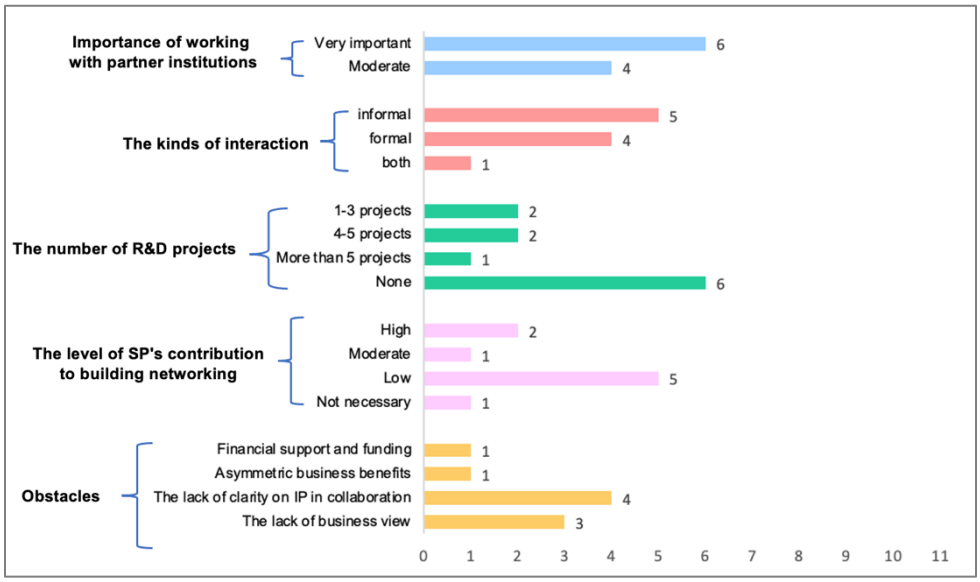
PI supports student teams through the Pilots Lite Programme, a one-year initiative that provides seed funding up to HK$130,000[17]. This programme offers co-working space, training, mentorship, networking opportunities, field trips, and more (CUHK PI Centre, 2022). Graduated teams are presented with the opportunity to continue receiving support from two SPs: HKSTP and Cyberport, with fast-track interview processes provided.

From the interviewed SP companies, we found that universities play a vital role in the exchange and sharing of knowledge, thus creating a number of collaborative projects. Relationships are formed both informally, through personal contact, and formally, through public events. The main obstacles include unclear IP ownership, limited business perspective among academic staff, and difficulty in identifying mutual interests. SP's contribution to this network is somewhat limited, as SP companies tend to utilise their own connections through alumni and personal contacts. Furthermore, they participate in additional government support programmes to hire talented graduates, enabling these companies to expand their networks through staff recruitment (see Figure 4.17).

Company 25 was the former tenant specialising in developing AI algorithms in speech and language technology, he stated that *"collaboration with academic staff is quite important. We have been collaborating with the CUHK with our previous PhD supervisors. We also have collaborative projects, one of which can be commercial, and we plan to apply for government funding together. However, we experienced the non-clarity of IP issues. The university usually needs to own the IP, and our company can use it via only licensing. For this kind of collaborative project, HKSTP did not help because we already had personal connection."*

[17] Approximately £14,000 for the Pre-Incubation Programmes. Calculated using the same exchange rate and inflation data as previously stated.

Figure 4. 17: The relationships and building networking between a Hong Kong Science and Technology Park company with other institutions



Source: Author

Company 27 started as a tenant in 2014, focused on the metal 3D printing service provider for medical parts and customised the medical devices for patient specific. They stated that *"collaboration with universities, particularly medical schools, is very important. We need their knowledge and experience, with their talents, to adopt the latest technologies. We also collaborate with them to access the equipment from the university and apply for funding through the university-industry partnership project. I have more than five projects with different universities and medical schools. We collaborated closely with the local medical institutes and universities since we needed clinical collaborations with various hospitals and medical schools.*

The relationships between us are very informal because we joined RTH funding and hired PhD students, and they had good connections with their universities, so it was very easy. However, obstacles to working with them are patent and IP conditions because universities care too much about their IP, so if we do not make it clear before the collaboration. It will lead to difficult work. In addition, different procedures and different requirements on the IP of each university may be the main reasons to slow progress."

The relationship between universities and SP management team is expressed in the interview with R&D institution staff. CUHK Staff 1 is an assistant community at PI centre. She described that

"We have a lot of informal partnerships with the HKSTP. As a first step, we engaged our students who are passionate about being startups in our community. Students will form a team in order to attend our pre-incubation programme. Student team means a mixture of team

structures so that they may form a team with at least one student from our university and others from different institutes or alumni. They will then present their milestones and documents to the PI's committee. The team is permitted to join the one-year programme and will get the funding on the condition that they must attend every meeting and five compulsory workshops, such as marketing and legal for business workshops. Once they have completed, we will advise them to join other programmes from SPs. Most student teams choose the HKSTP due to its geographic advantage and more attractive support programme.

Then, they are eligible for the Ideation programme's fast-track interview process, which the HKSTP's committee will judge. It is evident that these student teams will perceive their growth trajectory in every single step."

Two staff of CUHK stated benefits to having an SP nearby the university. *Students and academic staff can enjoy facilities quickly in the Park. For example, our academic staff can commercialise their projects or join the INCU-BIO programme. Then, they will have access to biomedical laboratories and a subsidy programme* (CUHK Staff 1). *In addition, students have an opportunity to visit and attend training that HKSTP organises. We also help to promote events for each other. Whenever we have events that we host, HKSTP residents can still come over and join us* (CUHK Staff 2)."

The engagement between universities and HKSTP companies is facilitated by a dedicated account manager tasked with supervising each startup. *"Some companies need our student team to help them develop their products. Therefore, they might contact our team directly if they already have a connection with us or through an account manager.* "According to student survey, we found that *students require HKSTP to build more networking between startups, external partners, and investors since the Park has many external partner connections* (CUHK Staff 1)."

Account managers act as the vital link between companies within the Park, external partners, and other SP companies. Based on their areas of expertise, HKSTP assigns individual account managers to monitor and assist each SP company. They are responsible for providing business advice, facilitating network development, and aiding in business expansion. However, the effectiveness of account managers in fostering and establishing networks between SP companies and stakeholders is controversial depending on what individual tenant's experience and the ability of their account manager to respond to such tenant's expectations.

Company 31 said that "*our account manager helped us and that we had a close relationship. I guess some companies that had a bad experience with their account managers joined the Incubation programmes. In this programme, the account manager has to deal with a lot of requirements from different companies."*

Company 27 stated that *“our account manager has a lot of work and is exhausted from claiming any funding applications for us, so they do not have the energy to help us on the other parts. Actually, we quite have strong relationships with our partners.”*

Company 30 joined the ideation programme and was permitted to join the Incubation programme in 2022; stated that *“our account manager introduced us to meet some people from the HKSTP event, and then we got one project with a big company outside the Park. The relationship between our account manager and us is very good and informal.”*

Notably, startups and SP tenants dissatisfied with their account managers are often those participating in the Incubation Programme. The SP management, tasked with the development of startups, argues that *“we provide ample support through over 20 account managers across all programmes. While some startups easily exceed these resources, others require more assistance. "In the Park, we do not dictate or handhold the companies; instead, we guide them towards maturity, providing the support they need to progress”* (Pun, 2021).

Company 24 stated that *“every startup has an account manager, but one account manager must take care of 100 companies. It is not easy to reach out and ask for help; they may pay more attention to you if you are a star company during the programme.”*

Company 21 observed, *'We have experienced having four account managers over a two-year period to oversee our company. There is a high rate of staff turnover at HKSTP, particularly in the position of account manager. Moreover, we found that they lacked insight into our business, thereby limiting their capacity to offer meaningful guidance for business growth.”*

In summary, the primary aim of interaction between SP companies and R&D institution staff is the exchange and sharing of knowledge and facilities. Universities in particular appreciate the proximity of an SP, as it facilitates resource sharing and allows both university individuals and SP residents to mutually benefit. This mutual benefit extends beyond mere access to facilities and knowledge; it also creates opportunities for collaborative projects and student recruitment to assist their respective SP companies. Both organisations exchange news, events, and activities, and HKSTP offers startups from universities a fast-track interview process to join startup programmes. Despite the existence of strong relationships, challenges arise due to unclear IP ownership. In addition, the lack of business perspective among academic staff results in a limited number of collaborative projects among SP companies.

In conclusion, the effectiveness of SP in fostering engagement with stakeholders remains contentious based on the interview results from SP companies, despite the significant effort exerted by the SP teams to facilitate cooperation. Seven out of the 11 participants suggested that HKSTP could improve its networking strategies, which can be distilled into two main aspects: tailoring activities for research and business and establishing networks with potential anchor players across different clusters.

Companies 23 and 25 emphasised that SP should strive to better understand the needs of their clients and the aspirations of the companies within the Park. This insight would allow them to design more suitable matching events to support startups effectively. Furthermore, SP should facilitate internal communication among its tenants and companies, not just within specific clusters, but also across different sectors (Companies 27 and 29).

Instead of focusing only on China (Company 28), HKSTP should seek to expand more opportunities for us" (Companies 26 and 31). Moreover, the SP should strive to identify and engage with more venture capitalists and dynamic investors (Company 27). The continuous improvement and adaptation of SP's strategies to the evolving needs and aspirations of its tenants will be critical for its future success and its ability to foster innovation in the Park.

4.2.5 Expansion and development of research and development Infrastructure of the Hong Kong Science and Technology Park

HKSTP completed the first phase of its expansion programme in 2019, aiming to provide additional R&D space for startups, entrepreneurs, and research institutes. During this phase, facilities such as the Robotics Catalysing Centre, the AI Plug, the AI laboratory, and a co-working space for INCU-Bio were developed. Additionally, HKSTP earmarked areas in the new buildings for global research collaboration by leasing space to InnoHK research clusters, namely the ‘Health@InnoHK’ and ‘AIR@InnoHK’ initiatives.

According to the interview of SP companies, they stated *“the R&D infrastructure in the Park is appropriate. Apart from offering equipment from the Park, it also has a company as a solution provider that they built, like IoT, a huge operation centre. Many companies in the SP prefer to use it for upgrading and creating their products* (Company 28).”

On the other hand, most biotech and biomedical companies interviewed claimed that the R&D infrastructure is inadequate for their research. Company 27, a biotech tenant, said that *“HKSTP has testing and analysis labs, so they have different facilities to help us. We have to pay for usage at a reasonable price. One company also works on certification, and we are doing the ISO quality system. However, the infrastructure and facilities for biomedical parts are inappropriate, even though I knew they had started doing more wet labs. It takes years.”* Company 31 stated that *“The R&D infrastructure is inappropriate for the medical device and bio-medical clusters*.”

In the second stage of the expansion plan, slated for 2022–2024, HKSTP responded to its full occupancy by converting a wet lab building into R&D spaces for tenants and admitting new enterprises. The Park will also construct new buildings and laboratories to cater to the growing demand. These designs will cater to the requirements of R&D activities in healthcare technologies, AI, and robotics (Legislative Council Panel on Commerce and Industry, 2021).

The expansion of HKSTP is in harmony with the developmental objectives of the GBA, a pivotal strategic initiative aimed at invigorating China's economic growth. The GBA aspires to spearhead innovation-led advancement by capitalising on the locational advantages inherent in regional integration. The government has authorised the establishment of a new SP in Shenzhen, namely the 'Hong Kong-Shenzhen Innovation and Technology Park'. Scheduled for completion between 2024 and 2027, the Hong Kong-Shenzhen Innovation and Technology Park will initially focus on healthcare technologies, big data, and artificial intelligence (Tungnirundorn, 2019, Hong Kong-Shenzhen Innovation and Technology Park Limited, 2022).

The economic development between Hong Kong and mainland China is expected to spur the growth of startups and entrepreneurs. The government's supportive schemes pave the way for these businesses. Furthermore, the new Park's targeted areas align with the two clusters that InnoHK emphasises. These companies will have enhanced opportunities to scale up or offer their products to a larger market. This development strategy will help the Park fulfil its objectives of supporting the development, and use of advanced technologies in Hong Kong and facilitating R&D and technological application in the manufacturing and service industries.

4.2.6 Indicators of successful Hong Kong Science and Technology Park performance

HKSTP used indicators as shown, below, in Table 4.3 to assess the SP performance. It is apparent that HKSTP's performance throughout the three years continues to grow, even though they have faced the pandemic.

The HKSTP uses a range of indicators to measure its performance, and despite the challenges posed by the global pandemic, these indicators show consistent growth from 2019 to 2022. For instance, the number of SP companies rose from over 830 in the 2019-2020 period to more than 1,100 in 2021-2022. In terms of nurturing startups, the number of incubatees graduating from the Incubation Programme grew from 700 to over 860 during the same timeframe. HKSTP also ramped up support for startups, the number of which increased from 473 in 2019-2020 to 568 in 2021-2022, while maintaining a stable survival rate with approximately 80 per cent of graduated startups remaining in business across these years.

On the funding and collaboration front, there was an impressive increase in the number of enterprises partnering with SP companies, rising from 65 in 2019-2020 to a remarkable 250 in 2021-2022. Alongside this, SP companies achieved exponential growth in fundraising, accumulating HK$3.06 billion in 2019-2020 and escalating to HK$33.74 billion by 2021-2022. SPARK membership also increased from 9,824 to over 15,000 across the three-year span, while the number of unicorn startups doubled from two to four. However, a slight decline was observed in the number of countries of origin for SP companies, decreasing from 24 to 22. The working population and the number of R&D practitioners at HKSTP both saw growth, and the utilisation of lab hours saw a significant jump from about 200,000 hours in 2019-2020 to over 360,000 hours in 2021-2022, reflecting increased activity within the Park.

Collectively, these indicators signify the robust growth and successful performance of HKSTP between 2019 and 2022.

Table 4. 3: Hong Kong Science and Technology Park performance from 2019 to 2022

Indicators	*2019-2020*	*2020-2021*	*2021-2022*
The number of SP companies	>830	>950	>1,100
The number of incubatees graduated in Incubation Programme	700	780	>860
The number of startups supported	473	541	568
The number of graduated startups still in business	nearly 80%	80%	80%
Countries of origin for SP companies	24	24	22
The number of startups unicorns	2	2	4
The number of enterprises partnered with SP companies	65	120	250
The number of SPARK members	9,824	>13,000	>15,000
The number of working populations	>13,000	>13,500	>17,000
The number of R&D practitioners	>9,100	>9,300	>11,000
The amount of funding raised by SP companies (HK$)	3.06 billion	11.23 billion	33.74 billion
The amount of utilised lab hours	~200,000	>240,000	>360,000

Source: Adapted from HKSTP Annual Report (Hong Kong Science and Technology Parks Corporation, 2021a)

In addition to supporting startups through incubation programmes and partnerships, the HKSTP also actively facilitates investment opportunities for these companies. HKSTP leverages its corporate venture fund and has connected the SP ecosystem with over 1,000 investors to provide various funding channels for startups within the Park. In the years 2020 and 2021, HKSTP facilitated over 670 one-on-one and group investment matching sessions, which led to a significant increase in the amount of funding raised by Park companies. The companies raised HK$11.23 billion[18], a nearly four-fold increase from the previous year (Hong Kong Science and Technology Parks Corporation, 2022a, Pun, 2021), This active facilitation of investment opportunities is a testament to HKSTP's commitment to the growth and success of its SP companies. (Hong Kong Science and Technology Parks Corporation, 2021a).

Within the context of the HKSTP case study, it is evident that the government emphasises economic development through innovation-driven approaches. This Park has received substantial government funding, supporting SP companies across various business sectors. Additionally, HKSTP maintains a robust relationship with local universities. The HKSAR has devised a strategy to catalyse innovation, spanning from ideation to the commercialisation of companies, facilitated by diverse funding programmes and knowledge

[18] Approximately £1.2 billion for the total amount of funds raised by Park companies from 2020 to 2021. Calculated using the same exchange rate and inflation data as previously stated.

exchange with universities. Significantly, HKSTP differs from TSP in several respects, though they share commonalities in certain aspects. The final section of this chapter will introduce an SP with a long history from a developed country.

4.3 Surrey Research Park

4.3.1 The overview of Surrey Research Park

4.3.1.1 History of Surrey Research Park establishment

In 1979, the University of Surrey initiated discussions with the Guildford planning authority about extending links with industry sectors, with the intention of securing an allocation for the development of a 70-acre site in the County Plan. Their support allowed the University to gain approval in principle to construct the SRP. However, two years later, when the UK government reduced the funding allocated to HEIs, the University of Surrey expedited its plan to establish SRP as an additional revenue source (Parry, 2014).

The SRP, planned in 1981 (Parry, 2019) and officially established in 1985 (Surrey Research Park, 2022). is situated close to the University of Surrey, the Royal Surrey County Hospital, and the Surrey Cancer Research Institute. As the second-largest SP in the UK, it covers approximately 70 acres and houses businesses of varying sizes. Moreover, its proximity to Heathrow and Gatwick airports makes it a prime location for technology companies (Surrey Research Park, 2021a).

Despite the land being owned by the University, governance is overseen by a board, including an external chair, external representatives, and international representatives. The SRP management team, on the other hand, retains the autonomy to launch commercial services. Their small size and high flexibility allow them to respond quickly to market changes (Bourhill, 2021a). The vision of SRP is to be *"A pioneering partner to scaling companies, building Surrey as an Innovation Powerhouse"* with five objectives outlined for its establishment as follows (Surrey Research Park, 2021b, p.3):

1. Creating a long-term source of independent income for the University.
2. Raising the profile of the University as a business-facing institution.
3. Delivering knowledge and technology transfer.
4. Giving tenants a competitive advantage through risk sharing and access to technology and talent.
5. Supporting local and regional economic development.

SRP also sets its direction based on four key strategic goals (Bourhill, 2022a):

1. Expanding our physical space and operational reach,
2. Revitalising SRP and creating a sustainable environment,
3. Creating a connected innovation community,
4. Boosting our brand for national impact.

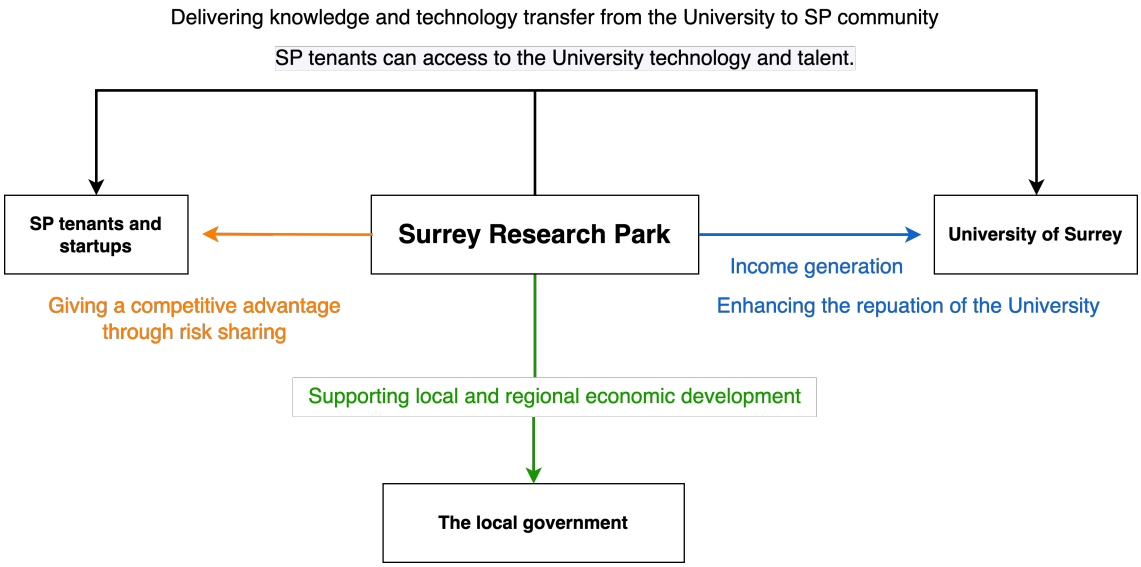
The objectives and goals of SRP synergise seamlessly. For instance, 'expanding physical space and operational reach' can foster income generation, while 'delivering knowledge and technology transfer' aligns with 'creating a connected innovation community'. Similarly, 'revitalising SRP and creating a sustainable environment' can offer competitive advantages to tenants. Thus, SRP's objectives and goals collectively exemplify a well-integrated approach to its success.

A diverse range of stakeholders is involved with the SRP (illustrated in Figure 4.18). SRP plays a pivotal role as a significant source of extra income for the University of Surrey (Bourhill, 2021b). According to the CEO, SRP currently operates as a profit-generating department within the University (Bourhill, 2021a). Over the last 30 years, the Park has contributed over £130 million to the University. In the fiscal year of 2019/20, SRP accounted for more than 80 per cent of the University's operating surplus (Surrey Research Park, 2021b) with over 70 per cent of its income originating from rentals (Bourhill, 2022c).

Furthermore, SRP endeavours to foster an innovation ecosystem that encourages knowledge and technology transfer, thereby supporting SP companies and enhancing the University's reputation. Through the support offered to these companies, they can gain a competitive edge by accessing the University's technology and skilled personnel. Additionally, SRP facilitates risk-sharing during the startup creation process, including assistance with business formation and support for established companies within the Park.

Another important stakeholder is the local government, which has approved planning permission for the Park's development. This decision was influenced by the aspiration to diversify employment opportunities in the region and stimulate local and regional economic development (Parry, 2019).

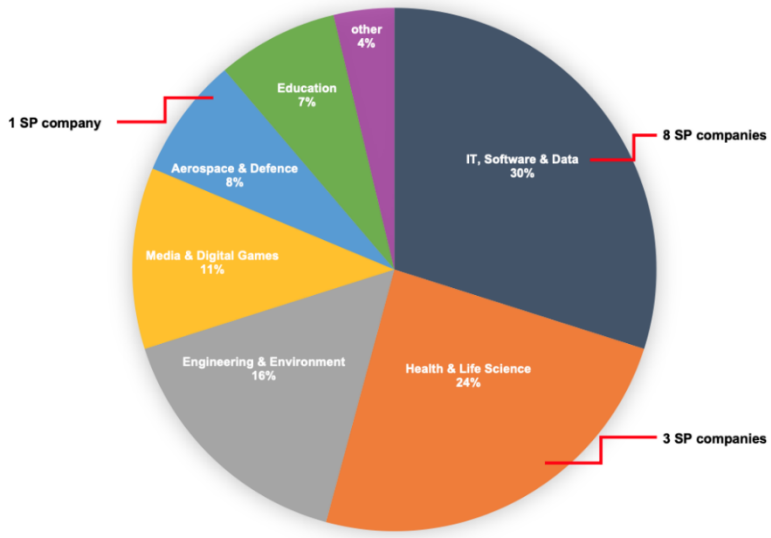
Figure 4. 18: Stakeholders & delivered value propositions of Surrey Research Park



Source: Author

Figure 4.19 depicts the clusters of Space, Human Health, and Cyber Security as strong and growing over time within the Park, while the Environmental and Animal Health sectors are emerging clusters. Figure 6.2 shows the percentage of SP companies categorised by clusters (Bourhill, 2022a).

Figure 4. 19: The Number of Interviewed Companies of Surrey Research Park classified by clusters



Source: Adapted from Stakeholder value report 2021(Surrey Research Park, 2021b) and author

The total number of SP companies and SETsquared[19] startups is 209, with 140 companies located in the Park and 69 being virtual SP companies, 46 of which are virtual SETsquared startups[20] (Bourhill, 2021b). Based on Parry (2014)'s study and the interview with SP management, it can be asserted that the presence of SETsquared startups has helped the Park maintain its occupancy rate. This occupancy translates into rental revenue and value for SP and the University (Bourhill, 2021b).

The first three clusters of SP companies are digital, health, and engineering respectively. In the case of SRP, ten companies were interviewed; one company works on digital and aerospace clusters, while another operates in digital and health clusters (see Table 3.3). Thus, these two companies have been counted in both clusters.

[19] Founded in 2002, SETsquared is a collaborative enterprise partnership among six leading UK universities, namely the Universities of Bath, Bristol, Cardiff, Exeter, Southampton, and Surrey. Due to its affiliation with these research-intensive institutions, SETsquared has the capacity to generate a considerable scale of spin-out companies, a feature that renders the network highly appealing to investors.

[20] Virtual SETsquared startups comprise member companies under the SETsquared umbrella. These startups have access to hot-desk facilities and are eligible for participation in university-related activities and services.

4.3.2 Surrey Research Park's strategy

Since its establishment, SRP has adopted a generalised technology focus strategy, intending to cater to all economic sectors. Consequently, the SP tenants have been granted the autonomy to work with their chosen technologies (Parry, 2014). In the current phase, SRP has implemented three strategies. Firstly, it focuses on enhancing SP companies by introducing them to a broader set of stakeholders, including the University of Surrey, nearby hospitals, and other research and development institutions. SRP serves a vital role as a bridging agent, providing service access to the University for SP companies and distributing relevant information. The Park focuses more on medium-sized companies, linking them with related institutes within the local community (Bourhill, 2021b, Riches, 2022).

This focus stems from the composition of the SP's tenants: out of the 140 SP companies, the majority are startups and SMEs, around 45 are medium-sized, and only five are large or international corporations. Nearly 25 per cent of SP tenants maintain ties with the University through collaborative research projects and student placements. The remaining 75 per cent can be divided into two groups. The first group interacts with suppliers and customers, while the second is focused on expanding or establishing their businesses, and as such, has not yet formed any collaborations.

Small businesses naturally prioritise profit generation for survival, often leaving little budget for research. Therefore, this group could greatly benefit from the University services and financial support to strengthen their growth. Conversely, medium-sized companies, which are typically more stable and have more resources for research than their smaller counterparts, could potentially become future collaboration partners for the University (Bourhill, 2021b).

Secondly, SRP is aiming to enhance its property assets by developing more space over the next five years while maintaining awareness of environmental sustainability. Currently operating at full capacity, the Park plans to utilise the remaining land to accommodate tech companies in high demand and provide expansion space for existing tenants. Additionally, there are plans to construct a new building for the Centre for Precision Veterinary Care, with the aim of creating Europe's premier animal health cluster (Riches, 2022).

This proposed expansion is expected to meet the needs of local tech businesses, support the growth of SP companies associated with other clusters, and increase the density of SP companies. This could lead to better opportunities for knowledge sharing and technology transfer from the University. Consequently, SRP is well-positioned to generate increased income and enhance the University's reputation over time. The planned enlargement of SRP is also likely to create more job opportunities for skilled individuals, thereby stimulating local economic growth (Riches, 2022, Bourhill, 2022a).

Lastly, the initiative to establish an Animal Health cluster has come to fruition. According to an interview with the CEO of SRP (Bourhill, 2022b), three key reasons motivated

the selection of this particular cluster. Firstly, the region surrounding Guildford is renowned as a leading hub for animal health in England, bolstered by the presence of a Vet School at the University, established in 2014, and the AURA Veterinary, founded at SRP in 2022. Other contributing factors include the Pirbright Institute, a centre for animal disease research, and the Animal & Plant Health Agency, a regulatory body, located near SRP. Furthermore, several animal health companies, including Zoetis, are established in the region.

Secondly, the close link between animal and human health was identified as a significant driver. The animal health sector has fewer regulations than the human health sector, easing the process of bringing animal health products to market and potentially paving the way for similar products designed for human use. Additionally, collaboration with the Digital cluster can lead to the development of innovative products such as remote health monitoring systems for animals, digital veterinary diagnostic tools, or AI-powered predictive models for animal disease outbreaks.

The final motivating factor is an opportunity offered by the UK Research Partnership Investment Fund[21], a long-standing government scheme that facilitates the construction of new facilities. This fund, aimed at providing capital for enabling high-quality research collaborations between universities and industry, has created the potential for expanding the Animal Health Cluster at SRP (Bourhill, 2022b). This expansion is expected to foster collaborations between academics and industry, leading to the development of new veterinary products and enhancing animal health (Riches, 2022).

The emergence of Human Health and Digital clusters within the SRP can be attributed to several factors. The Royal Surrey County Hospital, operational since the late 1970s, has fuelled the development of the Human Health cluster. Moreover, Guildford is recognised for digital gaming (Surrey Research Park, 2021c), and the University of Surrey houses Academic Centres of Excellence in Cyber Security Research (University of Surrey, 2020). These factors, along with a considerable number of digital-related companies specialising in various technologies, have established their presence within the Park (Bourhill, 2022b).

The SRP offers benefits that make it a desirable location for businesses. One of its key strengths is the flexibility of its occupancy contracts. The SRP provides a variety of options for businesses of all sizes, from co-working options under 30-day notice licenses to longer tenancy agreements ranging from 12 to 36 months, and leases from 36 months onwards (Surrey Research Park, 2021b). This allows companies to select an arrangement that best fits their requirements, making SRP accessible and appealing to a wide variety of businesses.

[21] https://www.ukri.org/what-we-offer/browse-our-areas-of-investment-and-support/uk-research-partnership-investment-fund/

Moreover, SRP has introduced a 'Virtual Office' service package in response to the needs of companies that, due to financial constraints or fluctuations in their business, may not be able to maintain a physical presence within the park but still wish to benefit from the SRP's offerings. This service is ideal for startups or small tech companies that are in the early stages of development. For a lower rental fee, these companies can access the knowledge, staff, and funding opportunities provided by the University, use the SP's address, and receive support from the reception service. The reception service can transfer calls to these companies and facilitate the hiring of meeting rooms or other business facilities. Using the SP's address enhances their credibility and reputation when they liaise with business partners or government agencies (Bourhill, 2021b).

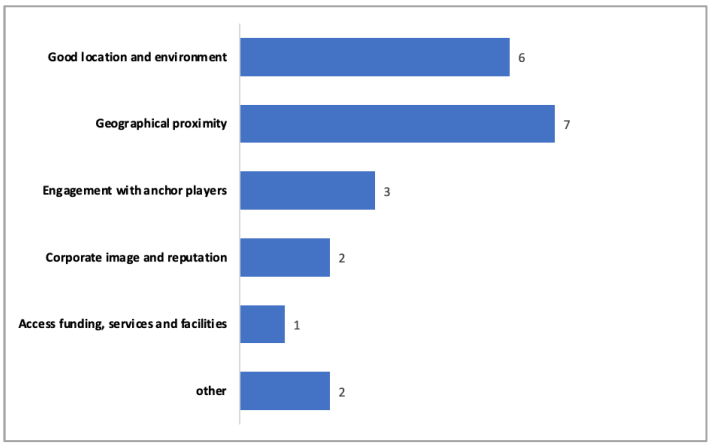
The CCO of SRP stated that *"we understand the nature of the business that goes up and down. Some companies cannot afford a physical presence in the Park but do not want to leave. They can pay a sum of money quarterly in advance to continue using the Park as their registered address for the post. They might work from home and still need to meet clients. From the perspective of customers and investors, it appears they are still headquartered in the Park. They can do everything the other tenants can, such as joining events. However, they would be required to pay an additional cost for some facilities"* (Riches, 2021).

Another strength is its strategic location and accessible infrastructure. Its proximity to public transportation, the University, the Hospital, and healthcare institutes not only ensures commuting convenience but also opens avenues for research collaborations. As evidence of this advantage, Figure 4.20 demonstrates that the geographic accessibility and strategic positioning of SRP played a significant role in attracting half of the companies interviewed.

Complementing this, SP companies affirmed the practical benefits of being based at the SRP. The availability of ample parking spaces was a significant highlight, meeting the needs of businesses with numerous visitors or patients (Companies 2,3,9, and 10). One company noted the convenience of commuting, with readily available train and bus lines, and the additional shuttle services provided by the Park (Company 8). Another company remarked on the easy access to the location, whether from Guildford or outside, with the added benefit of the close vicinity to A3 (Company 9).

The cost-effectiveness of the rent compared to other commercial areas, combined with the ease of management and flexibility provided by the Park, was found to be particularly beneficial for startups (Companies 1 and 8). The confluence of SRP’s strategic location, affordability, flexibility, and logistical advantages makes it a highly attractive proposition for businesses, particularly those within the tech sector.

Figure 4. 20: Reasons that companies chose to locate in the Surrey Research Park



Source: Author

While the SRP boasts an advantageous location in the southeast, not far from two international airports in London and close to train stations and the motorway, its proximity to the hospital can potentially pose transport challenges (Bourhill, 2021b). Nine out of ten tech companies interviewed have asserted the need for the Park to address these traffic issues.

Company 10 stated, *"we waited for an hour and a half in the evening to get off the Park. Traffic is inconvenient for our patients in and out.*" Company 9 further stated that *"the traffic is not good for our staff and patients. The traffic here would be horrendous. If there is an accident on A3, I would be in the car for an hour before starting to move. It is getting busy and busier after the pandemic."*

Nevertheless, SRP has proactively tackled this issue by implementing a free e-shuttle bus service that runs to and from the train station for all staff members of SP companies, thereby lessening vehicular congestion within the Park (Fletcher, 2021, Riches, 2021, Riches, 2022). Not only does this service ease transport difficulties, but it also fosters a communal environment where spontaneous interactions can lead to the strengthening of relationships (Bourhill, 2021a). This project was initiated and managed in partnership with Surrey Satellite Technology Limited (SSTL), a member of the SP community (Surrey Research Park, 2021c).

It can be concluded that SRP's strengths support the fulfilment of its strategic objectives. An agile SP management and a certain degree of autonomy allow for the quick creation and management of lease agreements, as well as prompt decision-making, to resolve common issues. These advantages contribute to a stable number of SP companies and startups, with a relatively low turnover rate - evidence of this can be seen when eight out of ten companies have resided in the Park for over five years. This consistency plays a significant role in SRP's revenue generation. Additionally, the strategic location of SRP stands as a key strength, encouraging stakeholder engagement. SP companies benefit from easy access to

knowledge, a variety of innovation service packages, and funding opportunities from the University.

4.3.3 Innovation services for Surrey Research Park members

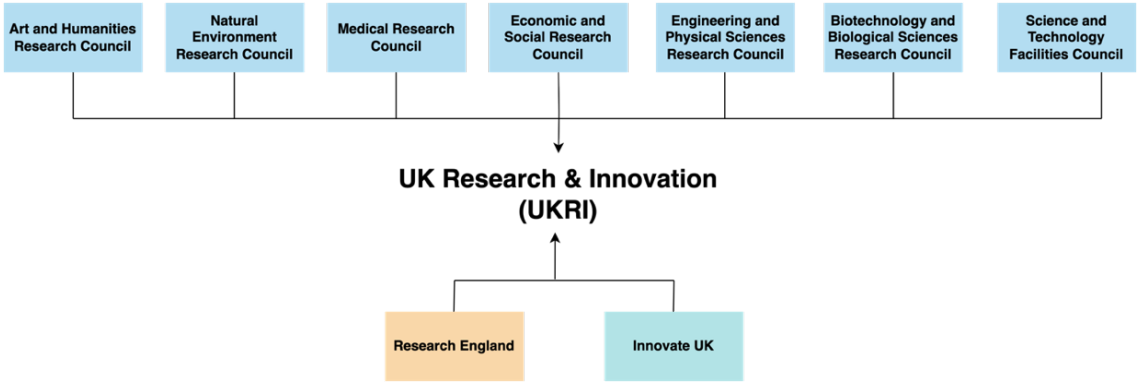
The SRP provides its members with a range of services, including office space, business facilities, and lifestyle services such as an e-shuttle bus. Additional amenities, like the sports club, can be shared with the University. Notably, the University is the main provider of innovation services and funding. Such services expedite the process of bringing the innovations and technologies of SP tenants to market by providing access to R&D equipment and experts (Albahari et al., 2019). Moreover, through financial support, risk is shared – a vital aspect of the innovation process (Poonjan and Tanner, 2020).

The SRP assists its member companies in identifying the appropriate University expertise to meet their needs and facilitates connections with relevant departments. Additionally, the marketing department maintains a service directory encompassing both University and SP company services. This department works closely with the University's Business Enterprise Programme teams (Fletcher, 2021). Further, the SRP advertises SP company job vacancies on its website and the student online application platform, Surrey Pathfinder. It also disseminates news or programme updates from the University to SP members via email.

In the UK, the chief vehicle for government research funding is typically United Kingdom Research and Innovation (UKRI), as shown in Figure 4.21. Established by the Higher Education and Research Act 2017 and operational since April 2018, the UKRI is a strategic entity that consolidates the initiatives of seven Research Councils, Innovate UK, and Research England. The purpose of this integration is to create a robust, agile, and cohesive body for financing UK's research and innovation efforts. The financial aid provided by UKRI takes two distinctive but complementary forms: one allocated by the seven Research Councils to their respective disciplines, and the other distributed as block grants to HEIs. This approach is widely known as the dual support system (The Royal Society, 2023).

Innovate UK, acknowledged as the UK's innovation agency, serves a diverse role that amplifies corporate access to expertise and advanced equipment, establishes strategic partnerships, and accelerates business development. It bolsters innovation efforts by offering financial support in the form of grants or loans. A notable aspect of Innovate UK's commitment to innovation involves minimising risk and enabling and supporting innovation. This commitment is realised partially through the provision of innovation grants and significant investment in Catapult centres, industry-focused innovation hubs within the country. Innovate UK plays a critical role in fostering and enhancing the UK's strong sphere of business innovation (The Royal Society, 2022, UK Research and Innovation, 2022a). In addition, the UK government provides an R&D tax relief programme with variations depending on the size and other specifics of your company.

Figure 4. 21: Summary of how the UK government distributes money for research and development



Source: Adapted from How does the UK government invest in R&D? (The Royal Society, 2023)

The SPace Research and Innovation Network for Technology (SPRINT) constitutes a segment of an investment facilitated by Research England's Connecting Capability Fund, specifically designed for the initiation of new collaborative endeavours. The initiative is a singular amalgamation of premier UK space-oriented universities, industrial sectors, governmental agencies, and the investment community. Its primary objective is to foster the expansion of SMEs within the UK through the commercial utilisation of space-related data and technologies. This programme enables SMEs to tap into the expertise—encompassing human capital, knowledge, facilities, applications, technologies, and training—afforded by the UK's leading space-focused universities (Bourhill, 2022a). The ultimate aim is to expedite the development of novel products and services that leverage space technologies for their core markets. Through its institutional affiliations, SPRINT serves as a conduit with the UK's space innovation ecosystem, thereby assisting SMEs in securing both technical and business support essential for elevating their business to subsequent stages of growth (Space Park Leicester, 2023).

This funding serves as a mechanism to bridge SP companies with academic staff, facilitated by SETsquared and SRP. SPRINT not only caters to companies specialising in space technology but also endeavours to enhance opportunities for other SP tenants operating in diverse clusters, particularly within the Digital realm. For example, Company 3, which focuses on GPS receivers for mobile phones and satellite communication for Wi-Fi usage, stated, *"We have secured funding from SPRINT. Our introduction to SPRINT was facilitated by a mentor within SETsquared. The funding is targeted at projects with a commercial focus."*

Economic growth in England is steered by the Local Enterprise Partnership (LEP). The LEP is a partnership between local governments and businesses that plays a pivotal role in determining local economic priorities and implementing activities to drive business growth

within the local region. Led by local leaders of industry, universities, and the public sector (LEP Network team, 2022), the LEP concentrates on promoting knowledge-intensive business activities, with universities as crucial stakeholders (Parry, 2020). The SRP is situated in Enterprise M3, one of 38 LEPs across England that receive support from the Central Government and local partners (LEP Network team, 2022). Enterprise M3 invests in innovation, skills, and businesses to stimulate business growth and improve the quality of life through the Local Growth Fund programme and can access European funding through its EUSIF programme (Enterprise M3, 2022).

This study will concentrate on the specific services and funding SP companies have experienced while collaborating with universities. Based on our primary research method of in-depth interviews, we will examine the particular services and funding that SP companies have benefitted from during their collaboration with the University. This approach will enable us to gain a deeper insight into the participants' experiences and thoughts (Saunders et al., 2019).

The service of student placement offered by the University has been highly commended by SP tenants. This could be seen as a strength of the Park in providing access to talented students and academic staff. SP tenants often take advantage of affordable student employment, with these students working on projects over the course of a year. Upon completion, companies can then decide whether to extend their employment. This is beneficial not only for SP companies but also enhances the University's reputation (Bourhill, 2021b).

Furthermore, the UKRI has inaugurated the Knowledge Transfer Partnerships (KTP) programme with the objective of enabling recent graduates to collaborate with companies. The initiative aims to foster synergies between academic institutions, research organisations, and businesses to facilitate the transfer of knowledge, technology, and expertise. This, in turn, serves to spur innovation and enhance competitive standing. A company has the opportunity to liaise with an academic institution on a specific project geared towards driving operational improvements and business growth.

Typically, the KTP framework employs a graduated individual, commonly designated as an 'Associate', to work full-time on the project. The programme's scope is covered, encompassing fields ranging from engineering and computer science to marketing and design. Its duration is flexible, varying between one and three years based on the specific requirements and scale of the project. The initiative is overseen by experts from both the participating company and the academic institution, thereby melding academic and practical insights. Funding for KTPs is usually a joint endeavour, with contributions from governmental bodies and the companies involved. Managed by the SRP team, KTP projects are executed in collaboration with both SMEs and large corporations, leveraging the extensive technical knowledge and expertise within the University of Surrey. Companies may receive grants ranging from £80,000 to £100,000 annually, covering up to 67 per cent of project costs for

SMEs and 50 per cent for larger enterprises. The remaining financial obligations are to be fulfilled by the participating company (University of Surrey, 2022, UK Research and Innovation, 2022b).

In addition to government funding, the University, in collaboration with SRP, launches an annual competition known as Collaborate22. This competition, funded by the Higher Education Innovation Fund, aims to support UK-based companies - particularly SRP companies and startups within SETsquared. Every year, the competition grants four to five projects with funding valued between £20,000 and £25,000 each. Winning projects have the opportunity to work directly with the University, utilise its expertise and facilities, and establish lasting relationships (Platinum Business magazine, 2022, Riches, 2022). The Park COO stated, *"We are delighted to award funding to three innovative projects. These are from three SP companies. It would enable the companies to access academic expertise and facilities in Chemical and Process Engineering, Veterinary Medicine, and Health Sciences as well as from the talent of postgraduate and doctoral students"* (Riches, 2022).

In summary, the SRP facilitates an ecosystem of innovation by providing a variety of services and facilities, from office spaces to lifestyle amenities. It fosters a close connection between the Park's companies and the University of Surrey, facilitating access to resources, expertise, and opportunities such as student employment. This partnership enhances innovation and reduces risk through shared financial support. The SRP aids companies in identifying appropriate University expertise and connects them with the relevant departments. The Park also utilises multiple channels to share opportunities and updates from the University. Furthermore, funding is provided by various entities including the UKRI, Innovate UK, SPRINT, LEP, and KTP. Each offers distinctive forms of support, including research funding, grants, loans, and innovation hubs, alongside a local economic growth focus. Additional initiatives such as the Collaborate22 competition foster connections between the University, SRP companies, and startups, providing funding and opportunities for direct collaboration. This multi-faceted support structure combines to create a robust environment for innovation at the SRP.

4.3.4 Building networking between a Surrey Research Park company with stakeholders

The SP collaboration network provides technology businesses with quick access to skills, knowledge, and resources that can help accelerate innovations (Yan, 2019). In the case of SRP, we interviewed the SRP management about its collaboration strategy with anchor players. In this section, we will probe the SRP tenants about their demand for building networks with stakeholders and to what extent the SP contributes to their networks. This will guide the investigation into whether the SRP strategy aligns with the tenants' needs.

- **Building networking between a Surrey Research Park company and other co-located companies**

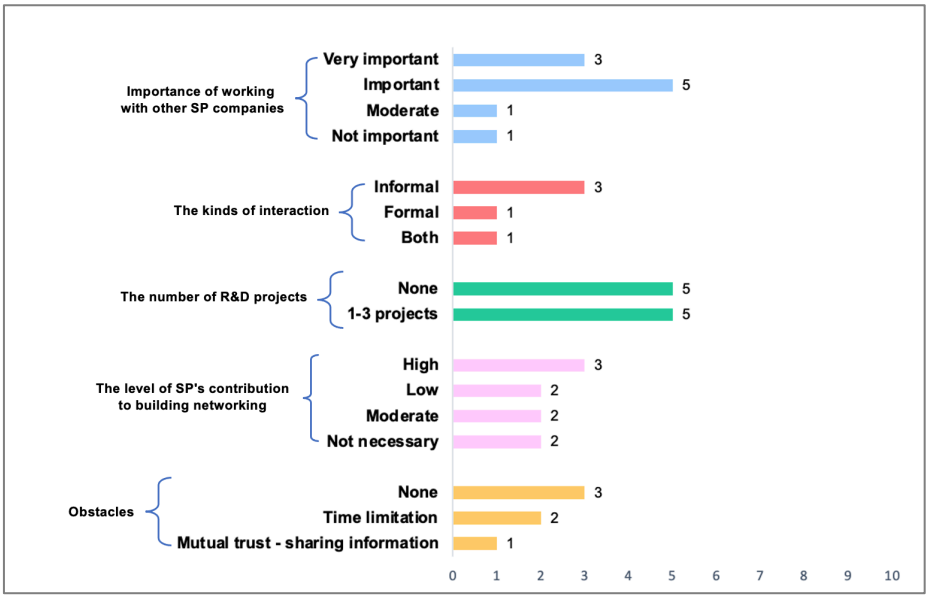
The CMO stated the tenants' responsibility is to open their minds and take the initiative in networking. She is interested in leveraging social media as a networking tool, stating, *"We aim to foster more tenant engagement on social media. We initiated this effort, but it is gradually gaining momentum"* (Fletcher, 2021).

Nonetheless, our research revealed that nine out of ten companies express a strong interest in collaborating with other SP tenants. Half of these companies have had prior experience in such collaborations. The majority of these relationships are formed through informal discussions, with formal connections facilitated through the tenant directory listing on the website, provided by the Marketing Department. Two main obstacles emerged from our findings - limitations on time and trust issues surrounding information sharing. However, only two companies expressed dissatisfaction with the SRP's contribution to network development. Interestingly, although the SRP team does not specifically encourage these relationships, SP companies appreciated SRP's responsiveness when they initiated contact (see Figure 4.22).

"We worked with one company on R&D tax claims based in the same building. We have used that company and got R&D tax credits back for us. We would say that the SP team will be getting better (Company 1)."

"We had two projects. SP facilitated pretty much because they introduced us to them. There was an issue with the competition, and it is always hesitation to transfer knowledge between companies (Company 5)."

Figure 4. 22: The relationships and building networking between a Surrey Research Park company and other tenants



Source: Author

*"It is good to build relationships. It is really convenient for people on the Park if they want to use our facilities. Just walk across the lake and come for the appointment during lunch break. It would be really beneficial for the community if we knew who our neighbours are. There will be some sort of research that we can sponsor at some points. We have been here for more than ten years. We went to the event that SRP organised and spoke to several people there. No one knew where our clinic was. We wanted to know more and more people in different areas, and finally, we got to know only three people. The Park should organise a specific event, and it would be much more beneficial. We would like to do an event, such as educating event. We are happy to have our consultants talk and make people aware, not of the clinic, just of the health and symptoms (*Company 9)*."*

In conclusion, from the perspective of SP companies, cultivating relationships with other SP companies is important in terms of collaboration and service provision. Our findings indicated that SP tenants, especially those functioning as service providers or clinics, express a need for the SRP to facilitate or organise activities that promote acquaintance and cooperation among them.

- **Building networking between a Surrey Research Park company and nearby partner institutions**

In this context, we explored the relationships between an SP company and the nearby key players such as the University of Surrey, SETsquared, and Surrey Hospital. SETsquared, located in the SRP, is a university partnership that offers services to start-ups and SP companies. It encourages the growth of early-stage, high-tech science and technology ventures from local communities and produces top-tier spin-off companies from university research. The partnership provides links to university experts, management expertise for assessing business idea feasibility, and well-equipped office space (Riches, 2021).

According to interviews with SETsquared's employees, SETsquared@Surrey collaborates with banks, offering entrepreneurial funding to support new businesses (Linda, 2021). SETsquared also connects local, national, and international networks, providing new ventures access to a broad range of funding options from business angels to venture capital. For instance, in collaboration with the University of Surrey and Enterprise M3, SETsquared won a bid from the European Regional Development Fund, providing £2.4 million over three years for the Digital Business Acceleration Hubs programme across the Enterprise M3 corridor. This programme attracted digital entrepreneurs by offering training, investor access, and specialised services connections, such as the 5G Innovation Centre (Watson, 2021).

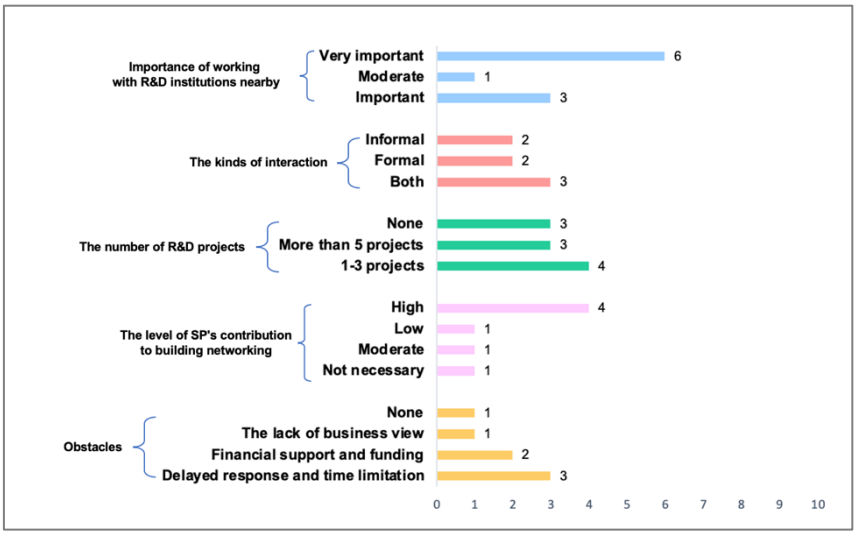
A SETsquared staff member extolled the S100 Club as a key pillar of SETsquared @ Surrey's success. Established in 2007, this non-profit club aspires to forge a robust investor network and to integrate startups into the investment milieu. In addition to presenting investment opportunities to angel investors, the club offers an array of support services including training and investor-entrepreneur matchmaking. Notably, unlike many angel

investment clubs, the S100 Club waives upfront fees for presenting companies. Its membership encompasses a diverse cadre of influential business leaders, seasoned entrepreneurs, and former corporate executives. SRP's tenants also can register as members and partake in the club's activities.

Furthermore, the University plays multiple roles that enrich the broader support ecosystem for SP tenants. Among these roles are facilitating student placements, fostering research collaboration, and offering University schemes and activities. Nonetheless, augmenting the level of active engagement between tenants and the University is a challenge keenly recognised by SRP management. Nonetheless, augmenting the level of active engagement between tenants and the University is a challenge keenly recognised by SRP management. To this end, informal events have been initiated to foster interactions between the SP companies and the academic staff. This event gained positive feedback and similar events, especially those focused on health, space, and environment, are planned post-pandemic (Bourhill, 2021b).

From the SP companies we interviewed, all participants recognise the importance of collaborating with nearby R&D organisations. Notably, geographical proximity is the primary reason for seven out of ten companies choosing to locate in the Park (see Figure 4.20). These companies seek to utilise the University's knowledge, facilities, services, funding, and opportunities for stakeholder engagement, along with benefiting from its affiliated connections. Most SP tenants-initiated collaboration through student placements and formed relationships through formal and informal interactions: Park referrals, social events, and personal connections. Despite challenges such as delayed responses, time constraints, and funding support, SP companies appreciate SRP management's commitment to fostering this type of network (see Figure 4.23).

Figure 4. 23: The relationship and building networking between a Surrey Research Park company and nearby other research and development institutions



Source: Author

Company 10, established in 2003, stated that *"it is essential because we can keep producing world-class research. We worked a lot of collaborative research with the University, sponsored and supervised two students through the school of engineering, and we are looking at doing some further taking another PhD student. We also participated in the Innovate UK and the KTP to develop a medical device with the School of Veterinary Medicine, the Department of Mechanical Engineering, and Surrey Business School. We did not need any help from the Park because we already knew them and had no problems working with them."*

Company 1, specialising in ICT, stated, *"Prior to our relocation to the SRP in 2014, our company was situated in another university research park. Our decision to transition was informed by several factors: SRP's advantageous location, cost-effective rental rates, the presence of SETsquared, and the esteemed reputation of the University of Surrey. Building good relationships with nearby universities is important for us. They are great when we have technical questions, we cannot answer ourselves. Sharing and improving ideas becomes a lot easier, and it has helped make our connections even better. With the help of SPRINT funding, we got good support from SETsquared and SRP. The only catch is that finding time to work together can take a while, but that is something everyone deals with."*

In conclusion, the majority of SP companies have built close ties with the University of Surrey, through student placements and access to services and funding. Some have also collaborated with Surrey Hospital. It is noteworthy that SP companies are more interested in engaging in student placements than other services. Conversely, SP companies partnering with academic staff have noted that University personnel tend to operate at an academic pace and sometimes lack commercial sharpness or a business perspective. In terms of SP's role in nurturing these networks, SP companies perceive the SRP management as actively fostering opportunities for tenants to familiarise themselves with University staff and engage in University activities.

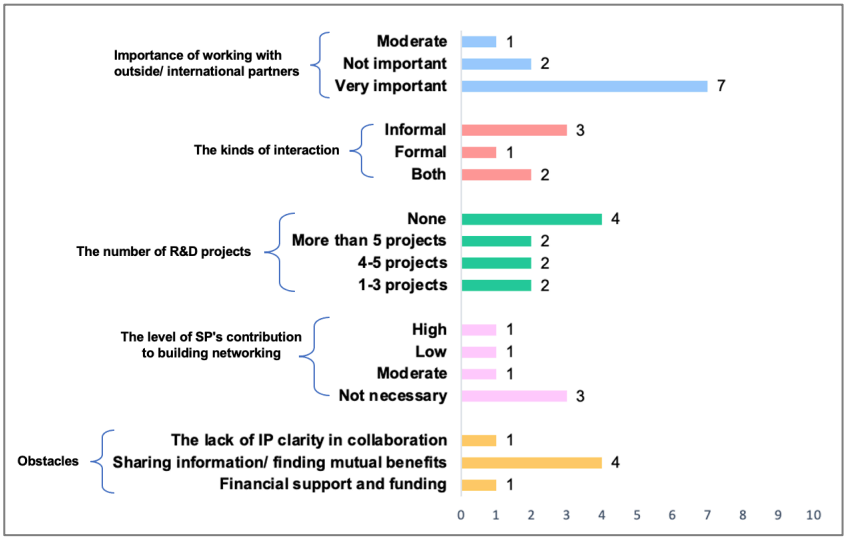
- **Building networking between a Surrey Research Park company and outside partners**

As part of their current strategy, SRP primarily focuses on identifying potential engagement opportunities between SP companies, the University, and other nearby organisations. Consequently, they have not yet developed a specific strategy for building networks with external or international organisations for their SP tenants. However, the results of the SP companies' interviews highlighted the importance of building relationships with external partners.

Six out of ten SP tenants have collaborated with external partners, with two of these engaging in more than five collaborative research projects. These partnerships were primarily established through personal connections and referrals, although some companies also made connections through formal interactions at exhibitions and events. The primary challenges in working with external partners include finding mutual benefits, clarifying intellectual property

(IP) issues, and securing financial or funding support. However, SP companies do not necessarily require the SRP team to facilitate or develop these types of relationships, as some companies with a global focus already have the potential to form such connections independently (see Figure 4.24).

Figure 4. 24: The relationships and building networking between an Surrey Research Park company and *outside partners*



Source: Author

Company 2, a healthcare provider, stated that *"we have good relationships with 12 universities across the UK. in terms of sponsorship of students and being involved in forming courses, both postgraduate and undergraduate courses. The number of collaborative research projects is quite huge with universities and international companies. We have also got many partners not only for collaboration but for developing products, such as Phillips and Siemens. We tried to overcome and understand our partners to ensure that we got a similar perspective on what they do. Sharing information and finding mutual interests are the parts that are quite sensitive, and we do not need SP to help us with that because we knew these partners before."*

Company 3 moved into the Park in 2018, stated that *"we had around five projects, and they knew us from previous work and referrals. We would say startups need financial support and government funding to mitigate risks. We do not need SP's helps because those are global companies. We cannot expect SP to do everything for us."*

Company 7, located in the Park for six years, stated that *"it is very important because it helps us reduce time and costs to try and recruit or bring special skills from the team without full-time need. The obstacles might be to find the right person to talk with and having mutual interests, as well as sharing or exchanging information. It would be nice if SP could help us with that."*

Company 8 stated that *"it is very important for us to have a strong partnership network. We often find our partners at trade shows and events. We have also done projects with the*

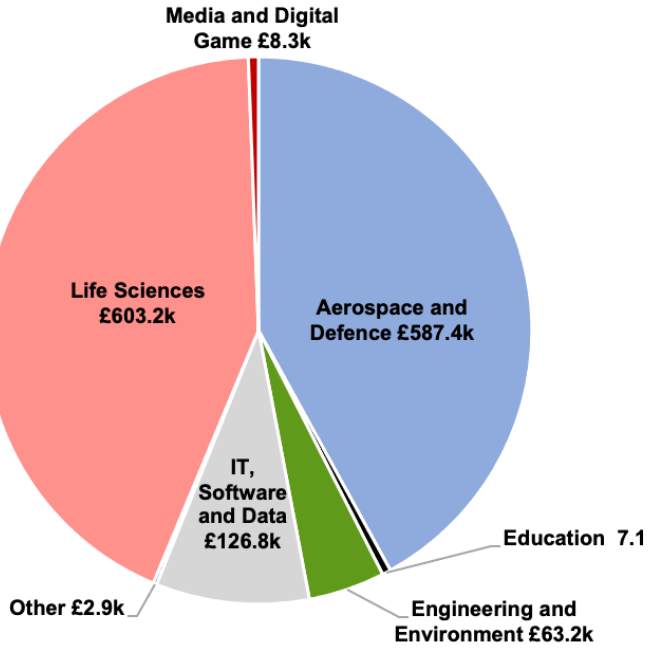
University of Southampton, primarily by sponsoring courses. Because the type of technology we possess does not exist on its own, we cannot accomplish anything without connecting to other people. Information sharing and poor communication are our barriers."

In conclusion, most SP companies recognise the importance of networking with external partners in terms of technology and knowledge sharing as well as collaborative research projects, particularly with universities and international partners. They leverage their own networks and do not require SRP's assistance. The main obstacles to forming these relationships include finding mutual benefits and issues around information sharing.

4.3.5 Indicators of successful Surrey Research Park performance

The primary source of income for SRP is rental and service charges, accounting for more than 80 per cent, while only 11 per cent derives from research and consultancy between SP companies and the University (Bourhill, 2022c). Income stemming from the engagement between the University and SP tenants includes consultancy fees, research income, and student placements. Figure 4.25 presents the total University income from engagement with SP tenants from 2018 to 2019, categorised by clusters. It reveals that the three highest incomes are derived from Life Science, Aerospace & Defence, and IT, Software & Data respectively (Surrey Research Park, 2021b).

Figure 4. 25: University income from engagement with Surrey Research tenants from 2018 to 2019 classified by clusters



Source: Adapted from (Surrey Research Park, 2021b)

A study examining the development of SRP conducted by its former CEO, Parry (2014), presents success indicators and factors correlated with the five objectives that underpinned the creation of SRP (Table 4.4). This study of Parry reported that almost 70 per cent of SP tenants have varying degrees of linkage with the University, from 'soft' connections such as using the University's facilities like the library, to 'hard' ones such as research contracts and knowledge transfer.

However, by amalgamating an extensive array of collaborative clusters, the task of deriving conclusive insights regarding the volume of high-value interactions from that particular report becomes considerably challenging. Our research delves into this issue in greater detail, elucidating that 'soft' links—such as utilising common facilities of the University, for instance, the library—do not reflect profound and enduring relationships between SP companies and the University.

In fact, the University posits that the potential exists for an augmentation in research and innovation income generated from SP tenants. To elucidate, in the previous year, research and consultancy income constituted 11 per cent of the total SRP revenue. This proportion could increase if the SRP stimulates more intensive networks between SP tenants and the University (Bourhill, 2022c).

Table 4. 4: Measures of success against the SRP building objectives

Objectives	Success indicators
1. Income generation	• Rate of development • Occupancy rates
2. Raising profile of the University	• Origin of tenant companies • International visitors • Membership of international organisations • Business incubation
3. Technology transfer	• University spin-out • University linkages • Staff and students transfer
4. Supporting local and regional economic development	• Employee numbers • Employment • Wages • Numbers of SP companies • Length of life • Capital raised • Company turnover
5. Support SP companies	• Growth companies on the SP

Source: Author and adapted from The Surrey Research Park; A Case Study of Strategic Planning for Economic Development (Parry, 2014)

Beyond the indicators as shown in Table 4.4, the SRP currently employs several additional indicators to assess its own performance. These encompass the length and size of leases, engagement with the University, student placements, tenant satisfaction, void rates, website traffic, and monthly enquiries. The CEO posits that the reputation of the SRP is fundamentally shaped by the achievements of its SP tenants (Bourhill, 2021a).

However, it is noteworthy that the SRP's indicators predominantly focus on its own business performance rather than capturing the innovative contributions made by SP members. Specifically, the SRP lacks tailored indicators to assess the growth of focused clusters or to monitor the UK government's R&D funding into SP companies.

This chapter has provided a comprehensive exploration of TSP, HKSTP, and SRP, each distinguished by its unique strategic vision, geographical positioning, and developmental path. Through an in-depth examination of their histories, objectives of establishment, and strategic approaches, we have gained insight into the diverse ways these SPs catalyse innovation. The analysis of the provision of innovation services and R&D infrastructure within these Parks has underscored the importance of building effective and varied stakeholder networks.

Additionally, each Park delivers unique value propositions to its stakeholders, reflecting their distinct strategic visions and operational contexts. These tailored value propositions enhance the parks' ability to meet specific stakeholder needs, thereby reinforcing their role in the innovation ecosystem. The performance indicators have enabled an assessment of the parks' successes and areas for growth, spanning innovation outputs to economic impacts. This evaluation offers a multifaceted view of their effectiveness and influence. Ultimately, this chapter contributes to a deeper understanding of the operational dynamics of SPs in different contexts and their vital role in supporting their tenants and fostering innovation ecosystems through developing IC. In the next chapter, we shall delve into the analysis of empirical findings, further enriching our understanding of the three SPs.

Chapter 5:

Data Analysis and Empirical Findings

The purpose of this chapter is to analyse the three case studies and their respective findings. The primary objective is to comprehend the distinct management structures and objectives, strengths, and weaknesses of each case. This entails a deep exploration into the unique strategies employed by each park in the evolution of ICs, revealing their current developmental stages and suggesting actionable pathways for their progression to subsequent phases.

This chapter begins with the TSP case analysis and its evolution of IC development in Section 5.1. The case analysis of HKSTP and SRP, including the evolution of IC development of each SP, will be presented in Sections 5.2 and 5.3, respectively. It seeks to offer a comprehensive insight into the operational dynamics and strategic orientations of these Parks.

5.1 Thailand Science Park case analysis

In the opening section of Chapter 4, we conducted an in-depth analysis of the TSP, encompassing its management structures, objectives, strategies, goals, and the like. This analysis demonstrates that TSP adopted a top-down approach. The Park is strategically designed to act as a conduit, linking SP tenants with research institutions and universities, thereby facilitating the dissemination of S&T knowledge. TSP's role in fostering networks across the public and private sectors accelerates the conversion of knowledge into commercial ventures through collaborative initiatives.

Government policies encourage foreign investment by offering benefits and privileges via the BOI, coupled with the establishment of a state-of-the-art R&D infrastructure within TSP. These policies yield benefits that extend beyond mere economic growth, promoting the distribution of advanced knowledge among park members and cultivating a dynamic innovation ecosystem. This approach not only underscores intensive R&D activities at TSP but also aims to invigorate local companies by providing access to R&D expertise and opportunities for forming business partnerships with MNCs.

Nevertheless, the primary appeal of TSP lies in its research centres, which serve as a powerful attractant for technology companies. These entities frequently engage in close collaboration with researchers to forge novel ideas and joint research initiatives (notably with Companies 13, 15, and 20), effectively reducing transaction costs. This finding aligns with the discourse in Chapter 2 on the collaborations between SP tenants and adjacent R&D institutions. Despite most TSP companies having prior experience in collaborating with researchers, challenges persist. This is largely due to the independent research conducted within the research centres, which can occasionally overlap with the interests of SP

companies, leading to project delays and an imbalance in business benefits. Researchers often prioritise their own research agendas, which may sporadically converge with the objectives of SP companies. Furthermore, this duality of roles positions researchers as both collaborators and competitors.

Our findings indicate that most SP tenants form networks with external entities based on pre-existing connections, thus requiring minimal intervention from TSP in these interactions. However, a subset of SP companies do rely on TSP's support to expand and penetrate international markets, frequently seeking venture capitalists or partners. Additionally, tenants engage with external universities and R&D agencies to access specialised knowledge at reduced transaction costs and to utilise equipment not available at TSP.

Table 5. 1: Summary of the Thailand Science Park case analysis

	Details
Vision	TSP to be the most-preferred ecosystem for science and technology business.
Mission	• To be a fully integrated R&D hub • To encourage cooperation among R&D institutes, public agencies, and industries • To act as a connecting provider in transferring R&D knowledge from lab to market • To stimulate industrial development by conducting private-sector R&D projects • To be a key source of strengthening the capability of talented people
Goals	• Drive TSP companies to grow in overseas markets • Engage regional partners to scale business and expand networks • Attract foreign corporations to locate or conduct research in the TSP • Strengthen the innovation ecosystem and create business opportunities
Strategy in the current phase	• Go international • Build science and technology business platform • Create a knowledge hub
Strengths	• Privileges and incentives are able to attract foreign companies (see section 4.4.3) • There are five national research centres to lure tech companies to be located there. • Account managers are effective intermediaries enthusiastic about facilitating and connecting SP companies with other R&D agencies. • NSTDA launched a holding company
Weaknesses	• Allocating R&D funding the government is dispersed to different R&D agencies. • The proportion of private R&D investments is relatively low. • Lack of integrated innovation programmes that links and transfer students or academic staff to join other programmes in the Park • Overlapping research between the research centres and SP businesses results in a lack of mutual trust. • A lack of autonomy in creating marketing campaigns aimed at attracting targeted companies.The innovation services and funding are offered by Other departments. • Thai entrepreneurs are constrained by low input costs and have insufficient budgets to develop their innovations.

Source: Author

The case analysis of TSP, detailed in Table 5.1, articulates a clear vision to position TSP as a preeminent S&T business ecosystem. This is supported by a comprehensive mission encompassing the development of an integrated R&D hub and the enhancement of collaborations between various entities. The goals ambitiously target expanding TSP's global footprint, leveraging regional partnerships, and attracting international research interests.

However, a critical analysis reveals significant challenges that could hinder these objectives. The dispersion of government R&D funding and the relatively low private R&D investment indicate a potential misalignment of resources. Additionally, the lack of integrated innovation programs and the apparent overlap in research between centres and businesses suggest inefficiencies and trust issues within the ecosystem.

These weaknesses not only raise concerns about TSP's ability to attract and retain talent and investment but also question its effectiveness in fostering a truly innovative and cooperative environment. Moreover, the limited autonomy in creating commercial services and the nature of Thai entrepreneurship, which focuses on low-cost inputs, might be barriers that prevent TSP from achieving its goals.

5.1.1 The Evolution of innovation cluster development in the Thailand Science Park

As indicated in Chapter 4 in the Section 4.1.2, TSP initially employed non-specific clusters and transformed into the focused-clusters approach around in 2017. This strategy aims to leverage existing networks to bolster individual clusters. The congregation of like-minded companies could facilitate sharing of innovation resources, relationship building, and the discovery of common interests (Kowalski, 2014, O'Dwyer et al., 2015, Wang et al., 2017).

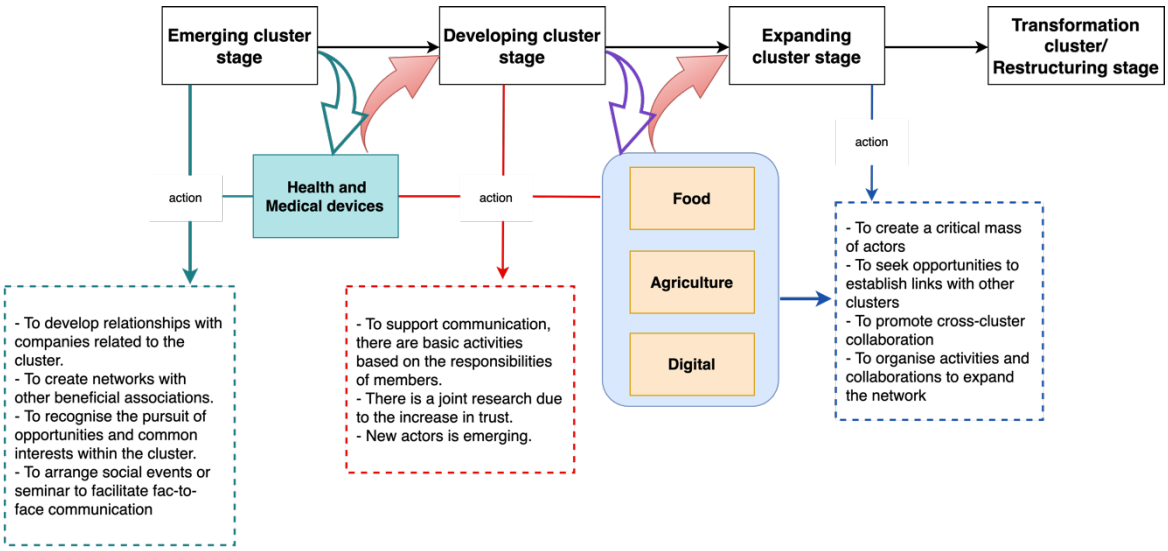
With a rise in the number of SP tenants, R&D personnel, and the proliferation of networks and partners, TSP began to focus on the development of clusters within the Park, an initiative spearheaded by the NSTDA. However, the automotive cluster experienced challenges in development, including difficulties in competing with neighbouring countries over minimum wages, a lack of mutual interest, and unstable government innovation policies. Additionally, the lack of participant engagement at each stage of cluster development led to decreased interaction, technology sharing, and idea exchange (Sozinova et al., 2017, Cooke, 2001). The automotive cluster's development was primarily driven by the NSTDA and TSP, rather than a top-down government initiative, leading to a lack of governmental recognition and intervention (Fromhold-Eisebith and Eisebith, 2005).

Conversely, the food cluster, receiving substantial support from government agencies, was consistently developed and expanded. The government's relocation of Food Innopolis to TSP provides comprehensive services, funding, and benefits to the food industry. This hub has become a magnet for talent within the SP, who are pivotal for cluster development (Cadorin et al., 2019). In essence, Food Innopolis has invigorated the food innovation ecosystem, attracting more food companies to engage in research or establish R&D centres.

This phenomenon aligns with Poonjan and Tanner's (2020) findings that, in some countries, government investment in infrastructure facilitates knowledge agglomeration, promotes continuous startup creation, and stimulates sustained R&D.

Given the life cycle classification of ICs, as cited in the Section 2.2.5 of Chapter 2, different clusters within TSP are at varying stages of development, as shown in Figure 5.1. The food, agriculture, and digital clusters are in the 'innovative development stage', while the health cluster is in the 'emerging stage'.

Figure 5. 1: Thailand Science Park's cluster evolution current stages and forward strategies



Source: Author

During the emerging stage, companies within the health cluster initiate the establishment of connections, synchronization of objectives, and the formation of networks with other beneficial alliances or associations, thereby fostering opportunities and nurturing collective ideation. TSP, acting as an intermediary and aggregator of companies and organizations with congruent mindsets, plays a pivotal role. This role includes orchestrating relevant social events, seminars, and conferences that facilitate direct communication among key stakeholders. Maintaining continued engagement is crucial for fostering trust, stimulating reciprocity, and encouraging cooperation—factors instrumental in progressing to further stages. To transition this cluster to the next stage, it is the responsibility of the cluster manager to promote within-cluster communication and activities designed to enhance trust. These concerted efforts culminate in the initiation of a collaborative project (Yim, 2014, Klimova et al., 2016, Sozinova et al., 2017).

As discussed in Chapter 2 regarding the quality of the location, our findings reveal that TSP not only has the potential to drive IC in the long run but also possesses attributes such as a vibrant network of innovative individuals, comprehensive R&D infrastructure and facilities, and government-provided financial and innovation services. Furthermore, the added advantage of support and collaboration from the five national research centers strengthens the Park's research endeavors in tandem with technology businesses within each cluster.

Supporting academic literature, interviews with SP tenants revealed their capacity to benefit from cost reductions, facilitated access to equipment for small-scale businesses, and government funding (Company 15). Additionally, it aligns with Mazur et al., (2016) and Sawasdee (2021), emphasising the importance of interconnectivity in location, state-of-the-art infrastructure for R&D, and the facilitation of social and business interactions. Inter-budgetary subsidies, federal programme integration, tax exemptions, and income tax all contribute to the successful development of ICs (Varga et al., 2013, Veselovsky et al., 2015).

Currently, the food, agriculture, and digital clusters are in the 'innovative development stage'. Progressing to the ‘maturity stage’ would require SP management to generate a critical mass of actors (Yim, 2014), forge connections with other clusters, activities, and regions, and devise new strategies for maintaining strategic and competitive advantage. Successfully established trust in the preceding phase can expedite these actions. Technology and plan reformulation are critical at this stage. A cluster manager needs to review and adapt the strategic direction of the clusters to ensure their survival and sustainability in the face of changing conditions (Klimova et al., 2016). The implementation of different strategies depends on the development stages of the clusters. For example, the 'Go International' strategy, as shown in the Section 4.1.2, necessitates the identification of cluster players' capabilities and needs.

In implementing this strategy for the health cluster, attracting multinational companies to collaborate with SP members or establish their base within the cluster is crucial. Currently, health companies occupy 10 per cent of TSP, with international companies representing 1 per cent. In contrast, food and agriculture make up approximately 27 per cent (Thailand Science Park, 2022d), with leading Thai food companies such as Betagro and Osotspa, comprising 50 per cent of these. The Food Innopolis, located within the Park and offering a range of services to the food industry, signifies that a critical mass has been achieved. To gain international relevance, the cluster may need to conduct regional activities, maintain formal and informal cooperation, and encourage interaction between established and emerging actors (Sozinova et al., 2017). This could provide more opportunities for IC managers to undertake intense marketing activities (Klimova et al., 2016).

Transitioning to the mature phase or expanding cluster phase necessitates enlarging internal and external networks, cultivating trust, and fostering inter-member commerce. In order to develop long-lasting ICs, cross-clustering or enabling technologies, such as digital,

sensors, or communication, are vital (Yim, 2014). The digital cluster, for example, is instrumental in advancing other ICs in TSP and facilitating the application of technology to commercial sectors, especially medical devices. These enabling technologies are seen as the foundation of innovation, fueling the evolution of ICs (Klimova et al., 2016). In essence, the digital cluster in TSP, with its broadened network, can spur the organic growth of other clusters by integrating into them to create valuable products.

We can summarise that the TSP has the potential to fulfil its cluster development roles through the provision of R&D infrastructure and facilities, the exploitation of opportunities for new partnerships while sustaining existing ones and enabling access to innovative services and incentives within the TSP community. Nevertheless, the sustainable development of ICs cannot be achieved without stakeholder participation. Policymakers play crucial roles in better understanding innovation pathways and cluster dynamics to craft and implement effective policy interventions and initiatives (Arthurs et al., 2009). A collective effort is required from all participants to ensure effective knowledge flows, resource pooling, and the efficient use of government cluster funding (Wang et al., 2017).

5.2 Hong Kong Science and Technology Park Case Analysis

Innovation policy in Hong Kong follows a top-down approach. HKSTP is regarded as a government-led SP (Nahm, 2000). HKSAR established the HKSTPC in 2001 to provide infrastructure, support services, and related activities to technology-based companies. It offers a broad range of services to accommodate business needs at various stages, from incubation programmes to the provision of land and facilities for production (Hong Kong Government, 2020). The HKSTPC manages HKSTP, three industrial estates, and other facilities in the city centre, as shown in Chapter 4 in Figure 4.10. Evidently, the HKSTPC manages operations from upstream to downstream, facilitating the efficient translation of research into commercialisation.

Findings indicate that tech companies primarily choose to locate in the Park for access to funding, services, and facilities. This aligns with the conclusion of Sharif et al., (2013) which states that tenants benefit from financial support such as rent subsidies, as well as new opportunities to forge connections with like-minded companies and HEIs.

Table 5.2 summarises the HKSTP case analysis. Since its inception, HKSTP has adopted a cluster-oriented strategy, aiding tech businesses in overcoming both internal and external limitations (Löfsten and Lindelöf, 2005). It achieves this by providing essential instruments and facilities, which help these businesses develop new products and enhance their growth potential (Diez-Vial and Fernández-Olmos, 2017). Moreover, HKSTP serves as a bridging agent, linking stakeholders with SP members (Lamperti et al., 2017).

Table 5. 2: Summary of Hong Kong Science and Technology Park case analysis

	Details
Vision	• Maximise potential and enhance HKSTP members' commercial success by capitalising on the development of GBA and other innovation policies of China
Mission	• Support the Park's startups and tech companies in achieving their goals through innovation support mechanisms: funding, R&D facilities, building networks, etc.
Strategic objectives	• Supporting tech startups and enterprises on their journey for innovation and growth. • Fostering the development of innovation and technology in Hong Kong. • Serving as a testbed for new technological developments. • Stimulating professional exchange, investor matching, and business development. • Supporting commercialisation through the well-developed infrastructure of innovation.
Strategies	• The cluster-oriented strategy • Utilisation of existing support mechanisms to seek potential tech businesses to come into the Park to strengthen the innovation ecosystem • Leverage opportunities to expand business growth relied on the innovation policy of mainland China • Finding strategic partnerships in the region and overseas to strengthen the development of clusters • Increasing and transferring the density of startups in HKSTP to a new SP in Shenzhen to create innovative connections (see Section 5.2.3)
Goals	• To drive Proof of Concept and adoptions in overseas markets and cross-border commerce • To engage regional partners, to scale business and expand networks • To attract top-notch tech startups and entrepreneurs to be members • To strengthen the innovation system • To enhance business opportunities for SP members
Strengths	• Innovation policies in Hong Kong is highly supported and integral aspect of China's economic policy • The government is clear and concrete in the country's innovation-driven policy by establishing the InnoHK project for developing the cluster of health and digital. • The HKSTPC administrates SP and industrial parks, enabling to push of innovative products to the markets quickly • The government allocated the majority schemes of funding directly to HKSTP to strengthen tech businesses from the early stage to the mature stage, as well as project-based funding to assist these businesses • Good relationships with the universities • There is no conflict of interest between researchers and SP members (see Section 5.2) • HKSTP formed a holding company and has a division responsible for acquiring investors and VCs • Ability to attract strategic partners who contributed to SP company's growth, such as AstraZeneca.
Weaknesses	• HKSTP is large scale. The Park is managed through a top-down operation, which leads to some communication among the Park's members slow and has an impact on their adaptation • Reimbursement takes a long time. This will lead to a lack of cash flow for the Park's startups and companies • Shortage and a high rate of turnover of account managers

Source: Author

HKSTP's operation focuses on the development of start-ups and small businesses while attracting large regional and overseas companies to conduct business within the Park. The aim is to build opportunities for small sector engagement with these entities, thereby facilitating business expansion into broader markets. It is apparent that innovation in Hong Kong receives considerable support from China, and the cross-border innovation policy between Hong Kong and mainland China continues to evolve.

The HKSAR established InnoHK in the HKSTP, focusing initially on healthcare, artificial intelligence, and robotics. This significant investment into the HKSTP has attracted both local and global institutions, as well as the private sector, spurring increased collaborative research. It can be said that the presence of InnoHK has resulted in both private and public sectors actively engaging in the development of such clusters.

Direct government funding into the Park attracts companies wishing to become SP members.

As a result, the Park can selectively admit potential start-ups and companies that can enhance its reputation. These companies, in turn, attract renowned local and overseas companies to engage in HKSTP, alongside potential investors. Furthermore, the presence of HKSTP's holding company accelerates the growth of SP businesses and provides existing investors or partners with co-investment opportunities.

HKSTP provides full-time researchers and engineers to support their members' R&D operations. These staff members, dedicated to the work of SP companies rather than conducting their own research, eliminate potential conflicts of interest. Thus, knowledge and networking sharing can occur without concerns about leaks or theft of proprietary information (Wang et al., 2017).

However, HKSTP is not without its administrative weaknesses. As a large-scale, top-down operation, HKSTP suffers from slow communication among its members, which can impact their ability to adapt. While funding is a strength of HKSTP, the reimbursement system is a weak point that all start-ups suggested needs improvement. This process can take more than six months (Company 24), leading to cash flow shortages – a prevalent problem for start-ups (Phongthiya et al., 2021).

In addition, the current ratio of approximately 20 account managers to 1,000 SPs presents a challenge, as these start-ups require significant attention due to their lack of business experience (Díez-Vial and Montoro-Sánchez, 2016, Henriques et al., 2018). These roles require multi-skilled individuals who can cater to the diverse needs of start-ups, each of which has different technologies, target customers, and business approaches. It is, therefore, a challenge for HKSTP to find individuals who can meet these diverse expectations.

HKSTP operates the Park based on identifying and attracting the right tech businesses to join its community. This strategy aids in the long-term development of the innovation ecosystem. The high concentration of clusters allows like-minded individuals to

congregate, encouraging knowledge spillovers among SP companies (Lecluyse et al., 2019). They share common interests and find opportunities for collaboration, and their proximity helps reduce transaction costs (Yan, 2019). While relationships among startups appear to be active, the level of collaboration and knowledge sharing is not substantial (Nauwelaers et al., 2014).

The exchange of knowledge and interaction between SP startups and academic institutions align with Sharif et al., (2013) 's findings that SP tenants can save time by leveraging, capturing, and utilising knowledge from public research institutions and universities. SP companies also have access to university and government facilities, such as laboratories. The government funding programmes are designed to support startups via universities, enabling them to enter the SP pipeline and join other programmes for their continued development. The more small businesses can access financial resources, the higher their chances of success (Mazur et al., 2016). Once entrepreneurs become Park members, they gain explicit knowledge through personal connections with academic staff or alumni networks from their previous universities. Knowledge sharing assists startups in overcoming obstacles (Wang et al., 2017).

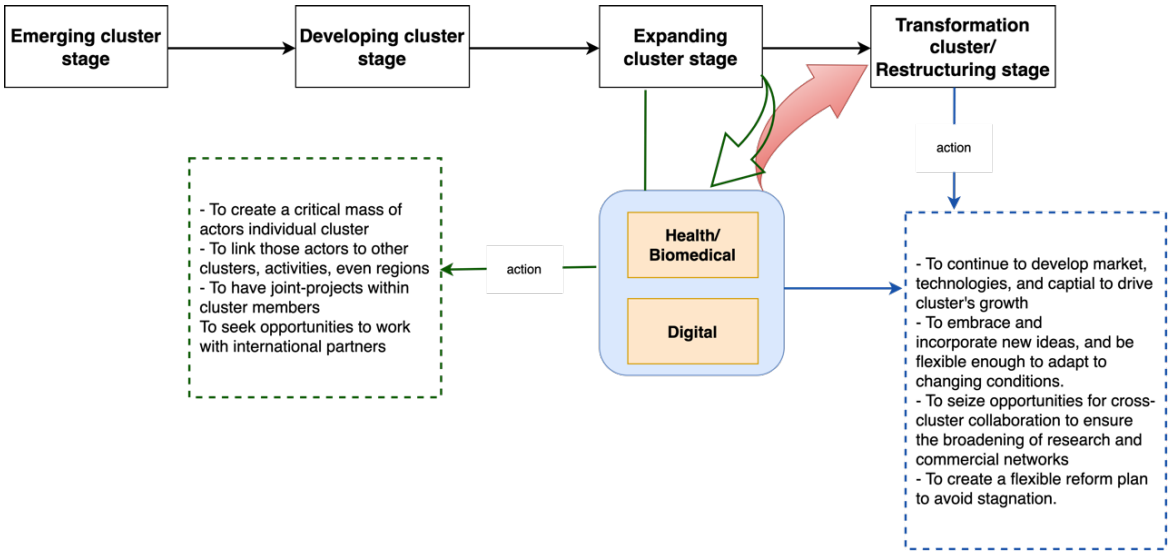
5.2.1 The evolution of innovation cluster development in the Hong Kong Science and Technology Park

From its inception, HKSTP has focused on digital and biotechnology clusters. These clusters are the result of top-down creation, with the HKSAR government providing the conceptual foundation and incorporating them into regional administrative systems. The government takes a considerably proactive role in creating and establishing clusters and also provides budget support to encourage the interaction of technical seeds developed by public research institutions and universities, enabling them to meet business requirements (Fromhold-Eisebith and Eisebith, 2005, Intarakumnerd and Vang, 2006).

The cluster-oriented strategy can attract like-minded companies and fosters a propensity for collaboration. As a result, there is active interactive learning and mutual benefits are identified (Engel and del-Palacio, 2011). This clustering benefits local businesses in terms of tech company growth, strengthening of innovation systems (Mazur et al., 2016), and knowledge sharing between stakeholders (Porter, 2003).

According to the concept adopted, as addressed in Chapter 2, Section 2.2.5, the findings indicate that the development of ICs in the HKSTP has reached the expanding cluster stage (refer to Figure 5.2). A critical mass of actors has been created, linking them to other clusters, activities, and regions. An internal dynamic emerges when enterprises form joint ventures (Sozinova et al., 2017), enhancing the positive external effect. Relationships between cluster members are solidified through planned joint projects (Klimova et al., 2016). It appears that companies in the SP have opportunities to collaborate with international companies, such as AstraZeneca, influencing cluster development.

Figure 5. 2: Hong Kong Science and Technology Park's cluster evolution current stages and forward strategies



Source: Author

To transition to the next stage, the actions, as elaborated in Chapter 2, Table 2.1, indicate that HKSTP will continue to develop markets, technologies, and capital to drive the clusters. Crucially, this involves generating new ideas, adapting to changing conditions, and constantly seeking opportunities for cross-cluster collaboration to ensure the survival of the clusters, as well as broadening research and commercial networks (Arthurs et al., 2009, Sozinova et al., 2017).

Start-ups and tenants of the HKSTP play a pivotal role as drivers of innovation. A defining characteristic of start-ups, as identified by Arthurs et al. (2009), is their exceptional potential, entrepreneurial spirit, and unwavering pursuit of opportunities to realise their objectives. This entrepreneurial spirit, prevalent among HKSTP members, affirms the vitality of their approach. Such dynamism is a cornerstone of the vibrant ecosystem within the Park, underscoring its status as a hub for technological innovation.

Furthermore, the advantages stemming from the country's policy context, highlighted by O'Dwyer et al. (2015), including financial stability, substantial budget allocations for innovation, and robust market capabilities (Yim, 2014), present an excellent opportunity for tech businesses in Hong Kong, particularly in relation to China. The prospects for long-lasting IC development are significantly bolstered by the HKSTP provision of R&D infrastructure. This strategic expansion includes the establishment of another SP in the GBA, an initiative that presents tech startups with substantial opportunities for business expansion. Managed by the HKSTP Corporation, this new SP represents a crucial extension of HKSTP's influence, further enhancing the Park's capacity to support and strengthen IC development.

5.3 Surrey Research Park Case Analysis

The SRP serves as an example of an SP under a university-led, single-ownership model, with the university acting as the sole proprietor. The initial development capital was obtained through the lease of land to anchor tenants. This transaction provided adequate funding to initiate the establishment of key infrastructure and allowed for the construction of the first phase of buildings. Subsequent construction funded by the University has relied on loan financing from banks, with these loans being secured against the income generated from leased buildings (Wasim, 2014, Parry, 2014).

Table 5. 3: Summary of the Surrey Research Park case analysis

	Details
Vision	A pioneering partner to scaling companies, build Surrey as an innovation powerhouse
Missions	• To expand community integration • To create new routes to economic and social impacts • To unleash new research and provide students/ staff opportunities in the University • To expand the University's commercial offerings in order to generate income for the University
Strategic objectives	• Creating a long-term source of independent income for the University, • Raising the profile of the University as a business-facing institution, • Delivering knowledge and technology transfer, • Giving tenants a competitive advantage through risk sharing and access to technology and talent, • Supporting local and regional economic development.
Strategies	• Strengthening SP companies by exposing them to a broader range of stakeholders, in particular, the University of Surrey, hospitals and other R&D institutions nearby, • Increasing property assets by creating greater developed space within five years, • Creating the Animal health cluster.
Goals	• Growing our physical space and operational reach, • Rejuvenating SRP and creating a sustainable environment, • Creating a connected innovation community, • Unleashing our brand for (national) impact
Strengths	• Good location • Close to the University, hospitals and R&D institutions that help encourage collaborative research between the public sector and industry • The SRP management team has autonomy and authority • Flexible rental space agreement • Providing virtual rental space for tech businesses in the early stage • Ability to access talented students and academic staff from the University of Surrey • The SETsquared located in the Park can attract more startups
Weaknesses	• Traffic congestion surrounding the park • Low engagement between SP companies and the University • SP tenants are heterogeneous clusters

Source: Author

Our findings reveal that the objectives guiding the establishment of the SRP are distinct from those of the other two SPs. This Park was initiated not only to encourage technology transfer from the University to the private sector but also to furnish the University with a self-sufficient, long-term source of revenue. The on-site Park management team serves as an intermediary, maintaining a balance between the expectations of SP tenants and the University's requirements (Parry, 2020). Table 5.3 presents a comprehensive summary of the SRP case analysis.

SRP is situated in a good location, given its proximity to a motorway, a train station, and two major international airports. The organisational proximity of SRP to the University of Surrey, Surrey County Hospital, and other R&D institutions. It is also conveniently located near accommodations, shopping centres, hotels, and other lifestyle amenities. Traffic congestion, a by-product of the Park's prime location, has been mitigated by providing bus service, a project undertaken in collaboration with an SP tenant, which underscores SRP's eagerness to partner with its tenants.

The Park administration enjoys autonomy and authority over the Park's complete management. They have the power to establish commercial services for SP members or create new campaigns to attract tech businesses to the Park. The responsive and agile management team, being compact, can swiftly meet tenant needs, such as rental space agreement management. This benefits stakeholders and facilitates the achievement of strategic objectives, such as enhancing SP companies' competitive advantage and accelerating knowledge transfer from the University to SP members, thanks to the SRP management team's robust connection with University departments that support and engage with the industry.

A virtual office is a business model that benefits all stakeholders. Virtual companies gain credibility from using the SP's address and can access all R&D services, PR news, and funding like ordinary tenants. This not only generates a small amount of revenue for SRP but also expands their network, allowing them to create collaborative opportunities with stakeholders. Moreover, this rental model helps SP tenants scale down to ensure business survival while maintaining relationships within the SP community and nearby R&D institutions.

Evidence from SP companies suggests that most SP tenants have more experience interacting with the Hospital, Healthcare Institutions, SETsquared, and the University nearby the Park than with other types. This is consistent with Parry (2020) survey of 174 SP companies in the SRP, in which 53 per cent of SP companies interacted with universities. Our qualitative study delves deeper, discovering that most SP tenant interactions with the University largely occur through student placements. In this respect, it aligns with the empirical study of Ng et al. (2020b), which examined seven SPs in the Netherlands. The study revealed that SPs located in proximity to universities positively influence human capital. SRP tenants benefit from engaging with university students for placements, who not only contribute to R&D

projects but also facilitate introductions between SP tenants and academic staff for potential collaborative research opportunities.

Our result is consistent with Parry (2020) who stated the presence of SP and its value proposition for universities include creating opportunities for academics and researchers to transfer knowledge and technology to commercialisation, attracting investment into a region, creating job opportunities for talented graduates that could help to encourage the development of a network, and raising the profiles of both the hosted university and SP tenants.

Regarding internal linkages among tenants, the number of SP tenants (five companies) having co-projects with other tenants is relatively low compared to the number of interactions between tenants and the University (seven companies) or outside partners (six companies). This is attributed to the heterogeneity and diversity of the SP companies and their ongoing business evolution and development (Company 7 and (Bourhill, 2021b).

The findings align with Yan (2019) and Lecluyse et al., (2019), who underscored that the heterogeneity of SP tenants complicates the identification of shared interests. Consequently, SP management needs to concern about the heterogeneity and diversity of the technological business profiles of incoming tenants. This recognition will enable tenants to identify common interests and business opportunities. The ability to collaborate and exchange information among tenants can aid in reducing transaction costs and risks (Kowalski, 2014, Yang and Lee, 2021, Wang et al., 2017, Yan, 2019).

In other words, the delivery of knowledge in technology transfer may not be restricted to just the University but could occur within the Park among the tenants. This has the potential to enhance the competitive advantage opportunities for the tenants. Despite SP companies being satisfied with the response they receive from the SP team upon reaching out, they could be proactive and inventive in constructing activities for this kind of network (Nauwelaers et al., 2014).

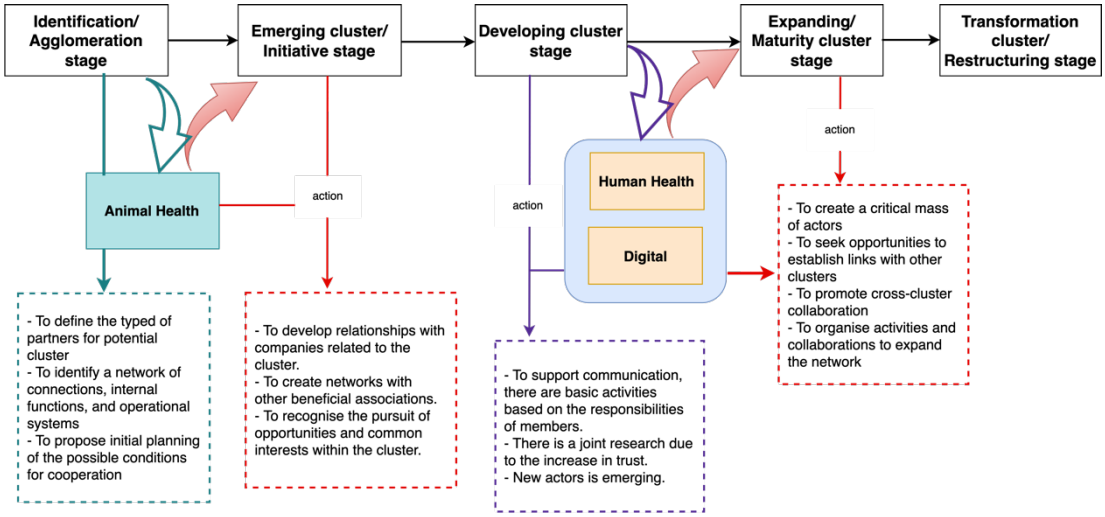
Interestingly, in the SRP case, tenants do not need the management team's assistance to build collaborations with external partners. They are self-sufficient in this regard, and most have robust relationships with their partners. These external collaborations predominantly take the form of joint research projects with universities in the UK and Europe rather than business collaborations.

The SRP is currently operating at full capacity. The Park's strategies aim to cater to the high demand from new tech companies and fulfil the spatial expansion needs of existing SP tenants, while also creating a sustainable environment for SP residents. The latest development plan proposes the construction of a new building for the Centre for Precision Veterinary Care, with the aim of fostering university-industrial collaborations (Riches, 2022).

5.3.1 The evolution of innovation cluster development in the Surrey Research Park

The inception of the SRP was characterised by the formation of non-specific clusters. Despite the organic growth of ICs within the Park, SRP has recently transitioned to a focused cluster strategy. The evolution of ICs within the SRP, particularly the Human Health and Digital clusters, has been significantly influenced by their strategic proximity to key partner institutions. These include the University of Surrey, the Royal Surrey County Hospital, adjacent healthcare centres, and health-related government agencies. An evaluation using the IC life cycle model reveals that both the Human Health and Digital clusters are currently in the developing cluster stage. This aligns with the conceptual framework outlined in Chapter 2, Section 2.2.5, and is visually represented in Figure 5.3.

Figure 5. 3: Surrey Research Park's cluster evolution currents stages and forward strategies



Source: Author

Progressing to the 'maturity stage' necessitates that SRP management builds a critical mass of actors (Yim, 2014), foster links with other clusters, activities, and regions, and conceives new strategies for maintaining strategic and competitive advantages. At this juncture, technological advancements and strategic reformulations are pivotal. The cluster manager considers revisiting and adapting the strategic orientation of the clusters to ensure their continued existence and sustainability (Klimova et al., 2016).

It is observable that the cluster manager has formulated a new cluster, which is the Animal health cluster. It co-initiated between SRP and the University of Surrey. This newly established cluster could potentially bolster and augment opportunities for collaboration, thus facilitating the transition to the subsequent phase of IC, the Maturity stage. The inclusion of an Animal Health cluster within the SRP may facilitate cross-cluster collaborations amongst Human Health, Animal Health, and potentially Digital Health actors.

This transition entails the formation of a critical mass of actors and the establishment of cross-cluster connections. Simultaneously, the expansion of both local and international strategic networks is vital to ensure opportunities for cluster actors, specifically in terms of joint ventures and accessibility to financial capital, thus fostering business growth (Klimova et al., 2016).

The Animal Health cluster's development currently resides in the 'Agglomeration stage'. This stage necessitates the clarification of partner categories, internal functions, and operational systems in this nascent cluster. Moreover, the identification of key actors for the assessment of potential cooperative conditions is vital (Yim, 2014, Sozinova et al., 2017). In terms of progressing to the subsequent stage, the SRP foresees the cultivation of relationships with companies associated with the cluster, with the intention of fostering a network with other beneficial entities. This endeavour is expected to facilitate the identification and pursuit of shared interests and opportunities within the cluster. Nonetheless, procuring sustained funding for long-lasting cluster development is a challenge for both SRP and the University. This is underscored by Hargreaves (2021), a manager of the University, who notes that, *"Although Animal health has developed, it suffers from a lack of continuity and tends to be superficial."*

In conclusion, the expansion of SRP development is likely to attract a significant number of companies specialising in human and animal health. Moreover, the SRP will be a sandbox for graduates in the Veterinary School and Medical School at the University that want to start their businesses. The Animal Health cluster is expected to grow independently yet inevitably overlap with the Human Health cluster. While both clusters will be individually strong, their interdependence will also strengthen their collective impact.

Chapter 6: Discussion

The purpose of this chapter is to compare and evaluate the strategic, operational, and policy aspects of three key SPs - SRP, TSP, HKSTP. The central aim is to understand their strengths and weaknesses and to identify successful practices that could be adopted by other SPs in the same context to improve their overall efficiency and effectiveness. The analysis delves into the unique approaches undertaken by each park in fostering ICs, their distinct management structures and objectives, as well as the operational strategies they deploy. Beyond comparison, this chapter also explores opportunities for reciprocal learning among these SPs. It explores how SRP, TSP, and HKSTP might leverage each other's successful strategies to mitigate their challenges, thereby fostering a process of continual enhancement through shared knowledge and experiences.

This chapter is systematically divided into three core sections, each presenting an in-depth comparative analysis of the three SPs as outlined in Section 6.1. In Section 6.1.1, a strategic comparison is initiated, examining the diverse objectives and stakeholders, alongside ownership, governance, and management strategies, in addition to approaches to IC development within the SPs. Section 6.1.2 then shifts focus to the operational context, comparing the SPs with respect to varied strategies in tenant attraction and retention, stakeholder networking, innovation facilitation via financial support and collaborative initiatives, and the SP indicators to assess their performance. Section 6.1.3 illuminates the advantages and disadvantages of innovation policy and natural advantages of the three SPs in terms of Innovation policies and Location and the provision of R&D infrastructure. Section 6.2 concludes the key findings from the comparative analysis.

6.1 Comparative analysis of the three Science Parks

In this section, we will undertake a cross-case analysis of the three SPs with respect to strategic and operational comparisons, as well as advantages and disadvantages of innovation policy and from location and local institutions aspects of the three SPs. The findings will lead to address our research questions.

6.1.1 Strategic comparison

6.1.1.1 Diverse objectives and stakeholders

SPs across the world are unique entities (Cadorin et al., 2019) in terms of size, strategic location, the objective of SP establishment, and delivered services for stakeholders (Poonjan and Tanner, 2020). SPs were built to nurture and assist tech companies in developing profitable products, services, and processes by leveraging government mechanisms, and incentives (The Economist Intelligence Unit, 2016). Governments, notably

those in Asia, further catalyse SPs' appeal by investing heavily in R&D infrastructure and facilities (Arauzo-Carod et al., 2018), thereby drawing leading companies and multinational corporations to base their R&D operations within these parks (Sawasdee, 2021). The findings of our study reflect this phenomenon. Both the TSP and the HKSTP underscore the significance of adopting a broader, international perspective within their foundational objectives. These Parks aspire not only to attract foreign companies for research collaboration but also to fortify their local tenants. This bolsters the role of SPs as a hub of innovation.

Apart from the objectives previously mentioned, the establishment of an SP also aims to generate additional revenue (Parry, 2014), and serve as a conduit for knowledge transfer from HEIs to the private sector (Lecluyse and Knockaert, 2020). The SRP exemplifies this model. Our findings reveal that the University of Surrey initiated the SRP as a means of creating a long-term, independent income source. Additionally, the Park is designed to facilitate the transfer of knowledge and technology, with the aim of fostering local and regional economic development (Surrey Research Park, 2021b).

Moreover, SPs are constructed with the intention of facilitating interactions among a diverse range of stakeholders, businesses of varying sizes, and different clusters. For example, the HKSTP directly offers specialised programmes to stimulate and empower bio and deep-tech start-ups. In contrast, the SRP does concentrate on local startups and early-stage tech businesses, yet it does not adopt the strategy of focusing on specific clusters nor does it provide them with direct support programmes as the HKSTP does. Instead, it serves as an intermediary (Díez-Vial and Montoro-Sánchez, 2016, Puncreobutr, 2017), facilitating members' access to funding and services from the University. This parallels the TSP, where TSP tenants access funding and innovation services from the NSTDA.

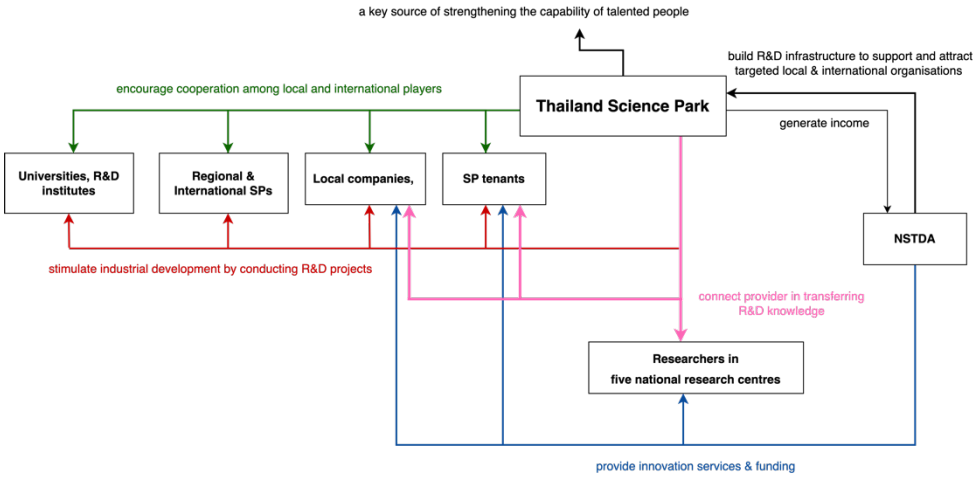
Figure 6.1 shows the differences of stakeholders and delivered value propositions in TSP, HKSTP, and SRP. The general information relates to the context of three distinct SPs, each differing in stakeholders and delivered value propositions. Firstly, the TSP is overseen by the NSTDA, which is responsible for promoting innovation through service programs and funding. TSP is dedicated to enhancing the expertise of talented individuals in science and innovation, creating income streams through its rental spaces, and nurturing collaborative networks. These networks encompass local and international tech businesses, research centres, and SP tenants, fostering the progression of R&D research from conceptual to commercial stages, thereby serving as an innovation pipeline.

Secondly, the HKSTP serves as a critical driver of innovation both locally and internationally. It supports the application of R&D in manufacturing and service industries and is home to a substantial number of technology companies and startups, including several unicorns. HKSTP facilitates access to advanced technologies and collaboration with research-intensive universities, thereby enabling SP tenants to tap into a pool of knowledge and talent. With substantial support from the local government, HKSTP enhances service provision and

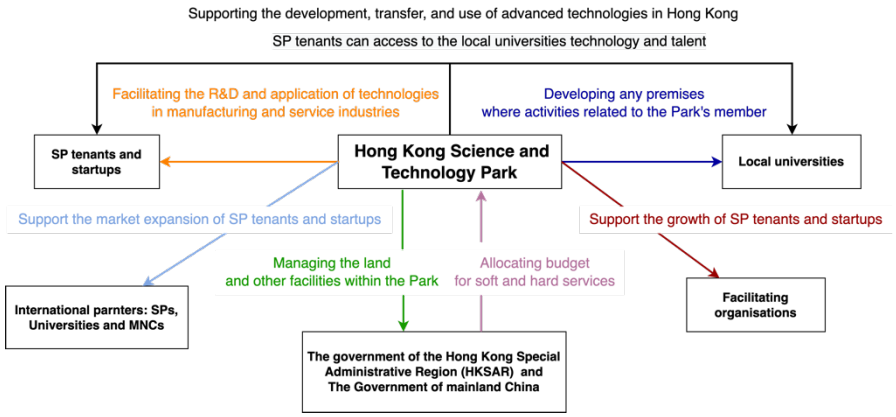
capitalises on funding programmes to support early-stage businesses and bolster the innovation ecosystem.

Figure 6. 1: The differences of stakeholders and delivered value propositions across amongst three Science Parks

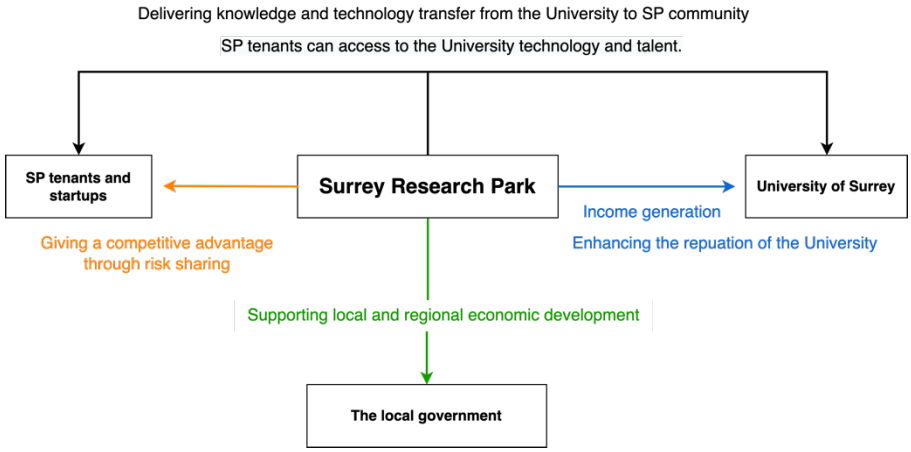
Thailand Science Park:



Hong Kong Science and Technology Park:



Surrey Research Park:



Source: Author

Lastly, The SRP is integral to the University of Surrey, acting as a significant source of income and contributing to the University's reputation. SRP facilitates the transfer of knowledge and technology from the University to the SP community, allowing SP members access to the University's technological resources and talent. This relationship benefits SP tenants and startups by providing them with a competitive advantage through risk-sharing arrangements and fostering local and regional economic development. The local government supports SRP, recognising its role in regional economic diversification and development. The Park's operations are geared towards profit generation, significantly contributing to the University's financial health, with a considerable portion of its income derived from rental services. SRP's innovation ecosystem supports SP companies, giving them a competitive edge through access to technology and expertise from the University of Surrey.

SPs support the growth of technology companies and attract significant government investment, particularly in Asia (Sawasdee, 2021). The key objectives of the three SPs include fostering R&D collaboration, generating profit, and facilitating the transfer of knowledge from universities to private enterprises. Additionally, they enable interactions among businesses, stakeholders, and various industrial sectors. Their primary function is to act as intermediaries, support SP members in securing funding and innovation services through their networks. All three SPs share a collective goal: to enhance their innovation ecosystems and create business opportunities for their stakeholders.

6.1.1.2 Ownership, governance, and management strategies: Lessons from Thailand Science Park, Hong Kong Science and Technology Park, and Surrey Research Park:

SPs can be categorised based on their ownership and governance structures (Nahm, 2000, Lecluyse et al., 2019). Both the TSP and the HKSTP were established through government-led initiatives, while the SRP was university-led. Significantly, each of these SPs has distinct ownership and is managed by different organisations. The TSP is overseen by the NSTDA, a government entity, with decision-making processes characterised by bureaucratic hierarchies, multiple approval layers, strict regulations, and guidelines. Conversely, the HKSAR created the HKSTP Corporation to manage the Park. HKSTP has a more streamlined decision-making process, demonstrating flexibility and agility in adapting to market changes and business needs.

On the other hand, the SRP operates as a department within the University of Surrey, granting the management team full authority to oversee the Park with the primary goal of generating income. As a result, SRP can provide flexible contracts and other offerings as well as take prompt action to support its tenants, particularly regarding rental contract agreements. The SRP, being university-operated, presents a unique management structure that allows for rapid adaptation to tenants' needs.

In this aspect, the TSP could learn from the HKSTP and SRP in terms of transforming their management approaches by granting the NSTDA more flexibility in park administration, reducing procedural steps. It is crucial to modernise the public administration process to respond quickly to the evolving needs of clients.

6.1.1.3 Approaches to innovation cluster development in Science Parks

We found that the formation of ICs typically is divided into two approaches: top-down and bottom-up (Fromhold-Eisebith and Eisebith, 2005). In Asia, governments often adopt a top-down approach, proactively creating and nurturing clusters. They provide annual budgetary support to foster interaction between original technical developments produced by public research bodies and universities. This aims to meet business needs, thereby stimulating the creation of an innovation ecosystem and new industries (Intarakumnerd and Vang, 2006). Conversely, a bottom-up emergence represents an industry-led cluster. This approach involves a focused group of active and practical players linked by pre-existing connections, forming a network of already affiliated businesses (Shivakumar, 2021).

Our findings corroborate these concepts. The HKSTP strategically implements a top-down approach, while the SRP appears to adopt a bottom-up approach, leveraging geographical advantages and the presence of key players within the park. The TSP utilises a hybrid approach. Government policy has guided the direction of the TSP in the first phase. Then TSP in the second phase formulated a more cluster-oriented strategy. Additionally, the TSP recognises its inherent strengths, such as the readiness of research centres to support private sector enterprises, the number of SP companies affiliated with each cluster, and the existence of relevant networks.

The approaches underpinning the development of ICs in the three SPs are characterised by their unique operational tactics. HKSTP leverages existing clusters, cultivated since the Park's inception, to expand into additional potential clusters that can benefit from the resources of the initial cluster. The HKSAR established InnoHK within the HKSTP to develop two clusters: Health and Biomedical, and Digital. Conversely, TSP concurrently conceptualises and develops four clusters—Food, Agriculture, Health and Medical Devices, and Digital—during its second phase, focusing on finding strategic local and international partners in order to enable the long-lasting development of ICs.

However, since its inception, the SRP has not explicitly employed a cluster-oriented operational strategy; rather, it has cultivated a network between SP companies and academic staff from the University. This strategy has been instrumental in fortifying existing clusters through collaborative arrangements between the SRP and the University, notably in the form of social events and seminars.

It is salient to note that the SRP has expressed interest in the development of the Animal Health Cluster. This particular cluster is positioned to benefit from government funding for the construction of new facilities within the Park. Moreover, the Park's strategic location

places it in close proximity to significant entities in the Animal Health sector, including the Pirbright Institute and the Veterinary School affiliated with the University.

The SRP could build upon the already established Health cluster, which has a direct relationship to direct relevance to the Animal Health Cluster. The anticipated growth of the Animal Health Cluster is expected to accelerate the attainment of critical mass in the Health and Digital clusters, thereby fostering inter-cluster networking and collaboration. This synergistic effect has the potential to catalyse the development of innovative products and services, such as digital sensing technologies for animals and AI-powered predictive models for animal disease outbreaks. Consequently, this synergy could contribute to the long-lasting development of all clusters within the SRP.

Table 6. 1: Summary of comparative analysis of the goals, Science Park management structure, and approaches to Innovation Cluster development of the three Science Parks

	TSP	HKSTP	SRP
Goals	1. To drive TSP companies to grow in overseas markets 2. To engage regional and international partners to support potential SP tenants 3. To attract foreign corporations to locate or conduct research in the TSP 4. To strengthen the innovation ecosystem and create business opportunities	1. To drive Proof of Concept and adoptions in overseas markets and cross-border commerce 2. To engage regional partners, to scale business and expand networks 3. To attract top-notch tech startups and entrepreneurs to be members 4. To strengthen the innovation system 5. To enhance business opportunities for SP members	1. To grow our physical space and operational reach, 2. To rejuvenate SRP and creating a sustainable environment, 3. To create a connected innovation community, 4. To unleash our brand for (national) impact
SP management structure: **1. Ownership**	- Government	- Government (HKSAR)	- The University of Surrey.
2. Management structure	- Supervised by NSTDA, the government agency	- Managed by HKSTP Corporation.	- A department within the University of Surrey has been granted full authority to operate the Park.
Approaches to IC development in SPs	- Hybrid strategy - The development of IC began in the second phase with government policy shaping the direction and its inherent strengths, such as the readiness of research centres to support private sector enterprises and the number of SP companies affiliated with each cluster	- Top-down strategy and cluster-oriented strategy since inception - Leveraging existing clusters expands into additional potential clusters that can benefit from the resources of the initial cluster. The presence of InnoHK within the HKSTP developed the clusters of Health and Biomedical, and Digital.	- Bottom-up strategy - The IC developed organically. Currently, the SRP targets the Animal Health Cluster due to its strategic location and the existing members. This focus could expedite the acceleration of critical mass in other clusters, enhancing inter-cluster networking. - Initially, social events and seminars enable SP companies to familiarise themselves with academic staff. Subsequent activities then target specific clusters to boost collaboration.
IC development success/ failure	- Food, Agriculture, and Digital clusters: Successfully developed and transitioning to expansion stage. - Autoparts cluster: Development failed due to a lack of government support, and the change of NSTDA policy.	- Health, Biomedical, and Digital clusters: successfully developed in the expansion stage. - Continual development of clusters, focusing on expansion to the GBA for seizing cross-cluster collaboration opportunities, thereby broadening research and commercial networks.	- Human Health and Digital: successfully developed and transitioning to expansion stage. - Current targeting of the Animal Health Cluster, utilising its strategic location and leveraging existing Human Health cluster membership to potentially hasten the achievement of critical mass in other clusters, thereby enhancing inter-cluster networking.

Source: Author

6.1.2 Operational comparison

6.1.2.1 Analysing the Diverse Approaches to Tenant Attraction and Retention

Our study found that the three SPs utilise distinct strategies to attract technology companies. As suggested in the literature review, Koh et al. (2005) discovered that the typical approach amongst Asian SPs is characterised by government-led initiatives. This method demands substantial public investment in advanced R&D infrastructure, with the goal of securing foreign investment, attracting MNCs, and catalysing high-tech economic growth within the country. This strategy aligns with that of the TSP, which has endeavoured to attract MNCs and industry leaders to establish R&D centres within its boundaries to rapidly build a critical mass within the knowledge-based economy. The presence of such companies is anticipated to stimulate participation from local companies.

However, this concept does not fully correspond to the strategy implemented by HKSTP. While HKSTP has committed a considerable budget to build world-class R&D infrastructure and facilities, it diverges by offering direct funding programmes with the goal of luring both local and international potential startups to become members. This approach not only provides R&D infrastructure and advanced equipment but also utilises these startups to attract established, leading companies and MNCs to locate within the Park.

The HKSTP has employed cluster-oriented tactics. Such an approach is designed to enhance the ease and efficiency of internal networking by assembling like-minded individuals within the same setting. Despite the finding from Chan and Lau's study (2005) that startups within the HKSTP did not experience substantial benefits from clustering and networking, this might be attributable to the Park's relative novelty during that period. In their early stage, an SP needs to navigate a period of understanding their tenants' requirements, accumulating knowledge, and establishing a knowledge-sharing system.

Furthermore, building a critical mass by bringing together strategic partners is key (Albahari et al., 2018a). Importantly, during the first phase of HKSTP's development, funding programmes were not provided, and dedicated R&D facilities for specific clusters were yet to be established. However, once the HKSTP began to offer Incubation Programmes and additional innovation services, it was well-positioned to draw both talent and capital, corroborating the findings of Parry (2018).

Although the NSTDA has established a specialised unit, the Business Incubation Center, to cultivate startups, this unit functions independently from the TSP. As a result, the progression of graduated startups to become TSP tenants rarely occurs. This situation might be due to TSP's lack of compelling programmes to support these startups in the next phase, especially when contrasted with HKSTP. To address this issue, TSP could formulate a strategy to promote collaboration between startups and existing TSP companies with the aim of developing an IC and increasing the number of cluster members. This plan could consider the

implementation of virtual offices or co-working spaces and secure funding with the goal of reducing costs and building credibility (Saraceni et al., 2015). This could, in turn, potentially foster future cooperation between startups and TSP tenants (Den Hertog et al., 2001).

The SRP seems to exert minimal strategic efforts in drawing technology-based companies to establish a presence within the Park. However, despite this minimalistic approach, the Park remains fully occupied and continues to experience high demand. This can be described by several advantages it offers, such as a prime location provided at a competitive price, and proximity to a highly skilled workforce sourced from the nearby University and surrounding research and development organisations (Engel, 2015, Yan, 2019). Consequently, the Park has achieved full capacity and sustains persistent high demand.

In the realm of retention strategies, our findings reveal that the SRP adopts a novel approach by providing virtual office spaces. These are tailored for businesses looking to downsize and minimise expenses. The provision of these virtual spaces extends to both existing tenants and new startups or small businesses, offering flexible criteria and bespoke lease agreements. It could be argued that in terms of maintaining a stable income and retaining a consistent number of SP tenants, SRP has achieved more success than the TSP. This success aligns with the objectives outlined in Chapter 4, Section 4.3.1. Consequently, SRP's retention strategy may be feasibly transferable to TSP, potentially assisting in preserving their existing tenant base and sustaining income levels.

We found that the three SPs have each adopted distinct strategies to attract technology companies. TSP employs a government-led approach commonly seen in Asian SPs, emphasising investment in advanced R&D infrastructure to attract MNCs. In contrast, HKSTP differentiates itself by offering direct funding programmes to both local and international startups. SRP, despite a more minimalist strategic approach, has reached full tenant capacity, due to its prime location and competitive costs. Furthermore, SRP has implemented tenant retention strategies, including the provision of virtual office spaces, to accommodate changes in business models or to meet staff demands for remote working—factors particularly relevant in its Digital cluster. This strategy contrasts with TSP, which lacks a tenant retention approach.

6.1.2.2 Building networking with stakeholders

In this section, the approach by which three SPs establish networks with internal and external partners is explored. This study examines the relationships between SP companies and neighbouring businesses, partner institutions in close proximity to the Parks, as well as outside SP and international partners.

Our study provides key insights into strategies for cultivating networking among tenants of the three SPs. Firstly, the importance of networks amongst SP tenants is well recognised by both SP management and tenants across all three SPs. Such networks can foster incremental innovation and reduce costs, a finding that aligns with Diez-Vial and Fernández-Olmos (2017). However, reluctance to exchange knowledge has been observed amongst SP companies due to fears of knowledge outflows. This reluctance may be influenced by the age of the SP companies. Startups tend to have less technical and managerial experience (Lecluyse et al., 2019). This issue was notably observed within the HKSTP, where the majority of SP members are start-ups (Arauzo-Carod et al., 2018).

With a high startup population within the HKSTP, internal communities, SPARK, have found considerable success in encouraging SP members to engage in events and seminars. This encourages interaction and dialogue among tenants. This value was corroborated in interviews with these tenants, with many companies citing their utilisation of this platform to establish connections. In contrast, the Tenant Club @ TSP has experienced less success in comparison to SPARK in terms of event participation. This may be due to the fact that TSP members are typically heterogeneous in size and cluster. Hence, identifying shared interests can pose a significant challenge. This phenomenon aligns with the empirical study conducted by Yan (2019).

Stringent tenant selection criteria in SPs, coupled with a focused cluster strategy, significantly bolster the enhancement of R&D collaborations. This nurturing of communities comprised of like-minded individuals within a shared space engenders an environment favourable to ideation, as well as to the creation, exchange, transformation, and absorption of knowledge (Sala et al., 2011). A compelling exemplar of this is seen in the empirical study of Hsinchu Science Park, where a rigorous tenant selection process, favouring companies exhibiting high growth potential, specifically within the IT cluster, demonstrates substantial impact. This exacting process leads to an augmentation of R&D productivity and galvanises the successful advancement of ICs within the park (Yang et al., 2009).

Regarding the relationships between SP companies and nearby institutions within the three SPs, this study discovered that they recognise the value of collaborating with local R&D organisations and engaging with universities through both formal and informal interactions. However, the nature of these interactions and the challenges faced by tenant companies in each Park vary.

Companies at SRP cultivate relationships with the University of Surrey via strategies encompassing student placements and access to services. This illustrates the concept proposed by Ng et al. (2020a), that the geographical proximity of a university potentially affords SP tenants access to vital research resources and human capital. Conversely, companies within the HKSTP already possess established connections with universities, primarily facilitated through alumni networks and personal contacts. Within the HKSTP framework,

robust relationships have been nurtured with six leading Hong Kong universities, facilitated by governmental mechanisms. These mechanisms have facilitated the creation of the Ideation Programme for university students, allowing participants a fast-track entry into subsequent Incubation Programmes within HKSTP. The HKSAR is demonstrably proactive in catalysing innovation and entrepreneurship, providing funding (Intarakumnerd and Vang, 2006), and promoting connections between various actors (Yan, 2019), including local universities in Hong Kong.

It is observable that the TSP is located near two leading institutions, TU and the AIT. Despite this, the nature of interactions between TSP tenants and these universities appears to embody fragile and intermittent connections. Their collaboration seems to be constrained by project-specific initiatives with limited budgets. This potentially originates from an absence of a shared vision between TSP and its neighbouring universities. Kharabsheh (2012) suggests that a pivotal ingredient to the success of SPs is a common vision amongst stakeholders. This shared vision not only eases the identification of mutual interests and benefits but also aligns the strategic objectives of universities and other involved parties, laying a robust foundation for prospective growth.

Our study agrees that companies within SPs establish relationships with external partners, both at regional and international levels. The primary objective of these companies is to develop and commercialise innovative solutions and products that leverage technology (UNIDO, 2021). To expedite their innovation processes, these companies actively seek collaboration with partners. This is substantiated by our interviews with mature tenants within HKSTP. These mature businesses are actively expanding their operations into markets such as Thailand and mainland China as a part of their commercialisation strategy. However, mature tenants within SRP target relationships with universities in the UK and Europe for R&D collaboration.

This provides a contrast to the objectives of the HKSTP tenants we interviewed. They express interest in forming associations with external, particularly international partners, each with diverse aims. HKSTP startups frequently seek overseas co-investment or funding as a means to ensure their business continuity. Concurrently, TSP tenants, differing from HKSTP occupants, tend to source local partners to support their businesses. These phenomena coincide with an empirical study of SPs in the Netherlands. It unveiled that Dutch SPs accommodate a broad range of technology-based companies, each with multifaceted objectives for location. Consequently, SP management is necessitated to take into consideration these distinct tenant types and tailor their facilities and services to meet the demands of their targeted groups (Ng et al., 2020a). This finding equips SP management with valuable insights to strategically prioritise their relationship-building with stakeholders.

In summary, this section provides an analysis of the networking strategies adopted by three SPs, exploring their engagement with other SP tenants, nearby institutions, and external partners. It highlights the importance all SPs place on fostering relationships, even with varying methods and challenges faced by tenant companies. Notably, the relationships between SP companies and nearby institutions underscore the significant benefits of collaboration, despite each Park presenting distinct interaction dynamics and challenges. Key points include the necessity of initiating collaborative activities and leveraging governmental mechanisms to foster robust connections with diverse stakeholders. Through learning from each other's experiences, SPs can optimise their networking strategies to more effectively support to their tenant in fruitful connections.

6.1.2.3 Innovation Facilitation: Financial Support and Collaborative Initiatives

All three SPs present unique advantages and opportunities for their tenants, each implementing varied approaches to funding and support services. The HKSTP sets itself apart by providing an array of programmes to cater to businesses at different developmental stages (refer to Figure 4.14), spanning from Ideation to Elite programmes. Moreover, members of HKSTP have the advantage of additional growth-stimulating programmes, such as the Research Talent Hub. These funding offerings are regarded as the main reason for locating businesses within the Park (see Figure 4.13). The provision of grants to research and development enterprises can bolster the cyclical growth of startups that catalyse technological innovation. Proper deregulation and incentives for inventive ideas and business models are deemed crucial components of the eco-innovation system (Yan et al., 2018). In the case of HKSTP can affirm this notion.

Both the SRP and TSP provide indirect funding and supplementary services to their respective tenants. Through its affiliation with the University, SRP facilitates access to various funding schemes, such as KTP, student placements, and innovation services. Conversely, TSP enables its tenants to utilise innovation and testing services, as well as financial support, via the NSTDA. Consequently, it may be concluded that SPs can act as intermediaries or conduits through which governmental bodies deliver incentives and financial support to enterprises. By establishing a collaborative platform and nurturing knowledge exchange, SPs can expedite the allocation of governmental resources, encompassing both budgetary contributions and market channels, to technology businesses (Herliana, 2015, The Economist Intelligence Unit, 2016).

Despite the divergences in their funding strategies, all three SPs share common goals and objectives: the promotion of innovation, the fostering of collaboration, and the bolstering of their tenants. Each Park acts as a conduit, orchestrating connections between tenant companies and the academic sphere, hence facilitating access to expertise, resources, and financial backing. Moreover, these Parks are committed to nurturing their tenant companies through innovation services, which encompass incubation programmes and tailored support

for diverse business stages. In consequence, these Parks make a substantial contribution to the expansion of the technology and innovation sectors within their respective regions. Given these points, it can be affirmed that our observations regarding the roles of SPs are in concordance with the scholarly literature (Henriques et al., 2018, Yan, 2019, Lecluyse and Knockaert, 2020).

Based on the unique offerings of innovation services and funding of the three SPs, there are several key lessons and potential transferrable approaches that other SPs can adopt to effectively support their tenants and foster innovation. Firstly, SPs proactively seek out opportunities to forge engagements with potential partners, a strategic move that yields benefits for the Parks themselves, as well as their members and tenants (Sala et al., 2011). Concurrently, they maintain enduring connections with stakeholders, particularly HEIs and R&D institutions. These organisations emerge as pivotal sources of new knowledge, facilitating sharing and transferring of this knowledge (Yang and Lee, 2021, Etzkowitz and Zhou, 2018) and the pooling of talented individuals (Diez-Vial and Fernández-Olmos, 2017). Consequently, the cultivation of such a robust network strengthens the capabilities of SPs (Yan, 2020, Phongthiya et al., 2021).

In the instance of HKSTP, it maintains robust relationships with six leading local science and technology universities. This connection is facilitated by government funding policy mechanisms. The Chinese University of Hong Kong, for example, established the Pre-Incubation Centre with the purpose of nurturing potential students into startup entrepreneurs. This Centre collaborates closely with HKSTP. Upon completion of their courses, teams are offered the opportunity to continue with support further programmes through either HKSTP or Cyberport, another SP with a focus on fintech. These SPs provide eligibility for a fast-tracked interview process.

Secondly, by proffering a diverse array of services — which may include incubation programmes, accelerators, and tailored support at various business stages — SPs can cater to the fluctuating needs of tenant companies, thereby assisting them in navigating an array of challenges. This assertion aligns with the findings of Poonjan and Tanner (2020), as well as Minguillo and Thelwall (2015), who highlight the efficacy of diverse support mechanisms within SPs.

Thirdly, it is important to furnish tenant companies with both direct and indirect funding opportunities to guarantee access to the financial resources for growth and expansion. This can be realised via a strategic combination of direct investment, grant schemes, and facilitating connections of tenant companies to external funding sources. Such an approach has been effectively underscored in the work of Herliana (2015) and Veselovsky et al.(2015).

SETsquared@Surrey, for instance, has established the S100 Club. This club operates as a non-profit organisation, its primary focus being to construct a robust and interconnected network of investors, whilst also facilitating introductions of startups to the investment

community. SP tenants, upon becoming members of the S100 Club, are granted access to participate in club events. Among these, a key feature is the matchmaking service, designed to foster connections between investors and member startups. Furthermore, SRP management actively encourages their tenants to join this Club.

Lastly, cultivating an environment that fosters collaboration and networking both internally amongst SPs and with external partners is of vital importance (Boschma and Frenken, 2009). Such an environment can facilitate tenants in establishing robust relationships and expanding their reach within the industry (Poonjan and Tanner, 2020, UNIDO, 2021). In this respect, all three SPs leverage both organisational and geographical proximity to foster collaboration. The HKSTP and SRP, both in close proximity to universities, enjoy mutual benefits, such as joint research initiatives and student placement opportunities. In contrast, TSP benefits from the presence of five national research centres within its boundaries. In the context of these proximities, our findings affirm the study by Shivakumar (2021).

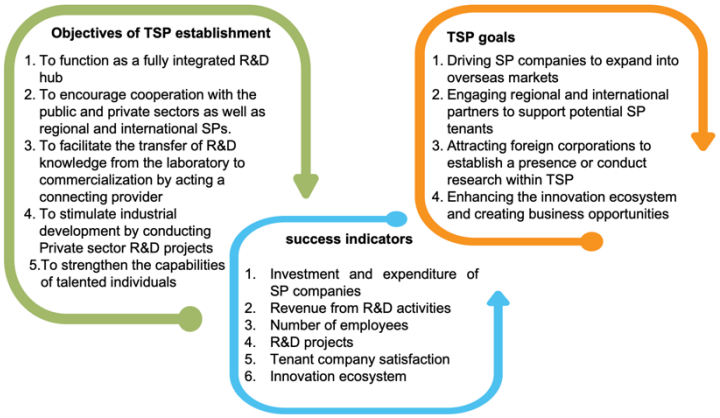
In summary, this section analyses the funding strategies and collaborative frameworks of three Each SP employs unique funding mechanisms and support services to foster innovation and development within their tenant organisations. The HKSTP, for instance, offers numerous growth-stimulating programmes catering to businesses at different developmental stages. Meanwhile, both SRP and TSP extend indirect funding and supplementary services to their tenants, with each Park benefiting from its distinct geographical and organisational proximity to other institutions. Despite differences in funding strategies, all SPs share common goals of promoting innovation, fostering collaboration, and supporting their tenants. They achieve these objectives by maintaining connections with stakeholders, offering a diverse range of services, and providing both direct and indirect funding opportunities. In light of this, our findings resonate with the scholarly literature, suggesting that the key to SPs' success lies in fostering robust networks, curating a conducive environment for collaboration and networking, and proactively seeking beneficial partnerships.

6.1.2.4 Performance Indicators in Science Parks: A Comparative Overview

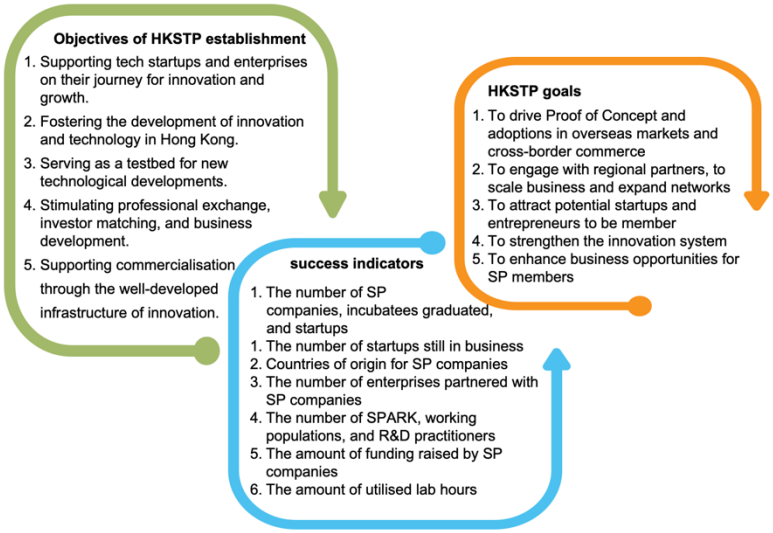
Assessing the performance of SPs presents a challenge due to their diverse goals and objectives. For a meaningful evaluation of their success, it is vital to identify and align the primary goals for each park. Following this alignment, their achievements can be measured against these agreed objectives using relevant performance indicators (Dabrowska, 2016). Evaluating the performance of SPs can be complex due to their individual goals and objectives. In a comparative analysis of the three SPs, it is crucial to clearly identify and align the objectives of each park. Once these objectives are established, they can be compared with the specific performance indicators that each SP employs.

Figure 6. 2: The objectives of the Science Parks, goals and indicators amongst three Science Parks

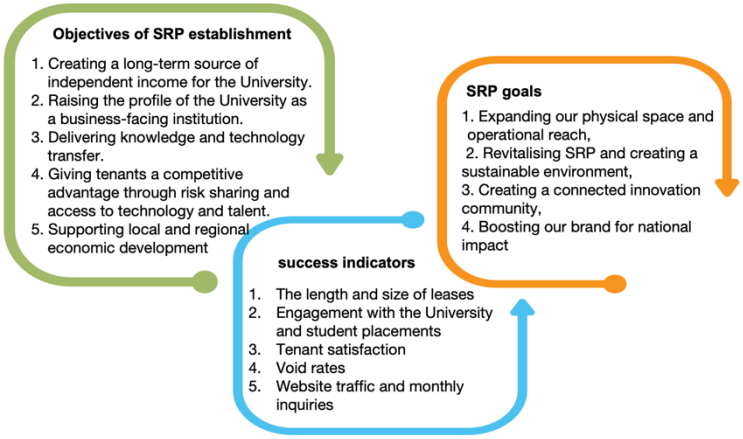
Thailand Science Park:



Hong Kong Science and Technology Park:



Surrey Research Park:



Source: Author

Figure 6.2 illustrates the objectives of SP establishment, goals, and success indicators. TSP focuses on R&D integration, international cooperation, development of local enterprises, and talent strengthening of SP members, with goals on market expansion and ecosystem enhancement. SRP concentrates on income generation, university collaboration, and regional development, with goals and indicators centred on expansion, sustainability, and tenant satisfaction. HKSTP, on the other hand, prioritises support for startups and tech companies, fostering innovation, professional exchange, and commercialisation, with goals emphasising market engagement, startup attraction, and system strengthening.

It can be seen that SRP focus on financial indicators such as void rates, and the length and size of leases, whilst TSP emphasises pushing investment in R&D within the Park to bolster the tenants' potential for expanding to the global market. Concurrently, HKSTP prioritises indicators related to the number of graduated incubatees and startups that are still in business. Moreover, this reflects an emphasis on building networks within the SP, as evidenced by the specific indicator regarding the number of members in SPARK, a feature that is not present in other SPs, despite their claims of its importance.

Alternatively, as explained in Section 2.1.7, we examined the success indicators that scholars have endeavoured to utilise in assessing SP performance. In our comparative analysis, we shall amalgamate the aforementioned success factors and apply them to the primary indicators employed by the UKSPA. Significantly, the UKSPA categorises the performance of SPs into two distinct elements: *'Economic Performance'* and *'Innovation and Technology Commercialisation Performance of SP Companies'.*

According to the UKSPA, SP performance is classified into two distinct categories: Economic Performance and Innovation and Technology Commercialisation Performance (see Section 2.1.7).

Economic Performance Indicators encompass various factors, such as the number of employees, revenue, turnover rate, and access to finance among companies. These indicators align with the SP performance indicator classification proposed by Yan et al. (2018), which categorises them under *'SP performance.'* However, they also use additional factors that have been considered in the academic literature, such as enhanced collaboration between SP tenants and local R&D institutions, the number of SP companies (Kharabsheh, 2012, Vásquez-Urriago et al., 2016), the age of the SP (Albahari et al., 2018a), and increased innovation activities (Albahari et al., 2013a).

Upon analysing the application of these indicators across the three SPs, distinct measurement approaches capturing various aspects of economic performance become evident. Both TSP and HKSTP consider employee numbers while also placing significant emphasis on revenues derived from R&D activities. HKSTP demonstrates a more comprehensive approach by measuring the number of startups supported, separate from overall SP members. It is remarkable that HKSTP has monitored the percentage of graduated

incubatees still in business. This holistic assessment allows HKSTP to track the development and commercialisation of technology within the Park effectively. Conversely, SRP shares common indicators with both TSP and HKSTP. Notably, SRP shows unique indicators not found in the literature, such as void rates, website traffic, and monthly inquiries. Of particular significance is SRP's keen concern and monitoring of void rates indicators, signifying their commitment to securing revenue generation, particularly from rental fees, which are obligated to be returned to the University.

Innovation and Technology Commercialisation Performance Indicators encompass new products or services launched (sales growth), the number of patents (Squicciarini, 2009, Phan et al., 2016, Arauzo-Carod et al., 2018), and the intensity of R&D investment, as R&D expenditure (Albahari et al., 2018a). Yan et al.(2018) also defines these indicators as benchmarks for SP company performance, positing that they not only reflect the overall success of SPs but also enhance their reputation.

In adapting these indicators to our comparative case study, the HKSTP adopts a broader perspective. It measures both the amount of funding raised by SP companies and the number of enterprises collaborating with these companies. Such variables suggest that HKSTP prioritises assessing the quality of collaboration between SP companies and their stakeholders. Conversely, the SRP appears to place greater emphasis on engagement with the University and student placements. This is indicative of SRP's strategy of fostering connections between SP companies and the University, rather than cultivating diverse partnerships. Meanwhile, the TSP places on R&D activities and the number of R&D projects.

Table 6. 2: Key Performance Indicators for Assessing SP Performance

	Key Performance Indicators
Thailand Science Park	1. R&D investment and expenditure, 2. Revenue from R&D activities, 3. Number of tenant employees, 4. Number of R&D projects, 5. Tenant company satisfaction, and 6. Innovation ecosystem
Surrey Research Park	1. revenue, costs and profit, 2. Void rates, 3. Length and size of leases, 4. Enquiries per month, 5. Tenant satisfaction, 6. Spend with the University and student placement, and 7. Website traffic
Hong Kong Science and Technology Park	1. Number of Companies and employees, 2. Number of incubatees graduated in Incubation Programmes and percentage of graduated incubatees still in business, 3. Number of startups supported, 4. Number of countries of origin for Park companies, 5. Amount of funding raised by SP companies, 6. Number of SPARK members, and 7. Amount of utilised lab hours and occupied office space

Source: Author

However, it is noteworthy that both TSP and HKSTP have employed a cluster-oriented strategy, but they do not have any indicators to assess the success of each cluster's development. In order to align with strategies, TSP and HKSTP could consider additional indicators to evaluate their cluster development, such as R&D projects classified by clusters, the number of cluster members and SP tenants, and the amount of funding raised in each cluster. There are potential lessons and transferable practices that SRP can learn from the other two SPs. SRP could set indicators for SP contribution to SP tenants, such as the number of R&D projects on which it collaborates with the University.

In the comparative analysis of three distinct SPs, the section outlines the varied approaches to assessing performance based on Economic Performance and Innovation and Technology Commercialisation Performance. HKSTP is observed to employ a comprehensive evaluation of collaboration quality, SRP emphasises university engagement and unique indicators like void rates, while TSP focuses on R&D activities. Noteworthy is the cluster-oriented strategy of TSP and HKSTP, a practice from which SRP could potentially draw lessons. The transferable learning among the three SPs encompasses the alignment of performance metrics with strategic objectives, the utilisation of distinct measurement approaches that reflect each SP's unique focus, and the need for continuous development and refinement of indicators, such as those relating to cluster development. The section underscores the complexity of evaluating SPs due to their diverse goals.

6.1.3 Advantages and disadvantages of innovation policy and natural advantages of the three Science Parks

In this section, a critical analysis of the policy and natural aspects of the three SPs will be conducted. This analysis aims to provide insights into the advantages and disadvantages of these aspects while identifying best practices that can be applied to other SPs. SRP, TSP, and HKSTP are renowned for their contributions to innovation and technological advancement within their respective regions. Evaluating their innovation policies and natural aspects, such as location, infrastructure, and access to resources for R&D and commercialisation, is crucial for understanding the roles of each SP in enhancing growth opportunities.

6.1.3.1 Innovation policies

The role of the government is to formulate policy and provide initial investment (UNIDO, 2021). Yan (2019)'s study emphasises that governments can catalyse innovation and entrepreneurship by crafting innovation policies that incentivise and foster connections among various stakeholders. Correspondingly, Poonjan and Tanner (2020) found that governments invest heavily in the construction of high-class infrastructure and offer specific incentives to bolster potential for economic growth and competitiveness. The results of our study align with these findings from the literature; in our case studies, the governments of each country encourage innovation through policies and funding. These are employed as primary mechanisms to support the growth of entrepreneurs, although the approaches vary.

The HKSAR enjoys the advantages of robust policies, substantial financial backing, and steadfast support from mainland China, thereby fostering knowledge exchange and business expansion (Pun, 2021). The government directly channels funding into SPs and HEIs (Chan, 2021). In contrast, our study found that the United Kingdom government lacks specialised funding schemes for SPs. In the future, the initiation of 'place-based' funding mechanisms by the UK government could potentially accelerate the growth of SPs within the country.

Beyond the financial assistance provided by the NSTDA to TSP's members, nine additional R&D funding agencies extend support both to TSP tenants and to other local technology entrepreneurs (Anusardsittikit, 2021). This stands in contrast to the HKSAR, which has specific programmes tailored exclusively for HKSTP startups. The overlapping functions of Thailand's multiple funding entities may engender confusion among technology companies concerning the distinct roles and criteria set by these agencies (Puncreobutr, 2017). Such ambiguity has led Thai companies to perceive government funding as difficult to access, thereby diminishing enthusiasm for investment in R&D within the private sector (Arwutpunyakun, 2022).

In the realm of innovation policies, the Thai government could learn from Hong Kong to enhance TSP's performance, such as by offering direct funding. However, since innovation policies are formulated by policymakers, compelling the government to allocate a direct budget to the Park or TSP companies poses a challenge. Initially, TSP, acting as an intermediary linking anchor players to promote technology, improve products and processes, and provide access to financial support to mitigate the risks and costs of innovation processes (Díez-Vial and Montoro-Sánchez, 2016), could work on clarifying the roles and criteria of its various R&D entities to simplify navigation for tech companies. The Thai government could also learn from the clear and practical success of the Republic of Serbia in terms of budget allocation, disbursement rules, and criteria for project assessment. Such action could enhance the value of ICs and attract more players (Varga et al., 2013) to SPs.

6.1.3.2 Location and the provision of research and development infrastructure

SPs are viewed as vital physical infrastructures principally facilitating knowledge-related activities and providing support for co-located companies (Ng et al., 2017). Their infrastructure cultivates an environment conducive to R&D activities and offers co-located companies administrative, management, or technological services (Salvador et al., 2013, Minguillo and Thelwall, 2015).

Strategic location is recognised as a critical factor in the establishment of SPs (Ng et al., 2017). Findings indicate that all three SPs implement distinct strategies. Particularly, HKSTP, with its seven associated Innovation Campuses, showcases a diverse and comprehensive approach towards fostering innovation, technology development, and commercialisation within the region (Hong Kong Science and Technology Park Corporation,

2021). The dispersion of facilities across Hong Kong caters to a variety of industries and fosters effective collaboration among different sectors, academia, and both local and international business communities.

The geographical dispersion of these campuses may present challenges in terms of seamless collaboration. To address this issue, the SPARK community was established, enabling people from all campuses to participate collectively (Chan, 2021). Additionally, the success of the Hong Kong-Shenzhen Innovation and Technology Park in attracting top talent and companies globally remains uncertain. With its first phase anticipated to launch in 2024, monitoring its development and evaluating its impact on the region's innovation landscape is essential.

A key insight underscores the importance of catering to industry-specific needs and tailoring innovation campus development accordingly. This is evident in how HKSTP's various campuses are designed to offer specialised support and services to different industries. For instance, Innocentre has been specifically established to advance fintech, as well as innovation in AI and blockchain (Hong Kong Science and Technology Parks Corporation, 2022a). HKSTP further exhibits its commitment to fostering innovation through state-of-the-art R&D infrastructure and dedicated R&D centres, which align with InnoHK's focus clusters. These include the Robotics Catalysing Centre, the AI Plug, and the AI Laboratory, all established in 2019 (INNOHK, 2022, Chan, 2021). Notably, two clusters—AI and Robotics, and Biomedical—are located within HKSTP. These clusters serve as attracting top minds from universities and scientific research institutions around the world. Experts convene in these areas, working in a cluster-oriented approach that encourages collaborative research (INNOHK, 2022).

In contrast, SRP benefits from its advantageous location, offering convenient commuting options (refer to Figure 6.3) and reasonable rental prices. While the Park provides basic R&D infrastructure, tenants benefit from its close proximity to the University and surrounding health institutes, which allows access to advanced equipment (Bourhill, 2021a). Consequently, SRPs are in high demand among technology businesses and become fully occupied over time (Bourhill, 2022a, Riches, 2022).

TSP was established in a previously underdeveloped area north of Bangkok, in close proximity to two leading universities. This location was chosen reflecting the government's aspiration to bring prosperity to the region (Thailand Development Research Institute, 2015). The Park has the potential for knowledge sharing (Bunnag, 2020) and offers an opportunity to commercialise products in the adjacent industrial parks. However, the relationships between TSP and the universities have been primarily shaped by a top-down policy, formalised through the signing of MOUs, rather than evolving organically due to geographical proximity. Despite regular meetings, they have been unable to identify mutual benefits due to the divergent expectations between researchers within TSP and the hospital's needs (Junthong, 2022). This

finding challenges Rowe's assertion (2013) that closer proximity to universities fosters stronger connections between park members and the universities.

In response to their challenges, TSP could adopt the collaborative approaches used by HKSTP and SRP, particularly their partnerships with universities. The successful cooperation between Hong Kong universities and HKSTP, facilitated by government funding mechanisms, serves as an inspiring example. These mechanisms encourage student startups, nurture their growth, and aid their transition into mature businesses within HKSTP through supportive programmes (Pun, 2021). These strategies provide a robust roadmap for potential startups, demonstrating a strong governmental commitment to entrepreneurship.

Alternatively, the Thai government could implement incentive schemes for companies located within the industrial parks, encouraging them to conduct their R&D within TSP. TSP management could facilitate collaborations and business expansion opportunities between local SP companies and larger entities in the industrial park. Furthermore, TSP might develop a comprehensive directory of its tenants and post their requirements on university platforms (Fletcher, 2021). This directory, a list of all companies based in TSP, would parallel the strategy employed by SRP, where companies draw on the potential of students for collaborative research through student placements.

In summary, the strategic location and robust infrastructure of SPs play critical roles in promoting knowledge-related activities and supporting co-located companies. The strategies employed by the three SPs each highlight unique methods. HKSTP's model, with its diverse innovation campuses and the SPARK community, exemplifies a comprehensive approach that caters to a variety of industries and fosters effective collaboration. SRP capitalises on its prime location and close proximity to the institutions, creating an environment for technology businesses. TSP, located near two leading universities and industrial parks, has significant potential for knowledge sharing and commercialisation.

Despite challenges in building relationships with adjacent institutions, TSP can draw inspiration from the HKSTP and SRP, particularly in relation to university partnerships. Furthermore, government-backed incentives, tenant directories, and facilitated collaborations are strategies that can enhance the role of TSP as a hub for R&D and commercial activities.

6.2 Conclusion

This study has critically analysed the strategic, operational, and innovation policy aspects of three SPs - SRP, TSP, and HKSTP - to gain insights into their advantages and disadvantages, as well as identify best practices for other parks.

In terms of strategy, the SPs exhibit distinct approaches to IC development, management structures, and goals. HKSTP implements a top-down strategy and exhibits adaptability, SRP adopts a bottom-up approach and operates within the university structure,

and TSP follows a hybrid approach with bureaucratic management and inherent strengths. These diverse tactics reflect the unique regional context and objectives of each park.

Operationally, SPs utilise distinct strategies to attract tenants, as well as to offer benefits. The HKSTP, for instance, directly provides Incubation and Ideation Programmes to its members. In contrast, the SRP capitalises on its advantageous location and leverages innovation services from the University of Surrey to entice technology companies to become members. Unlike HKSTP and SRP, the TSP employs a different tactic: it attracts international companies by offering a range of incentives and privileges, as well as access to skilled researchers at its five national research centres. Additionally, TSP benefits from the presence of large and international companies among its tenants, which serves to attract local firms. This attraction stems from the local companies' expectation of forging business connections with these industry leaders.

In terms of innovation policy and natural aspects, the SPs demonstrate varying degrees of success due to their innovation policies, locations, and infrastructure. HKSAR and England benefit from strong policies and support, while Thailand struggles with inconsistent policies and fragmented collaboration. Strategic location is crucial for SPs, with HKSTP employing a diverse approach, SRP capitalising on its advantageous location, and TSP situated in an underdeveloped area, as the government aims to utilise TSP as a tool to enhance the economic development of Thailand.

However, all three SPs can learn from each other to improve their overall performance and contribution to regional and global technology and innovation sectors. Key areas of learning include:

Collaboration and partnerships, TSP can strengthen its connections with nearby universities and organisations by adopting HKSTP's strategy of fostering collaboration. This involves initiating ideation projects at local universities, transferring graduates to TSP, and providing a startup grooming mechanism to support their growth.

Innovation policy, Thailand's policymakers could learn from the robust policy frameworks and support systems in HKSAR and England to enhance their own innovation ecosystem. By adopting a more cooperative strategy and addressing existing challenges, significant improvements could be achieved. For instance, pushing for a linkage of funding programs from upstream to downstream could groom graduate students into mature global companies. This approach has been seen in HKSAR's development and joint funding programs, which extend from universities to SPs.

Chapter 7: Conclusion

This concluding chapter synthesises the findings of our comprehensive study on *'The Roles of Science Parks in Supporting the Development of Innovation Clusters.'* Throughout this research, we have delved into how SPs in developing countries, with a specific focus on Thailand, contrast with those in more developed economies in fostering sustainable ICs. The chapter will highlight the key insights derived from addressing our three central research questions, which have guided this investigation from its inception. These questions explored the strategic approaches of SPs in developing long-lasting ICs, the management of R&D infrastructure, services, and networking in support of IC development, and the critical elements SPs could focus on in their strategy for the development of ICs, along with the support from policymakers and stakeholders.

Firstly, this chapter summarises the research findings that answer the three research questions proposed in Chapter 1. Next, the theoretical contribution of this study is clarified. Finally, this chapter points out the limitations associated with the research and provides some suggestions for future research.

7.1 Addressing research questions

RQ1. How do science parks in developing countries, as compared to science parks in more developed economies, currently seek to develop long-lasting innovation clusters?

SPs in developing countries, such as Thailand, adopt approaches distinct from those in more developed economies when developing long-lasting ICs. As highlighted in Chapter 2, Section 2.2.2 of our study, Asian governments are proactive in establishing and nurturing ICs. (Intarakumnerd and Vang, 2006). For, example, the Thai government's establishment of Food Innopolis, a hub designed to stimulate innovation in the food and agriculture sectors.

The study's findings suggest that developing countries often encounter several barriers. One primary barrier is a bureaucratic governance structure. TSP, managed by a government agency, is characterised by multiple layers and complex decision-making protocols. Learning from the HKSTP could be advantageous, where the government-initiated HKSTPC manages the Park with a more flexible approach, despite its similar inception by the initiation of government as seen with TSP.

Cultural barriers present challenges in managing trust and sharing benefits among tenant companies, which a culture of openness could alleviate. Lessons from the HKSTP demonstrate the benefits of fostering collaboration between startups and existing SP companies by providing shared spaces such as virtual offices or co-working areas and arranging social events under the SPARK. These actions enable tenants to share mutual interests and work together more effectively.

Furthermore, integration issues amongst key players and overlapping work among R&D agencies are significant barriers in developing countries. To overcome these, they could improve communication within clusters and utilise their network to develop clusters. Learning from SRP's Animal Health cluster, for example, in the case of TSP, could develop its Health cluster by fostering cross-collaboration with related clusters, leading to interdisciplinary innovations and comprehensive health sector solutions.

Moreover, SPs in developing countries could look to the HKSTP's model of establishing robust partnerships with universities and encouraging student involvement in R&D activities, which can significantly enhance innovation. Building engagement among key stakeholders within clusters is critical. The Prince of Songkla University Science Park (Jacobsen et al., 2022), as explored in Section 2.2.7 of the literature review chapter, exemplifies how targeted development of clusters can be achieved by nurturing inter-sector connections and forging links with external actors.

Additionally, SPs could implement strategic development approaches and performance indicators (Ylinenpää, 2001, Wang et al., 2017), as illustrated in Table 2.2. This includes drawing in temporary members such as external businesses, researchers from other R&D institutions, and potential partners related to the park's focus areas. This strategy is alongside an emphasis on existing tenant companies and the maintenance of strong local and international networks. Such an approach ensures a balanced emphasis on both new and established relationships within the SP ecosystem and linkage with the outside one for the fruitful SP ecosystem.

Continuity of cluster development policy is critical. Consistency of policies and stakeholder contributions to enhance management practices has been identified as vital for the success of ICs. Government support in improving products and services for cluster members, the allocation of inter-budgetary subsidies, and the integration of cluster development activities into federal programmes are key.

In conclusion, this study sheds light on the unique strategies employed by SPs in developing countries like Thailand for supporting long-lasting ICs, distinguishing them from approaches in more developed economies. Key findings reveal that bureaucratic governance and cultural barriers are significant challenges, with strategies from the HKSTP offering valuable lessons in flexibility and collaboration. The study underscores the importance of cross-collaboration from the lesson learned of the SRP. Furthermore, it highlights the necessity of balanced stakeholder relationships within the SP ecosystem, alongside consistent policy and government support, as vital for the long-term success and sustainability of ICs in developing context.

RQ2 How do science parks in developing countries manage research and development infrastructure, services, and networking in support of innovation cluster development?

The examination of TSP, HKSTP, and SRP reveals diverse approaches to managing R&D infrastructure, services, and networking in support of IC development in developing countries. Each park demonstrates unique strategies tailored to its regional context and resources.

TSP and HKSTP focus on providing advanced R&D infrastructure, including state-of-the-art equipment and extensive facility management. This approach is instrumental in attracting both local and international companies, indicating a trend where infrastructure quality is a significant draw for SPs in developing regions. However, the effectiveness of this approach in fostering deep, innovative research versus simply attracting established companies merits further investigation.

In contrast, SRP's strategy of offering physical space with flexible rental terms suggests a different approach, potentially more accessible to startups and spin-offs. This indicates a nuanced understanding of the varying needs of companies at different stages of development. SRP's focus on leveraging its geographical location and ties with the University of Surrey for networking and service provision reflects a resource-efficient strategy, possibly more suitable for SPs with limited initial investment capabilities.

The services provided by these SPs highlight a range of support mechanisms. TSP's role as an intermediary in securing funding and HKSTP's provision of direct funding and operational support cater to different stages of company development. The diversity in service offerings across these SPs illustrates the need for a multifaceted approach in supporting IC development, a crucial consideration for SPs in developing countries where resource allocation must be strategic and targeted.

Networking activities are central to all three SPs, with each leveraging local and international networks to varying degrees. The emphasis on different target groups for networking activities among these SPs points to the importance of contextualising networking strategies to the specific strengths and goals of each SP. For instance, TSP and HKSTP's focus on a wide range of stakeholders, compared to SRP's more localised approach, may reflect differences in their operational scale and objectives.

The collaboration between TSP and HKSTP, as evidenced by their MOU, presents an interesting case of inter-SP cooperation. This could be a model for other SPs in developing countries to enhance their capabilities through shared resources and knowledge. Furthermore, TSP's proximity to leading universities suggests untapped potential for closer academia-industry collaboration, a common challenge in many developing countries.

To contribute more critically to the discussion on SPs in developing countries, it would be beneficial to explore how these strategies address specific challenges faced in these contexts, such as limited funding, the need for skill development, and the integration of local industries into the global innovation network. Additionally, examining the long-term impact of these SPs on their respective innovation ecosystems would provide deeper insights into their effectiveness and areas for improvement.

In conclusion, while TSP, HKSTP, and SRP each contribute significantly to IC development, their varied approaches reflect the diverse needs and contexts of SPs in developing countries. Understanding these differences, and the specific challenges they address or fail to address is crucial for developing comprehensive strategies to support R&D infrastructure, services, and networking in these regions.

Table 7. 1: Overview of research and development infrastructure, innovation services, and innovation cluster development support among the three Science Parks

SPs	R&D infrastructure	Innovation services	Networking in support IC development
TSP	1. Provides a fully equipped R&D infrastructure, including advanced R&D equipment, testing, and standardisation labs. 2. Attracts large local and international companies to the Park through its comprehensive R&D infrastructure.	1. Facilitates SP tenants' access to innovation service from NSTDA. 2. Develops service platforms for SP tenants to access services from other places. 3. Acts as an intermediary to facilitate indirect funding for members through existing networks and funding organisations.	1. Encourages SP tenants to establish connections with researcher within the Park and partners. 2. Strengthens individual clusters by leveraging existing networks. 3. Expands its networks both locally and internationally to foster SP companies in scaling up and overseas markets. 4. Promotes knowledge sharing within the Park
HKSTP	1. Provides R&D infrastructure and advanced equipment to SP companies. 2. Manages an extensive range of facilities for all campuses to support technology companies, from upstream to downstream.	1. Provides direct funding to companies in the Park and financial support. 2. Provides full-time researchers and engineers to support their members 3. Offers a wide range of program support for SP members at different stages.	1. Acts as a bridge, connecting stakeholders with SP members. 2. Builds opportunities for startups and small businesses to engage with large regional and foreign companies. 3.Strengthens collaboration and knowledge sharing among startups and academic institutions. 4. Expands networking to drive the clusters,
SRP	1. Provides physical space to accommodate tech businesses, startups, and spin-offs. 2. Offers an acceptable rental price and flexible rental agreements to serve tenant needs. 3. Expands to accommodate new tech companies and meet the expansion space requirements of existing tenants by constructing and renovating certain buildings for tech companies.	1. Offers a virtual office model, allowing increase credibility of tech companies, provides access to R&D services, PR news, and funding for virtual companies. 2. Facilitates the provision of student placements to SP companies. 3. Acts as a liaison between SP companies and the University of Surrey, thereby facilitating their access to other services from the University.	1. Promotes networking among internal and external stakeholders, particularly with local universities and government. 2. Tenants are actively engaged in joint research projects with universities in the UK and Europe. 3. Recognises potential for cross-cluster collaboration and development between the existing clusters and newly emerged ones.

Source: Author

RQ3 What key elements should such Science Parks focus on in their strategy for the development of innovation clusters, and where do they need support from policymakers and stakeholders?

Our study found that the development of ICs within SPs in developing countries necessitates a multifaceted approach, focusing on several key elements and requiring robust support from policymakers and stakeholders. This approach encompasses fostering interactions, establishing robust stakeholder interconnections, adopting public-private partnerships, and promoting cross-cluster collaboration. Additionally, the role of policymakers in providing R&D infrastructure, innovation services, and financial support is pivotal.

Fostering Interactions and Stakeholder Interconnections:

SPs could prioritise creating environments that encourage regular face-to-face interactions, like the HKSTP's SPARK programme. Policymakers could facilitate this by funding social events and seminars, while stakeholders, particularly from academia, can actively participate.

Building robust interconnections within clusters reduces transaction costs and enhances competitiveness. Policymakers can streamline regulatory processes to ease these interactions and create platforms for stakeholder engagement. The private sector's active involvement is also crucial in providing market insights and driving innovation.

Adopting Public-Private Partnerships and Cross-Cluster Collaboration:

Public-private partnership frameworks are essential for equitable risk distribution and innovation stimulation. Policymakers could create conducive policies for such partnerships, drawing inspiration from models like InnoHK, as discussed in Chapter 4, Section 4.2.2. Stakeholders from academia and industry need to collaborate, leveraging their unique strengths.

Cross-cluster collaboration could lead to interdisciplinary innovations. Policymakers could develop regulations and incentives to facilitate such collaborations. Stakeholders could be encouraged to engage in cross-disciplinary activities for innovative advancements.

Provision of research and development Infrastructure and Innovation Services:

Policymakers could invest in advanced R&D infrastructure, subsidise access to advanced equipment, develop technology hubs, and foster university-industry partnerships. These initiatives create a solid foundation for SPs to thrive.

Supporting incubators, accelerators, and skill development programs are essential. Policymakers could also encourage knowledge transfer networks to facilitate the flow of ideas and innovations.

Financial Support and Policy Framework:

Establishing grants, funding programs, and tax incentives specifically targeted at startups and SMEs within SPs is crucial. Facilitating access to venture capital and encouraging public-private partnerships could lead to sustainable financial models. Simplifying regulatory procedures,

protecting IP, and facilitating international collaborations are vital policy areas where policymakers can significantly contribute.

By focusing on these elements, policymakers could create a thriving ecosystem for ICs in SPs in developing countries. SPs need to strategically plan and execute these elements, with substantial support from policymakers and stakeholders. The integration and effective implementation of these strategies, coupled with adaptability, innovation, and collaboration, are key to the successful development of ICs in the dynamic landscape of developing countries' SPs.

7.2 The Contribution of study

This research significantly enhances our understanding of the roles SPs play in supporting the development of ICs, particularly with a focus on developing countries. A standout feature of this study is the detailed comparative analysis conducted by it, contrasting the strategic approaches of SPs in developing nations, such as Thailand, with those in more advanced economies. This comparison of SPs in developing and advanced economies is crucial in explaining the unique challenges and administrative models that shape SP operations within the diverse landscapes of the knowledge-based economy.

The research delves into the cultural barriers and integration issues prevalent within SPs in developing countries. It discusses strategies adopted by entities like the HKSTP to overcome these hurdles, thereby offering practical solutions to encourage collaboration and shared spaces among tenant companies.

A critical aspect of this study involves exploring the various methods employed by SPs such as TSP, HKSTP, and SRP in managing R&D infrastructure, services, and networking. The findings highlight the importance of implementing multifaceted, context-specific strategies for R&D management, thereby making a significant contribution to the operational knowledge of SPs worldwide.

The importance of public-private partnerships and cross-cluster collaborations is another key focus of this study. Examining models like InnoHK provides insights into how these collaborative efforts can be effectively utilised in developing countries to boost innovation and competitiveness.

The research also contributes to strategic management discussions within SPs by underscoring the significance of aligning performance indicators with SP goals and the necessity of rigorous tenant selection. These insights are particularly invaluable for SPs striving to develop operational strategies.

Furthermore, the study reveals the ongoing evolution required in the infrastructural provisions, innovation services, and networking opportunities offered by SPs. It underscores the role of comprehensive innovation support, a skilled workforce, and government initiatives in creating conducive business environments.

A notable aspect of the research is its emphasis on the crucial role played by SP management teams. It highlights how these teams are instrumental in facilitating interactions within the SP ecosystem and also play a vital role in fostering regional collaboration and robust industry-academia relationships.

The research also offers valuable insights into the strategic decision-making process regarding the adoption of a focused-cluster or a non-specific approach in SP management. This analysis is crucial in understanding the impact of such strategic decisions on the efficiency and success of SPs.

In conclusion, this research makes a profound contribution to the field of SP development. It provides an understanding of the strategies, challenges, and operational dynamics within SPs in developing countries. The study offers practical guidelines and strategic insights for SP management, policy formulation, and stakeholder engagement, thereby enriching the academic discourse on the development and management of ICs within the evolving landscape of developing economies.

7.3 Limitations

This study offers important insights into the roles that TSP, SRP, and HKSTP play in the growth of ICs. Nevertheless, there are a few limitations. First, the most notable one is related to the selection criteria for the SPs (see Table 3.2). Because the research focuses on specific SPs that meet these criteria, the results might not apply to all SPs. This means the findings may not fully represent the broad diversity of SPs globally.

Second, this research provides a view of SPs' operations and strategies at a certain point in time. This approach may not fully capture the dynamic and evolving nature of these entities, potentially causing the study to inadequately reflect the continuous strategic adaptations of SPs.

Third, due to time constraints and the limited number of SPs analysed in this study, the depth and breadth of the research were inevitably affected. This factor may limit the broader comprehension that could have been attained from a study involving a larger variety of SPs or a more detailed, longitudinal approach.

Lastly, this research highlights the need for in-depth insights, such as examining the roles of SPs within regional contexts similar to TSP. However, this area remains unexplored in this study, which presents a limitation.

Despite these limitations, this study meaningfully contributes to the existing body of knowledge on IC development within SPs. It establishes a solid foundation for future research, deepening our understanding of the key role SPs play in fostering IC growth. Furthermore, it highlights potential pathways for future investigation, indicating possibilities for an insightful examination of the roles of SPs perform in developing ICs.

7.4 Future research

SPs across the world are distinct entities (Cadorin et al., 2019) in terms of their establishment objectives, strategies, goals, and the number of resident companies, etc (Albahari, 2015). While this study uncovers crucial aspects of how TSP, SRP, and HKSTP foster ICs, it also identifies areas ripe for further exploration.

Firstly, given the limitations tied to the selection criteria for the SPs, upcoming research could endeavour to incorporate a more varied array of SPs. Such an approach could enhance the applicability of the findings, presenting a more comprehensive depiction of SPs' global impact.

Secondly, as this study offers a snapshot of SPs' operations and strategies at a single point in time, future studies might benefit from a longitudinal perspective. Monitoring the development and dynamics of the three SPs over time could yield a more thorough understanding of their evolving strategies and the subsequent impact on ICs.

Lastly, future research could delve more profoundly into the roles of SPs within regional contexts similar to TSP, especially in developing nations. Such a study would not only provide additional insights into their strategies and consequent impact on IC development, but also contribute to better-informed policymaking, more effective strategic planning for SPs, and the creation of supportive environments that nurture innovation and economic growth in these regions.

Given these recommendations, it is evident that ample opportunities exist for future exploration. Each suggested pathway contributes to deepening our understanding of the vital role SPs play in nurturing ICs. Thus, this study not only augments the current knowledge base but also provides a springboard for subsequent research.

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Appendix 1: Participant Information Sheet

DEPARTMENT OF MANAGEMENT SCIENCE

University of Strathclyde Business School

Participant Information Sheet

Name of Department: **Management Science, Business School, University of Strathclyde**

Title of the Study: **The Roles of Thailand Science Park in Supporting the Development of Innovation Clusters in Thailand: Comparative cases from Surrey Research Park, Hong Kong Science and Technology Park and Thailand Science Park**

Introduction

My name is Prapatsorn Wejprasit. I am carrying out a PhD research project on the development of innovation clusters focused particularly on The Roles of Thailand Science Park in Supporting the Development of Innovation Clusters in Thailand supported by a Thai government scholarship and co-funding from Thailand Science Park, at Strathclyde Business School in the University of Strathclyde under supervision by Prof. Tim Bedford and Prof. Robert Van Der Meer.

What is the purpose of this research?

My research aims to study the strategy and performance of the Thailand Science Park in developing long-lasting innovation clusters and investigate how other similar science parks do with R&D infrastructure, services, and networking in supporting long-lasting innovation cluster development to compare to Thailand Science Park. The study is in three stages, the first of which is to conduct a systematic literature review, and the second stage is to design a survey to select particular science parks to be my case studies. The third stage of my study and the particular element that I would welcome your participation in focuses on how science parks operate and develop innovation clusters by providing R&D facilities, innovation services and financial support, and networking activities to their members. In terms of science park tenants, I investigate what benefits they leverage from locating in the park and how science parks should develop long-lasting innovation clusters. This study will take the form of a qualitative interview with semi-structured questions. The questions relate to your views on and experience of science parks.

Do you have to take part?

I am very keen to hear what you have to say but this is entirely voluntary. The decision you make will not affect you or your role in anyway and we shall not disclose your decision to anyone else. You may also withdraw your consent at any time before, during or after the interview without consequence and any data collected will be destroyed.

What will you do in the project?

Given the current circumstances of social distancing, the investigation for this study will be conducted using either online-conference-call-based interviews (Microsoft Teams or Zoom) or telephone-based interviews, with an approximate duration of one hour. I shall make an audio recording of the interviews to ensure all information is captured for analysis later. It is expected that the interviews will take place from August 2021 to June 2022.

Why have you been invited to take part?

I am investigating the roles of science parks in supporting the development of innovation cluster. As science park management, tenants, and others related to the science park, you have been invited to participate in this study based on your experience in this area. Sharing your expertise and insight through research will help spread good practice and contribute to improving Thailand Science Park performance, and the extent of government intervention by incentivising and funding to build technology company capabilities in Thailand.

DEPARTMENT OF MANAGEMENT SCIENCE

University of Strathclyde Business School

What information is being collected in the project?

I shall collect personal information for contact purposes only. The interview recordings and data generated will be anonymised and securely stored with a codename for each participant. Participants will be identified only by their speciality and anonymised locality. Your name and the name of your organisation will not be included in any publication.

Who will have access to the information?

Only approved members of the research will have access to the study data. Personal information will not be shared with any individuals or organisations outside the University.

Where will the information be stored and how long will it be kept for?

All information (including contact information and the key to identifying each participant) will be stored in the University's secure storage system, which is password protected. Once the study is completed, data will be kept in an anonymised form for a maximum of 5 years to support future research.

The University of Strathclyde is registered with the Information Commissioner's Office who implements the Data Protection Act 2018. The information that you provide will be processed in accordance with the provisions of the Data Protection Act 2018.

What happens next?

If you would like to find out more about this study, please contact me for an initial informal conversation (my contact details are shown below). If you are happy to participate, you will be provided with a consent form to confirm the same and copy the University's standard Privacy Notice for Participants in Research Projects. Should you wish to decline, you will be sent an email confirming that no further participation will be requested from you.

Sharing the outcomes of the study

I shall be pleased to share the outcomes of this study with all participants once the findings are available in report form.

Thank you for reading this information – please ask any questions if you are unsure about what is written here.

If you have any questions about the study, please feel free to contact us:
Prapatsorn Wejprasit, Tel: 078 588 17889, Email: prapatsorn.wejprasit@strath.ac.uk
Prof. Tim Bedford, Tel: 0141 548 5982, Email: tim.bedford@strath.ac.uk
Prof. Robert Van Der Meer, Tel: 0141 548 3512, Email: robert.van-der-meer@strath.ac.uk

Participant Consent Form
The Role of Thailand Science Park in Supporting the Development of Innovation Clusters in Thailand
I have read the participant information sheet and agree to take part in the questionnaire and interview. I agree to the information I provide being used as part of the study as specified in the participant information sheet. I have signed this document and/or give a verbal approval at the start of the interview.

_____
(PRINT NAME)
Signature of Participant:

Date: _____

Appendix 2: Questionnaire

The Roles of Thailand Science Park in Supporting
the Development of Innovation Clusters in Thailand

Introduction and reason for this survey

My name is Prapatsorn Wejprasit, and I am carrying out a PhD research project on the Development of Innovation Clusters supported by a Thai government Scholarship at Strathclyde Business School, University of Strathclyde under supervision by Prof. Tim Bedford and Dr Robert Van Der Meer.

I am carrying out a comparative study of innovation cluster development at Science Parks in order to support the development of innovation clusters in Thailand, in particular at Thailand Science Park.

Therefore, collecting and analysing data with particular science parks that appropriately compare with Thailand Science Park, in terms of their performance, services, and organisations, where are located in the park, is essential for my research. Your contributions hereby will make a significant difference and be a part to develop Thailand Science Park performance through sharing experience of your park.

The survey has 10 questions, and you can fill in a comment in the final part. Your valuable response helps me to make the right decision for the further step of the study. The general feedback of my research will be provided you later.

Confidentiality

The information you provide within this survey will be retained securely and anonymously. All data obtained from participants will only be reported in an aggregated format.

Questions about this research

If you have any further questions regarding this study, you may contact me at:

Email ID: prapatsorn.wejprasit@strath.ac.uk

I would like to thank you for the questionnaire respondent are gratefully acknowledged for the time devoted to the present survey. You provide useful information for my study.

1. Which organisation/ organisations operate your science park?

- Public sector
- Private sector
- Public/ Private partnership (Please specify into the box below)

2. Please indicate the TRL ranges that organisations in the science park focus on. (please tick all that apply)

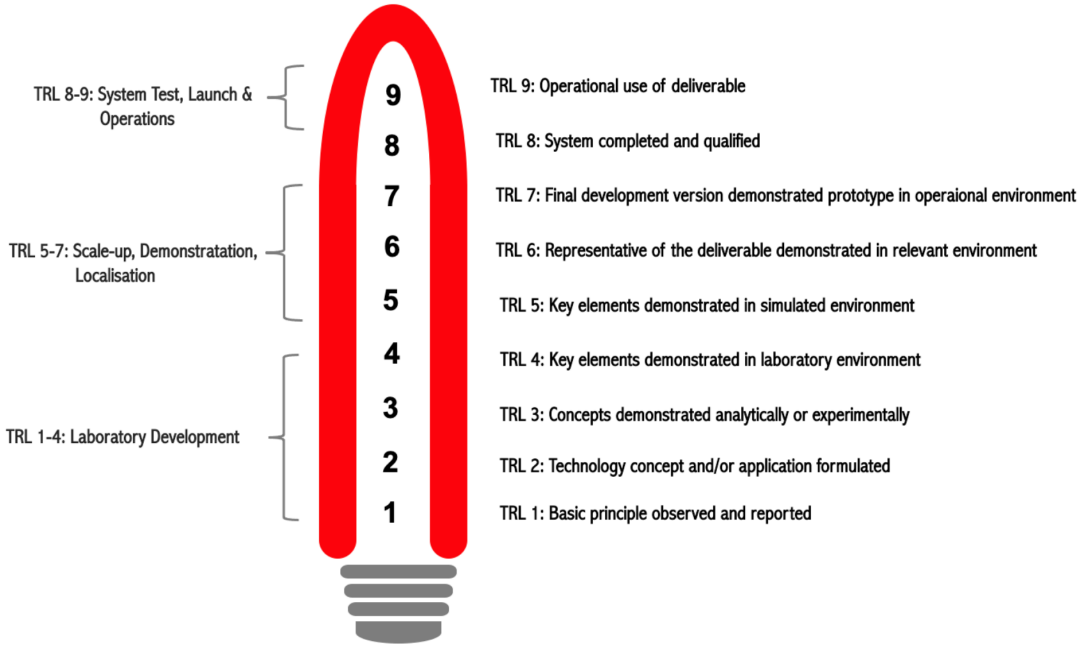

Figure1: The Range of Technology Readiness Levels (TRL)

Source: NSTDA Style, 2015 (Adapted from Sandia National Labs "Measuring the Maturity of a Technology: Guidance on Assigning a TRL", October 2007)

- ☐ TRL 1-4 Laboratory Development
- ☐ TRL 5-7 Scale-up, Demonstration, Localisation
- ☐ TRL 8-9 System Test, Launch & Operations

3. How many anchor R&D institutes are located in your park intended to play a role in stimulating/ collaborating R&D projects of science park tenants?
(If they are specialist centres, then should be counted separately)

- None
- 1-2 R&D organisations
- 3-4 R&D organisations
- More 4 R&D organisations

4. How many universities or HEIs are located or adjacent[1] to your science park? (If they are specialist centres, then should be counted seperately)

- o None
- o 1-2 universities
- o 3-4 universities
- o More 4 universities

5. Which clusters does your science park focus on?

- ☐ Food
- ☐ Agriculture
- ☐ Health and Wellness
- ☐ Digital
- ☐ other (Please enter into the box below)

6. What are the top three services[2] that are most in-demand with science park companies?
(Please rank the following choices on a scale of 1 to 3, with 1 being the most in-demand services)
_____ Financial services support from the Government support e.g., funding, tax exemption
_____ Financial support provided by private sector organisations e.g., low interest loans, venture capital investors, angel investors
_____ Innovation process support, e.g., Intellectual Property Management, product regulations
_____ R&D services, e.g., testing services, R&D advanced equipment, lab space, scale-up facilities
_____ Marketing support
_____ Export services
_____ Other (Please specify into the box)

7. What criteria are most important to measure the overall performance of the overall science park contribution to innovation and the economy? (please tick all that apply)
Criteria (measured across all SP companies/organisations)

- ☐ Sales from new products to the market
- ☐ Sales growth
- ☐ The number of high-tech skilled employees

- ☐ R&D expenditure
- ☐ Patent numbers
- ☐ The number of research projects with a commercial outcome
- ☐ The level of private sector investment
- ☐ Others (please enter into the box below

(1) Geographical proximity is close either to R&D organisations, research centres, universities, and higher education institutions within 5 km. or adjacent to a university campus/ R&D institution in order to favour and facilitate R&D activities as well as the exchange of knowledge or common issues.
(2) The purpose of services is to launch high-tech products/ services into markets, to reduce costs or the process of production, to advise on operations. The kinds of financial support, funding, R&D services that government support and stimulate technological companies through a science park.

8. How many tenant companies do your science park have? updated as of 2020

- o Less 80 tenant companies
- o 80-150 tenant companies
- o Above 150 tenant companies

9. What proportion of the tenants are actively engaging in R&D?

- o Less 50% of tenant companies
- o 50-70% of tenant companies
- o Above 70% of tenant companies

10. Please indicate approximately the number of science park (SP) tenants collaborate R&D activities with other key actors as follows:
(Please tick appropriate box)

	Low (Up to 20%)	Medium (21% - 60%)	High (Above 60%)
Informal collaboration/ network[3]			
1. SP tenants with research centres/ R&D organisation in the park	o	o	o

2. SP tenants with universities either close or adjacent the park	o	o	o
3. SP tenants with other SP tenants in the same area	o	o	o
4. SP tenants with other SP tenants in another science park either in the same region or international	o	o	o
5. SP tenants with another R&D institutes or companies outside the park in the same region or international region	o	o	o
Formal collaboration/ network[4]	o	o	o
1. SP tenants with research centres/ R&D institutes in the park			
2. SP tenants with universities either close or adjacent the park	o	o	o
3. SP tenants with other SP tenants in the same area	o	o	o
4. SP tenants with other SP tenants in another science park either in the same region or international	o	o	o
5. SP tenants with another R&D institutes or companies outside the park in the same region or international region	o	o	o

Comments/ Suggestions

_____

_____

(3) Communicate or share common issues/ problems or even knowledge without commitment or official projects

(4) Participate in or establish of official research contracts as well as purchase R&D services from either science park tenants or off-park firms

Appendix 3: A list of semi-structure questions

SP Management:

Part 1: Organisation

1. The organisation profile, facts and figures, etc.
2. Brief history of the Science Park
3. The Science Park Strategy
    - How do you attract potential companies to the park?
    - How do you select the tenants?
4. What indicators does your park assess science park performance?
5. What things does your park should more improve for the tenants in the future?

Part 2: Interactions between the actors in TSP

6. How do you promote linkages and interaction of the local player? What roles do you play?
7. How do you facilitate the interaction between the tenants and other members in the park?
8. What are the barriers and difficulties in doing that?
9. What things does the park offer to members in supporting innovation cluster development?

Part 3: About local settings of the Science Park

10. To what extent do local settings of the Science Park (i.e. location factors, physical infrastructure and facilities, and supports and services) influence the development of innovation clusters in the park?
11. What is the additional factors in accelerating the innovation cluster development?

SP tenants

Part 1: Location choices

1. Main concerns for choosing firm's location
2. Initial reasons or expectations for locating in this Science Park
3. Benefits and Drawbacks of locating in the Science Park
4. What things do you need the science park more improvement in the future?

Part 2: Interaction experience

5. How important is it for you to cooperate with other tenants?
6. How important is it for you to cooperate with academic staff or R&D institutes?
7. How important is it for you to cooperate with outside companies?

8. How do you cooperate with other tenants?

- What are the kinds of interaction? Whether it is formal or informal.
- How many projects do you collaborate with members in them?
- What obstacles have you experienced while interacting with them?

9. How do you cooperate with academic staff or R&D institutes?

- What are the kinds of interaction? Whether it is formal or informal.
- How many projects do you collaborate with members in them?
- What obstacles have you experienced while interacting with them?

10. How do you cooperate with outside companies?

- What are the kinds of interaction? Whether it is formal or informal.
- How many projects do you collaborate with members in them?
- What obstacles have you experienced while interacting with them?

11. To what extent does the science park management team facilitate building networking for you with other tenants?

12. To what extent does the science park management team facilitate building networking for you with outside companies?

13. To what extent does the science park management team facilitate building networking for you with academic staff in the university or R&D institutes?

14. How does the science park should encourage more interaction between tenants and your organisation?

Part 3: Local settings of the Science Park

15. How and to what extent do the local settings (i.e. location factors, physical infrastructure and facilities, and supports and services) in the science park influence the interactions between your company and other organisations, especially the organisations nearby?

- What services in the park do you use? Why?
- Does the SP provide and facilitates R&D infrastructure proper for advanced research?
- Have you got the aids of finance from the park or government? (funding or grant)

15. What is your understanding of the innovation cluster?

If yes

- How successful do you think?
- What makes it successful?

If no

What is the most important factors science park should realise?

R&D institution staff

1. What are the benefits or drawbacks of having a science park near the university?

2. How important is it for you to cooperate with tenants?

3. How do you cooperate with tenants?

- What are the kinds of interaction? Whether it is formal or informal.
- How many projects do you collaborate with members in them?
- What obstacles have you experienced while interacting with them?

3. Could you comment on the framework of your organisation regarding interaction (both formal and informal ones) tenants?

4. What are supporting schemes available from the science park to encourage interactions between your organisation tenants?

5. How does the science park should encourage more interaction between tenants and your organisation?

6. To what extent does the science park management team facilitate building networking for you with other tenants?

6. What is your understanding of the innovation cluster?

If yes

- How successful do you think?
- What makes it successful?

If no

What is the most important factors science park should realise?

7. What is the additional factors in accelerating the innovation cluster development?

8. Your further comments regarding the development of innovation clusters in the park