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Establishing Science and Technology Parks:
A Reference Guidebook for Policymakers in Asia and the Pacific

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Establishing Science and Technology Parks: A Reference Guidebook for Policymakers in Asia and the Pacific

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ABBREVIATIONS AND ACRONYMS

ASEAN	Association of Southeast Asian Nations
EPZ	Export Processing Zone
ESCAP	United Nations Economic and Social Commission for Asia and the Pacific
EPZ	Export Processing Zone
FTZ	Free Trade Zone
GDP	gross domestic product
GPT	general-purpose technologies
ICT	information and communications technology
IT	information technology
OECD	Organisation for Economic Co-operation and Development
R&D	research and development
SDG	Sustainable Development Goal
SME	small and medium-sized enterprise
STI	science, technology and innovation
STP	science and technology park
UNCTAD	United Nations Conference on Trade and Development
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNIDO	United Nations Industrial Development Organization

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EXECUTIVE SUMMARY

During the past several decades, science and technology parks (STPs) in Asia have witnessed rapid development. This is reflected not only in the emergence of new STPs, but also in the successes of some prominent STPs in the region.

With the current level of economic development in the region, Governments may perceive STPs as a means of upgrading production, promoting collaboration in research and innovation, and climbing global value chains. Therefore, it is likely that more STPs will be established by many developing countries in Asia and the Pacific. On the other hand, the challenge of establishing and managing successful STPs must not be underestimated. Even in developed or advanced economies, questions are frequently raised about the effectiveness of STPs.

This guidebook is intended to serve as a reference source for policymakers in charge of policy or planning related to the development of STPs in Asia and the Pacific. It reviews the historical development of STPs and discusses how they fit into the national policies in the region. The key messages for policymakers from this guidebook are summarized below.

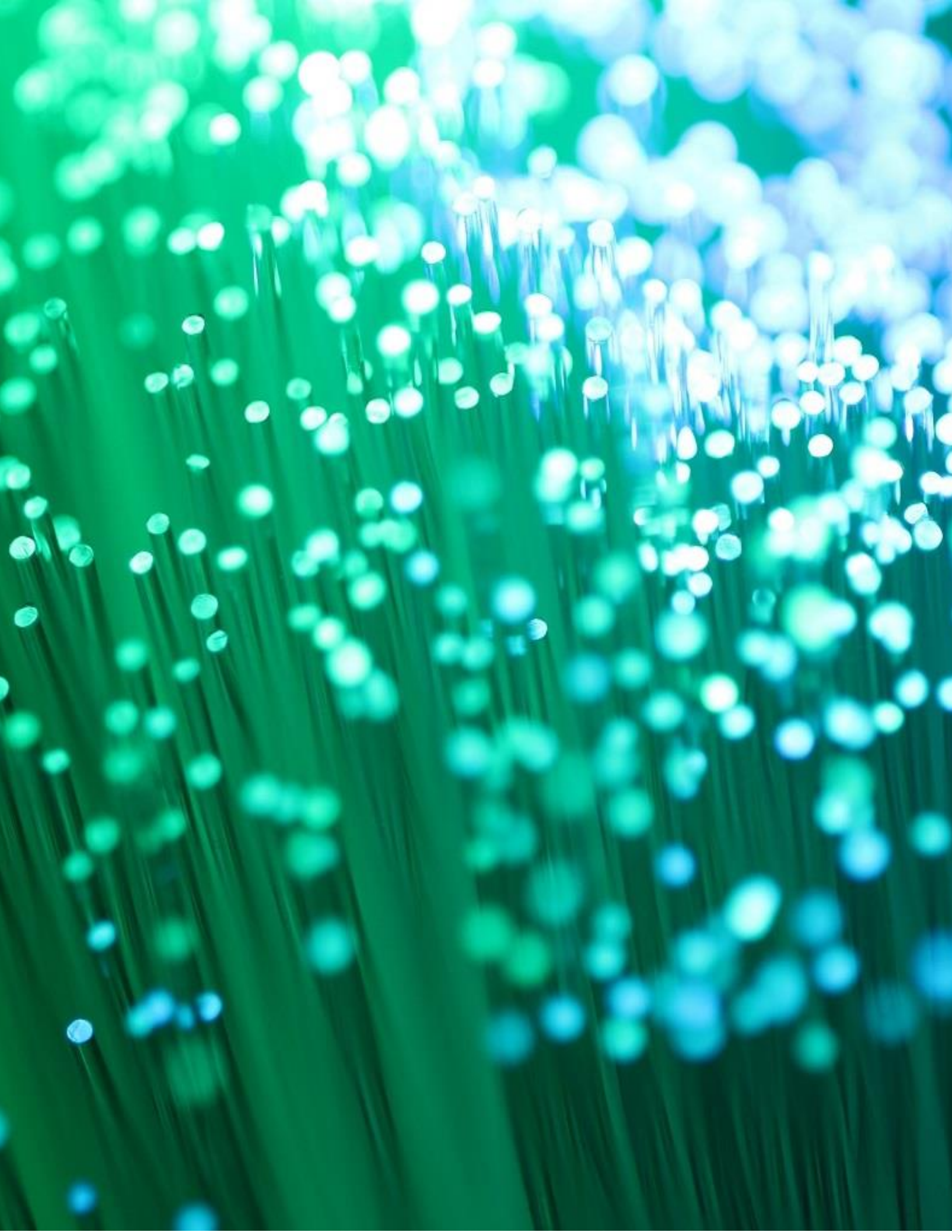
First, to establish an STP is a means to an end, not an end in itself. Before an STP is established, policymakers need to be very clear on the ultimate goal(s) to be achieved through the establishment of an STP. Such goal(s) may be achieved through several policy instruments, with the establishment of an STP being one of them. Policymakers need to weigh the pros and cons of all available policy tools before selecting the best solution.

Second, before an STP is developed, it is essential to check whether the precursory conditions are in place. These precursor conditions, among others, may include ensuring that: (a) the key tenants or the anchor tenants – such as national research institutes that are ready to stay in an STP – are available; and (b) the management team with all the necessary skills needed to manage the STP can be assembled. The management team is often responsible for managing multiple tasks such as coordination and communications among various stakeholders, research and development (R&D), the necessary talent, capital, infrastructure, and other activities and construction work. To fulfill such management tasks, the management team needs to have expertise not only in R&D, but also business, marketing, negotiation and communication skills. Furthermore, the management team must be able to adjust its strategy in an ever-changing environment. Such multiple tasks mean, for many developing countries, that assembling an effective management team can be a real challenge as it is necessary to ensure that: (a) a strong science base in the areas surrounding an STP is already available; (b) the city or area where an STP is located is attractive to talented people and students; (c) an entrepreneurial culture is available in the city or country where an STP is located; and (d) finance, especially seed and venture capital, is available in the city or country where an STP is located. Without checking these precursory conditions, it may be problematic to develop an STP based on a "if you build it, they will come" mentality. If these precursory conditions cannot be met, at least some mitigation solutions need to be identified.

Third, the social investment in an STP needs to be justified by its social benefits. If a Government or public sector finances the development of an STP or provides other incentives such as tax exemptions or reductions, it is imperative that the STP provides social benefits such as advancing R&D or boosts economic development in the region. In this regard, the economic or social contribution of an STP to a country should be measured and monitored.

Fourth, the effectiveness of the incubation and innovation programme offered by an STP needs to be better scrutinized. Innovative business ideas, directly associated with entrepreneurial spirit, are often drawn from, and respond to market demand. In contrast, many STPs are designed in a predictable and mechanistic manner, which is inherently incompatible with this spirit of entrepreneurship.

This guidebook is also forward-looking. In the era of the digital economy, there are new opportunities for STPs. ICT will facilitate cooperation among partners within and beyond the parks. While this is not a one-size-fits-all solution, the general recommendations in this guidebook can be summarized as the five "Cs", i.e., Capacity, Collaboration, Content, Capital, and Communication. Capacity emphasizes the digital and business skills of all stakeholders of an STP, such as policymakers, the STP management team and tenants. Collaboration involves discussing how information and communications technology (ICT) can be utilized to promote greater in-depth collaboration within and beyond an STP. Content places emphasis on the local niche market on which an STP should focus. Capital refers to venture capital that a start-up within an STP should utilize. Finally, Communication emphasizes the fact that an STP should communicate effectively with the public about its contribution to the local and national economies.

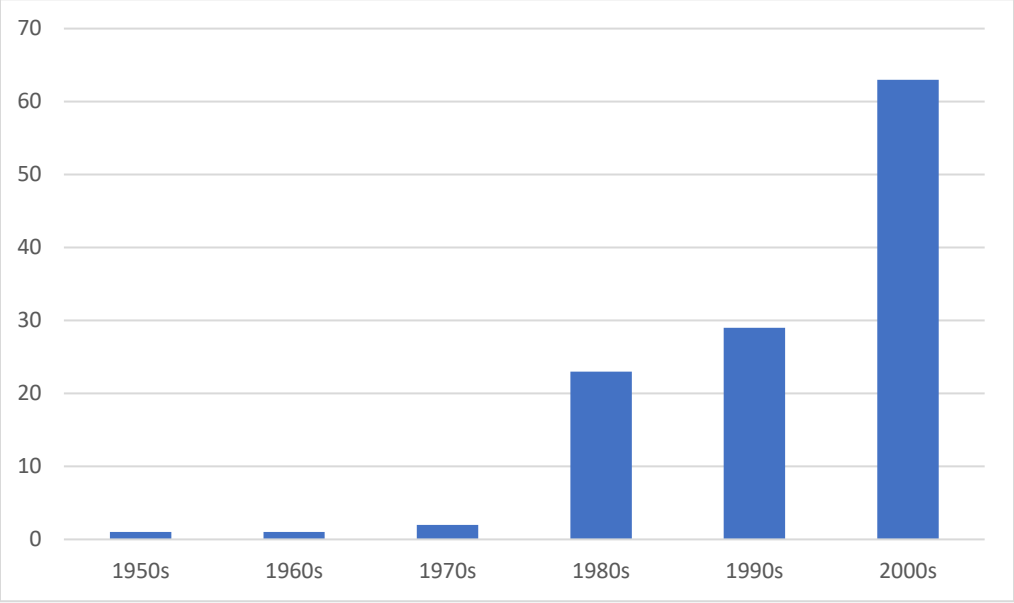


CHAPTER 1

INTRODUCTION

The success story of Silicon Valley has inspired the development of STPs worldwide. Originally known as Stanford University Science Park, Silicon Valley dates back to the early 1950s. It was followed by Sophia Antipolis (France) in Europe in the 1960s and Tsukuba Science City (Japan) in Asia in the early 1970s. This trio represents the world's oldest science parks in each region.1 Since the 1980s, the number of STPs has increased dramatically (figure 1.1).

Figure 1.1. The number of STPs launched in each decade

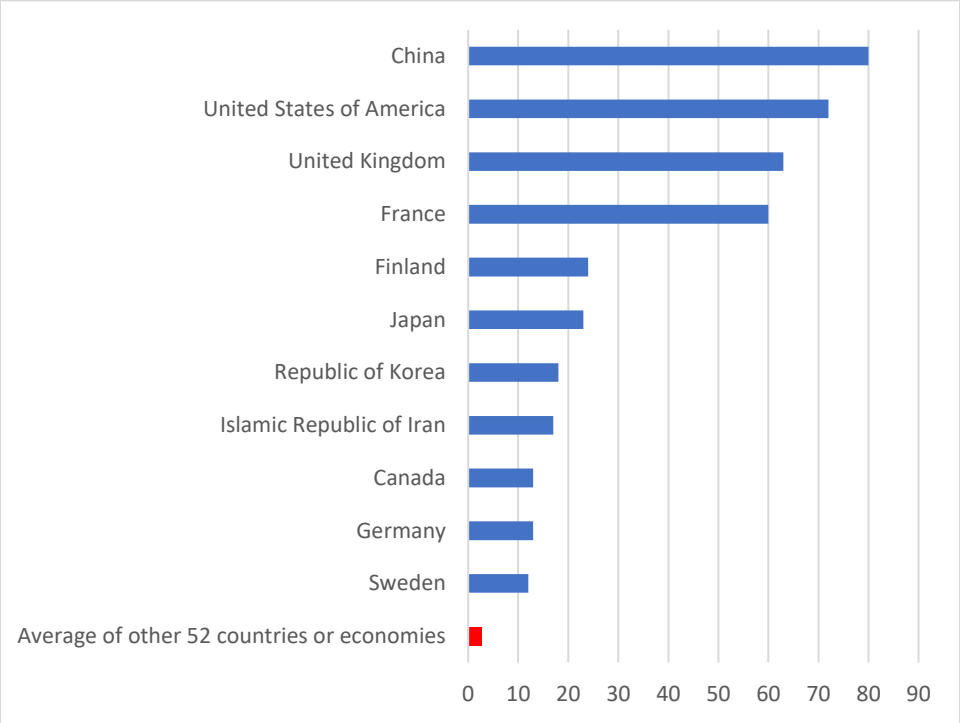


Source: Derived from a survey conducted by the International Association of Science Parks and Areas of Innovation, 2012.
Note: The survey covers 119 parks from 38 countries.

According to the United Nations Educational, Scientific and Cultural Organization (UNESCO, 2018a), there were an estimated 534 STPs worldwide by 2017, including 169 STPs in Asia and the Pacific (figure 1.2). Most STPs are located in advanced or large economies. As developing economies attempt to close the technology gap, governments are increasingly turning to parks as part of their national strategy. For example, the United Nations Conference on Trade and Development (UNCTAD, 2018; table IV.4) reported that approximately 80 per cent of the countries surveyed (including developed, developing and least developed countries) planned to use specialized zones, including STPs, as a part of their twenty-first century industrial policy.

[1] See UNESCO, 2018a. Available at http://www.unesco.org/new/en/natural-sciences/science-technology/university-industry-partnerships/science-parks-around-the-world/, Accessed on 25 January 2019.

Figure 1.2. The number of STPs by country or economy, 2017



Note: (1) The numbers of STPs in this figure should be interpreted with caution due to different definitions of STPs. A facility may have all the functions of typical STPs but may not be called an STP, and therefore, may not be counted as an STP when the statistics in this figure were prepared; (2) the other 52 countries are not listed in the figure. The number of SPTs in these countries range from 1 to 9.
Source: Prepared by the authors, based on UNESCO, 2018a.

1.1. Challenges for STPs

While constructing the basic infrastructure of an STP might not be very difficult, the management is often a challenging task. Although Silicon Valley and Hsinchu Science Park are often cited as successful examples, several challenges related to STPs, as highlighted below, cannot be underestimated.

First, it is challenging to gain a full understanding of what role a government should play in guiding and supporting the development of STPs. The traditional argument for government involvement in STPs is the existence of positive externalities related to research and innovation. Therefore, Governments in many countries directly support the development of STPs through funding, provision of tax incentives or ownership of the parks. A key question is whether government subsidies can be justified by the social or economic benefits. Evidence in this regard appears to be quite scarce. One study found that only 25 per cent of STPs in the United States (a) achieved their goal of attracting and fostering research and development (R&D) activities, and (b) contributed to job creation and economic growth, while the remaining STPs contributed very little to economic objectives (Luger and Goldstein, 1991). As such, Governments should consider carefully whether an investment in STPs will be able to achieve their intended outcomes, or whether another policy instrument might be better suited to their economic goals.

Second, the management of STPs is not uncomplicated and can easily become pure real estate operations. The management team is often responsible for managing multiple tasks such as coordination and communication among various stakeholders, R&D, talent, capital, infrastructure and other activities and construction works. To fulfill such management tasks, the management team need to have expertise in not only R&D, but also business, marketing, negotiation and communication skills. Furthermore, the management team must be able to adjust its strategy in an ever-changing environment, so that the STP can thrive beyond a simple real estate endeavour.

Third, the successful collaboration among different players in STPs should not be taken for granted. Geographic proximity does not automatically translate into technology transfer or synergy. Selecting the right tenants for STPs can be difficult and getting those tenants to collaborate with each other can be even more challenging.

1.2. Aims and outline of the guidebook

Against this backdrop, this guidebook seeks to provide information on best practices and guidance for policymakers on developing STPs in the Asia-Pacific region. The primary target users are policymakers in charge of national planning of STPs rather than managers of STPs. Accordingly, the daily management of STPs is not the focus of this guidebook.

This guidebook makes an original contribution to the existing literature. Discussion on STPs has been mainly limited to developed countries (e.g., Massey and Wield, 2003). In Asia and the Pacific, a few publications have focused on more advanced economies such as Hong Kong, China (Sun, Ni and Leung, 2007) and Singapore (Koh, Koh and Tschang, 2005; and Phillips and Yeung, 2003). However, research is still lacking on policy guidance for STPs in developing countries in Asia and the Pacific.

Most of the data and information used in this report are secondary. While every effort has been made by the study team to validate accuracy, there is no guarantee that all the data and information reflect the actual situation. In addition to desk research based on secondary data, an expert group meeting was organized to discuss the guidebook content and its recommendations.

The guidebook chapters are structured as follows:

Chapter 2 sets out the key definitions and park models. Parks are dynamic and unique entities – each with a different structure, specific focus and varying incentives. These variations make categorizing and studying parks very difficult. Furthermore, differences in park governance, management and financing structures, make pinpointing success factors quite challenging.

Chapter 3 discusses where STPs fit into the national policies in the region. It reviews the national policies on STPs in China, Japan, the Republic of Korea, Singapore and Thailand. This chapter shows how these countries have established STPs in line with their economic development and as a part of their plans to enhance R&D.

Chapter 4 reviews a few Asian STPs, including: Kanagawa Science Park in Japan; Zhangjiang Hi-Tech Park in China; the Skolkovo Innovation Centre in the Russian Federation; Puspiptek in Indonesia, Daedeok in the Republic of Korea, Pardis in the Islamic Republic of Iran, and the Thailand Science Park in Thailand.

Chapter 5 discusses on how STPs can adjust in an era of digital technology. ICT and communication technologies will facilitate cooperation among the partners within and beyond the parks. On the other hand, as digital technology also greatly facilitates cooperation between the players within the park and partners faraway, this means the physical presence in the same park may not be necessary. How can the STPs embrace the new opportunities?

Chapter 6 further builds on discussion in the previous chapters, and examines a few questions related to policy implications for establishing STPs. Furthermore, this chapter summarizes discussions in this guidebook and provides policy recommendations on developing STPs.

CHAPTER 2

NATURE AND CHARACTERISTICS OF SCIENCE AND TECHNOLOGY PARKS

This chapter starts by reviewing and defining STPs. An STP can be called differently, such as science park or technology park. Therefore, it is essential to look at the key functions that an STP can offer. This chapter also reviews alternative theories related to STPs and investigates how such theories have been reflected by evidence.

2.1. Definition of a Science and Technology Park

While the earliest STP, Stanford Industrial Park, was developed in the 1950s, various types of parks have proliferated worldwide since the 1980s. Different terms, such as research park, STP, business innovation centre, innovation park, techno-city, technopole, technopolis, and innovation and technology centre, have been used in countries worldwide. There is a high degree of diversity in their nature and functions, in part due to their evolution over time. There is no single standard definition of the different types of clusters or STPs, and a few definitions of an STP are provided in table 2.1.

Table 2.1. Definitions of STPs

	International Association of Science Parks (IASP)	UNESCO
Definitions	A science park is an organization managed by specialized 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.	The term "Science and Technology Park" encompasses any kind of high-tech cluster.
Alternative titles of STPs	Technology park, technopole, and research park.	Technopolis, science city, cyber park, hi tech (industrial) park, innovation centre, R&D park, university research park, research and tech park, science and tech park, science town, technology incubator, technopark, technopole, and technology business incubator.

Sources: IASP,2018, UNESCO 2018b

The World Bank and UNCTAD place STPs under the wide umbrella term of Special Economic Zone (SEZ). SEZs are defined as geographic areas where the rules of business are different and where a variety of incentives are used to attract investors and businesses from a wide range of manufacturing, technology, and service industries (table 2.2).

Table 2.2. Different types of special economic zones

Industrial zone, estate, park	Facility promoting co-location and clustering of industrial activity through the provision of low-cost land, infrastructure and on-site services. Usually covers industrial and services sectors, and targets both foreign and domestic investors, providing an array of incentives and facilities.
Export processing zone (EPZ)	A specialized industrial estate located outside the customs territory and predominantly oriented to export production. Enterprises located there are allowed to import capital equipment and raw materials free from duties, taxes and other import restrictions.
Free trade zone (FTZ)	A designated and secured area in which commercial and industrial activities are carried out. Investment projects often benefit from incentives and are usually for export purposes. Customs checkpoints control the movement of goods at the entry and exit points. Zones can also cover commercial, trading and trade activities. Many are located near a port.
Eco-Industrial Parks	Dedicated area for industrial use at a suitable site that ensures sustainability through the integration of social, economic and environmental quality aspects into its siting, planning, management and operations.
Science and Technology Park (STP)	Facility or area that supports and promotes technological development, including through research and attracting technology-based companies. The purpose is to facilitate innovation and knowledge-based economies. Such parks provide an environment and ecosystem (e.g., proximity to research institutes and universities) conducive to innovation, knowledge-based work and R&D activities.
Innovation districts/clusters	Top-down urban innovation ecosystems designed around four multilayered and multidimensional models of innovation – urban planning, productive, collaborative and creative – all coordinated under a strong leadership, with the ultimate objectives of accelerating the process of innovation and strengthening the locations' competitiveness.

Sources: Adapted from UNCTAD, 2018, and the United Nations Industrial Development Organization (UNIDO), World Bank Group and *Deutsche Gesellschaft für Internationale Zusammenarbeit* (GIZ) GmbH, 2017.

Industrial parks/estates are seen as the precursors to modern-day STPs. In their early iterations, they were typically more manufacturing-oriented and had a limited association with innovation or R&D. Industrial parks focused on creating an environment for industrial tenants (e.g., textile or heavy chemical producers) by providing land to operate, basic facilities and dedicated infrastructure. More specialized industrial areas, such as Export Processing Zones (EPZs) and Free Trade Zones (FTZs), evolved to provide tailored local customs regulations (e.g., tax incentives and tariff exceptions) and specialized business services (e.g., streamlined permits and visas).

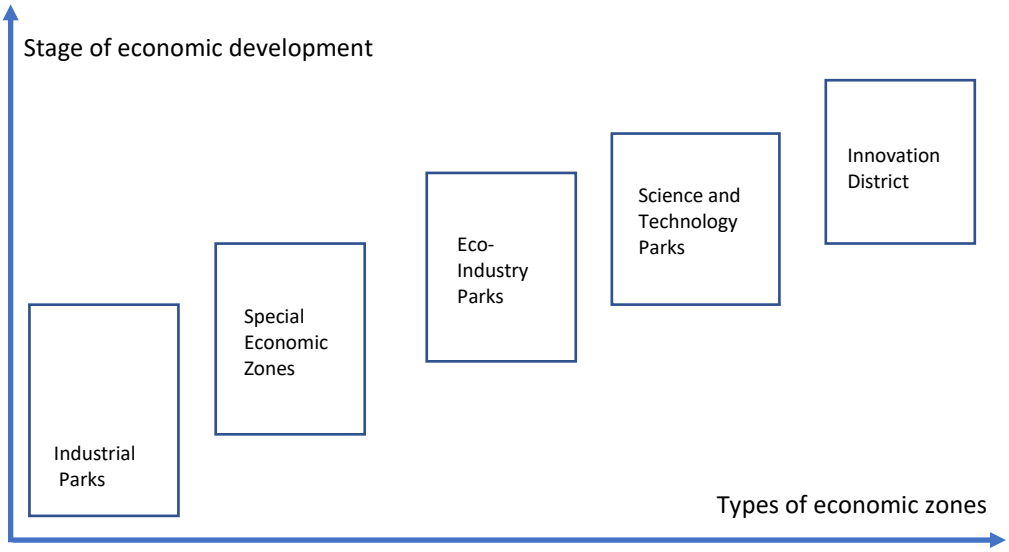
The early generation industrial parks were often centred around trade and investment facilitation as a means to encourage industrialization and expand the economy, with hopeful secondary effects of technology transfer, knowledge flow and collaboration.[2] As a result, many early industrial parks (EPZs and FTZs) were purely containers of economic activity, and they failed to develop the technological capacity of the local area or contribute to wider, regional, long-term economic development.

In contrast, most STPs have targeted management strategies for promoting knowledge exchanges and technology diffusion as well as strategies for building relationships with public research organizations and science industry professionals.

[2] See Rodríguez-Pose and Hardy, 2014, European Commission, 2013.

Establishing different types of SEZs is often dictated by the economic development of the host countries. In a less developed economy, it is more feasible to begin with the establishment of industrial parks (EPZs and FTZs), in order to capitalize on sources of competitive advantage, such as low-cost labour, natural resources or proximity to sea ports (figure 2.1). As an economy advances, it becomes relatively easier to establish STPs due to the underlying foundation available, including research capacity, human resources and an active entrepreneurial environment.

Figure 2.1. Special economic zones and stages of economic development



Source: UNIDO, 2015, country office, Viet Nam.

Given the variety of functions and names of STPS, in this reference guidebook an STP should encompass the components shown in table 2.3.

Table 2.3. Essential components of an STP

Essential components	Explanation
Area and infrastructure	An STP should occupy an area that may nor may not be fenced.
A management team as a landlord	A dedicated team to manage the STP. The functions of the team may vary, but will at least need to cover property management as the landlord. The management team often needs to select the firms (tenants).
Multiple firms as tenants	These firms are the tenants of the STP. The key activities of the firms need to cover R&D and innovation. Often, it is useful to include some research institutes in an STP, but this does not necessarily have to be the case.
Promoting R&D and/or innovation as a key objective	An STP should target management strategies for promoting knowledge exchange, technology diffusion and innovation. To this end, an STP may promote and facilitate R&D collaboration. An STP may also encourage and support the start-up and incubation.

Source: Authors' compilation.

While the essential components of an STP define the common denominator of STPs, STPs may differ from each other in terms of size, functions, ownership and location. For example, in terms of ownership, an STP may be initiated by a Government. The drive and the decisive energy of this type of STP come from a Government with a focus on R&D. Examples of such STPs include the Hong Kong Science Park and Singapore Science Park. Alternatively, an STP may exist as an extension of a university in a dedicated neighbouring area. For example, Stanford contributed to the early development Silicon Valley, and the Cambridge Science Park built upon the research strength of nearby Cambridge University.

In terms of location, an STP may be located in a suburban area. For example, the Thailand Science Park is located 42 kilometres north of Bangkok, and the Pardis Technology Park is 20 kilometres outside the Tehran metropolitan area in the Islamic Republic of Iran. Some STPs are located in an urban area. For example, the Zhongguancun Science Park in China is located inside Beijing city.

2.2. Theories, assumptions and evidence about STPs

This section attempts to explain the origin of STPs based on the following theories: clusters, 'triple helix' model and growth pole. Evidence shows that these theories may not always be valid in practice. Furthermore, this section also provides an analysis of why some tenants choose to stay in STPs – in spite of lack of the evidence in support of these underlying theories – showing that "pragmatism" is a key factor.

Cluster theory

STPs can be placed in the broader context of clusters, which are geographic concentrations of interconnected companies, specialized suppliers, service providers, and firms in related industries and associated institutions in specific fields. The geographic collocation of firms can create positive economic externalities, referred to as agglomeration economies. Clusters are therefore often referred to as spatial agglomerations of firms and related institutions or organizations. Individual firms are often unable to innovate on their own and require a functioning innovation system or ecosystem and network of firms. Agglomeration economies help to explain why firms, particularly small and medium-sized enterprises (SMEs), often form clusters to improve their ability to compete and survive. Clusters may offer the benefit of knowledge spillovers, resulting from the informal transfers of knowledge (especially tacit) and exchange of ideas among firms located in the same STP.

However, there is always sharp warning or suspicion on the relevance of cluster theory in the context of STPs. For example, Saxenian (1994) critically noted that "spatial clustering alone does not create mutually beneficial interdependencies. An individual system may be geographically agglomerated, and yet have limited capacity for adaptation. This is overwhelmingly a function of organizational structure, not of technology or firm size".

In practice, examples of successful collaboration among the players within an STP have been surprisingly rare. It has even been argued that science parks in a specific context might be a "technology fantasy" (Bakouros, Mardas and Varsakelis, 2002). Even for the science parks in the more developed economies in the region, such as Singapore, one report argued that: "The empirical findings show that…the extent of R&D activities and collaboration among tenant firms tends to be relatively low."

'Triple helix' model

The collaboration between a Government, private firms and universities is known as the 'triple helix' model, which sometimes forms the basis of the structure of many current STPs. At the heart of the triple helix model, each actor contributes something to the STP. Universities can offer R&D experience, research methodologies,

and access to expensive testing and research equipment. Private firms and entrepreneurs offer business experience, regional knowledge about gaps in the market, and an opportunity to commercialize the research being cultivated inside the universities. Governments can play a vital role in incentivizing R&D and knowledge-intensive environments by channelling specific domestic innovation strategies into their STPs.

In practice, the triple helix model may face many difficulties in an STP. Universities and academic researchers are often more interested in exploring knowledge and publishing research papers. However, such research breakthroughs may have little value in developing innovative solutions and applying them towards boosting the economy. The firms within the STP may be more interested in developing products. In addition, the expertise of universities may not be compatible with the key business of the firms located in the STP or the market dynamics.

Growth pole theory

STPs are often rationalized as a critical physical setting for promoting indigenous R&D capabilities and for spearheading urban and regional economic growth. This perspective examines the role and contribution of science parks in the context of regional development.

STPs can contribute to regional economic growth in two ways – internally within an STP and externally beyond the STP. Internally, an STP markets itself as a place for start-ups and an incubation programme. However, serious questions need to be asked about how effective an STP can be in stimulating start-ups and an incubation programme for the following reasons.

First, the assumption that an STP can stimulate start-ups and an incubation programme is based on a linear model of innovation – from scientific discovery, through technological development in firms, to the marketplace (or a process that can be described as invention –> innovation –> diffusion). However, this linear model of innovation has often been criticized. Innovation is not equal to invention. Ideas of innovation mainly stem from the demand by the market, and a new business model is not necessarily dependent on new technologies. It may involve new processes, new solutions. According to Phillips and Yeung (2003), "it would be a mistake to expect a certain output of high-tech entrepreneurs in a predictable, mechanistic manner, just because there has been so much investment, facilities and people put into the effort. The long-term consequence… is that the nation will be far less directed by the Government and more market-driven".

Second, the management of an STP may not have expertise in innovation. In the context of Asia, STPs are often managed by Ministry of Science and Technology personnel who may not have expertise in the dynamism of the market.

Third, if an STP is funded by the public sector, there may be a tendency towards risk-aversion. However, start-ups are a high-risk business. One study showed that 9 out of 10 startups fail.[3] Therefore, the tough question for an STP is how it can ensure that it really adds value to start-ups. Another question is how to select the eligible start-ups if such a start-up programme is funded or subsidized by the Government.

Externally, technology plays a self-reinforcing role in developing regions that respond to the rise of the informational economy. The idea of planning and developing science parks has strong underpinnings in this technology-driven view of urban and regional development. Aptly called "technopoles" that are justified by growth pole theories of urban and regional development, Castells (1996) argued that the "processes of

[3] See http://fortune.com/2014/09/25/why-startups-fail-according-to-their-founders/.

formation of innovation industrial milieux" might lead to a "truly dynamic regional or economic growth". The prevalence and location of the physical place may be accounted for by this type of economic theory. The belief that an STP can serve as the growth pole of the region explains why some Asian countries/economies support the development of STPs. For example, in financial year 2018, the Government of Hong Kong Special Administrative Region of China earmarked HK$ 40 billion (US$ 5.1 billion) for the expansion of the Hong Kong Science Park in an attempt to turn the city into an innovation and technology (IT) hub.[4]

A difficult question is how to adequately assess the contribution of STPs to regional economic development. In a narrow sense, the assessment can be focused on an STP itself by checking the number of patents, products and employment opportunities that are contributed by the STP. However, it may be difficult to assess how an STP actually contributes to technological upgrading, or the STP's ability to generate business and job opportunities in its surrounding areas.

Situated at Klong Luang, Pathumthani province, TSP covers four zones: NSTDA and its research centres; an incubation space; rental space for tech-based firms; and land for rent for building of R&D centers

Pragmatism

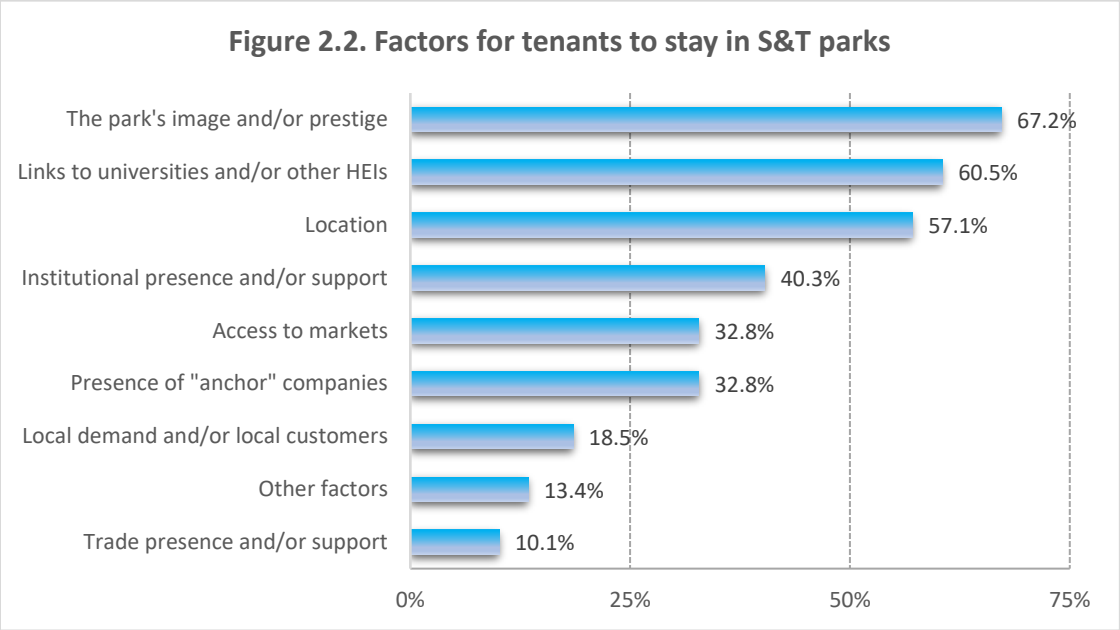
The theories for establishing STPs, as noted, above may lack a basis of practical experience, and some STPs may be established or developed without an explicit theory. An STP can serve as a base for R&D. Research institutes need a home. Collocation of research firms or institutes (in and of itself) does not guarantee research collaboration, but it does not do any harm either. The bottom line is that such collocation provides an opportunity to collaborate, although collaboration may or may not take place.

Furthermore, an STP may make R&D economically viable. Some equipment for research can be expensive for an individual company, especially if that company only needs such equipment from time to time. Therefore, it will be more cost-effective if many companies within an STP use the equipment whenever possible.

The argument that pragmatism may underpin the development of STPs is also echoed in a survey conducted by the International Association of Science Parks and Areas of Innovation (2012), which found that many firms regard a park's image or prestige as the key reason for being located in the parks (figure 2.2). Similarly, in Singapore, the tenants had all the pragmatic reasons to locate to the STP (table 2.4).

[4] *South China Morning Post*, available at https://www.scmp.com/news/hong-kong/economy/article/2135332/all-eyes-hong-kongs-science-park-after-massive-hk40-billion (accessed on 25 January 2019).

Figure 2.2. Reasons for tenants to stay in STPs



Source: International Association of Science Parks and Areas of Innovation, 2012.

Table 2.4. Reasons for tenants locating to the Singapore Science Park

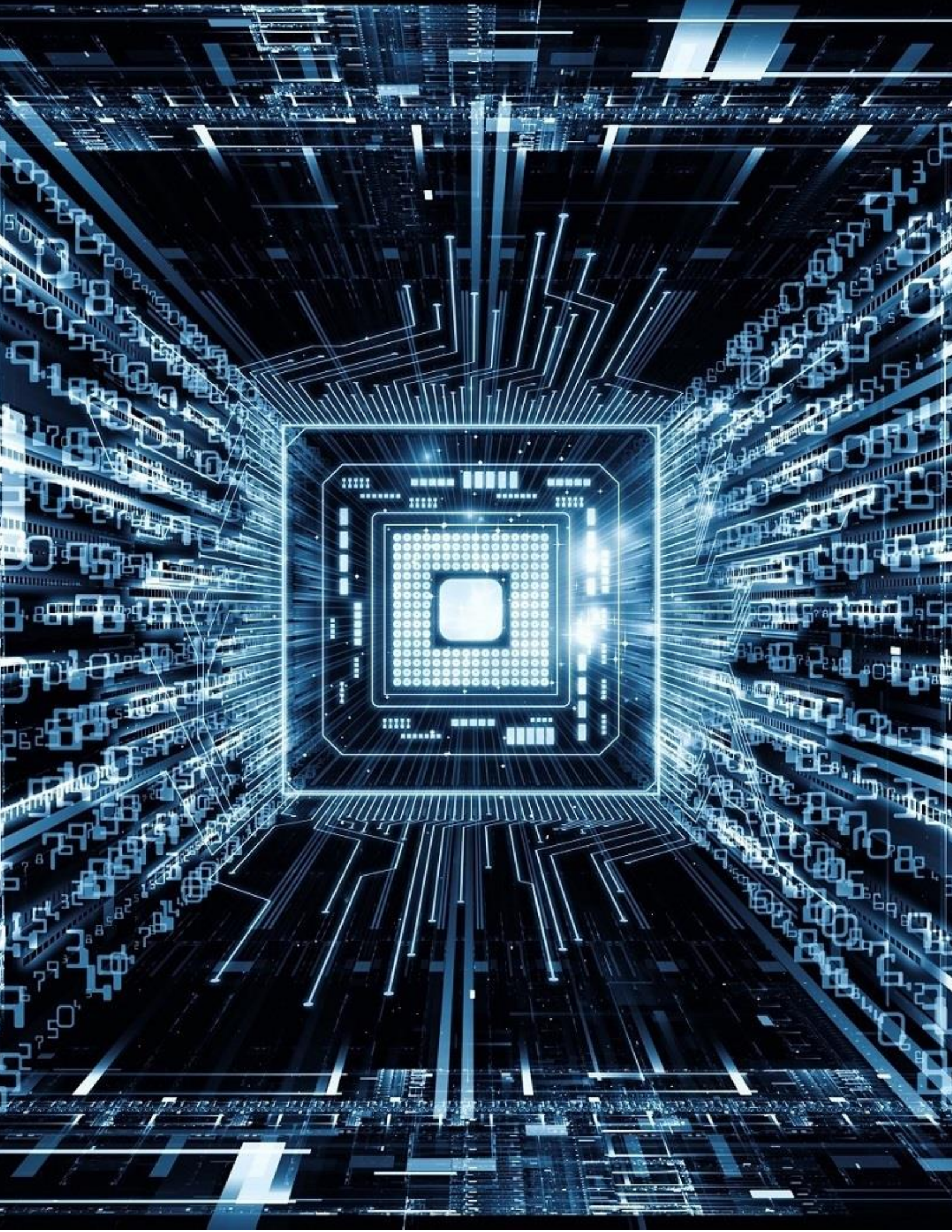
Category	Factors	Responses	
		Number	Percentage
Science park perks	Attractive infrastructure and support service.	26	33.3
	Supportive management.	3	3.8
	Lower costs.	4	5.1
	Total:	33	42.0
Government benefits and incentives	Invited to establish in park.	7	9.0
	Supportive government policies.	7	9.0
	Total:	17	30.0
Spatial proximity	Close to market/demand.	3	3.8
	Convenient location.	10	12.8
	Links with suppliers and industries.	0	0.0
	Total:	23	28.0
Total		70	100.0

Source: Phillips and Yeung, 2003.

2.3. Summary

The reasons for establishing STPs can be illusory. Arguably, the cluster theory, 'triple helix' model and growth pole theories may provide goals to guide policymakers in making their decision to establish an STP. For example, policymakers may wish to facilitate the collaboration of firms and research institutes collocated in the STP, encourage collaboration among academics and firms, or use the STP as a growth pole for local and national economies. However, these theories have been challenged, partly because in practice there have only been rare examples in the Asia-Pacific region that show the validity of these theories.

This chapter finds that pragmatism can be an important reason for establishing an STP. For example, an STP can provide a home for research institutes and some universities, or the expensive equipment for research can be used by multiple companies located within an STP. While collaboration among firms may not occur, it will also do no harm to collocate these companies and firms to within relatively close proximity.



CHAPTER 3

POLICIES ON SCIENCE AND TECHNOLOGY PARKS

At the outset, it is useful to point out that a national policy is not a prerequisite for setting up an STP. Stanford Science Park was established by Stanford University. It was an initiative by a university rather than a central or local Government.

On the other hand, as discussed in chapter 2, the growth pole theory shows that the traditional argument for government involvement in science and technology-related research is the existence of positive externalities (e.g., creating knowledge and technology flows, increasing R&D collaboration, improving human capital mobility etc.). Governments in many countries, therefore, directly support science and technology-related research through funding or tax incentives and by actively managing many public research organizations.

STPs intersect with many different sectors and can be a part of a country's trade, investment, industrial or STI policy. Industrial policy, in general, refers to any type of selective intervention that attempts to alter the structure of production towards sectors that are expected to offer better prospects for economic growth than would occur in the absence of such intervention in the market equilibrium. Industrial policies do not have to be written down or publicized. Whenever a Government consciously favours certain economic activities over others, it can be treated as the implementation of industrial policy.

National science, technology and innovation policies articulate a Government's vision regarding the contribution of science, technology and innovation to the country's social and economic development. They set priorities for public investment in science, technology and innovation, and identify the focus of government reforms.

This chapter contains examples of how STPs have developed in several selected countries in Asia. Each country description includes a brief history of the development of STPs inside the country and the current initiatives that are facilitating the creation of STPs.

3.1. Case studies

China

As part of China's economic transition in the 1980s, the Government implemented the Torch Programme, which was a plan to develop China's science and high-technology industry. Since then, through a series of five-year development plans, China has used industrial estates and STPs to aid the country's economic transition. In the 1990s, China invested heavily at the national level in the planning, oversight and funding of its national STPs. The aim of national STPs included acting as policy sandboxes, developing science and technology industries, creating clusters of innovation and generating technology-based SMEs.

To achieve these aims, China focused on two factors. First, with a clear directive from the central Government, China strategically created STPs inside several major eastern coastal metropolitan areas. These coastal areas were already equipped with many of the precursory elements needed for an STP to succeed, such as large concentrations of people, infrastructure, institutions and access to major shipping ports. Second, the national

and regional Governments coordinated to target a specialized export-oriented industry for the parks, such as ICT, electronics or high-tech manufacturing (Rodríguez-Pose and Hardy, 2014).

The Ministry of Science and Technology (MOST) deals with STP planning, development and promotion by providing policy guidance and financial support. MOST is responsible both for policy design and project implementation. The State Steering Committee of S&T and Education coordinates policies across several different ministries that interact with STPs, such as the Ministry of Finance, Ministry of Education and the Academy of Science.[5]

In March 2013, MOST issued the "Implementation Plan for the Innovation Driven Strategy Improvement of the National High-tech Industrial Development Zone", indicating that STPs would pay more attention to the formation of innovative environment and begin to transform into an all-round development of "innovative economic ecology".

Japan

The development of STPs in Japan dates back to the 1960s. Initially, Japanese STPs were merely technology transfer centres from foreign companies. However, following the oil crisis in the 1970s, the Government created a new plan for 'technopoles' – combining practices from Silicon Valley and the decentralization methods of small British garden cities. The new national STP plan was part of an R&D programme in which local and regional authorities would be responsible for regional development. By 1989, the central Government had constructed about 55 technopoles. Today, there are about 111 STPs in Japan, the names of which include technology park, science city, technopole and science park (UNESCO, 2018a).

The Ministry of Education, Culture, Sports, Science and Technology (MECSST) and the Ministry of Economy, Trade and Industry are the two most important ministries with regard to STPs. The STPs are managed both by the public and the private sectors. MECSST makes a specific STI plan that provides funding support to STPs. Meanwhile, central and local Governments are in charge of STPs and must provide infrastructure and services for them.

There are three STP management systems in Japan, i.e., public, private and third-sector. A large portion of STPs are managed by prefectural or other local government bodies. Some STPs are managed by private companies, such as the Kyoto Research Park. Many of the innovation centres, science parks and R&D parks are managed by third-sector companies or public foundations, such as the Yokosuka Research Park, an R&D cluster for ICT that is focused on radio and communications technologies.

Republic of Korea

STPs have been featured heavily in the Republic of Korea's development strategy. Beginning in the 1960s, the Republic of Korea began implementing national industrial policies that would quickly transform the country from an agricultural economy into an industrialized one. These centralized policies were targeted at increasing national economic growth, creating and nurturing heavy industry (such as fertilizer and cement production), and developing national infrastructure (such as building roads, railways and shipping ports). Industrial parks were a key tool used to achieve these goals.

[5] See http://www.globelicsacademy.org/pdf/CanHuang_paper.pdf, pp.3-5.

Early in their industrial development, the industrial and STPs were separate specialized entities – meaning that the R&D and research institutions at STPs remained isolated from production activities at the various industrial parks around the country.

Since in the 1980s, the country has sought a more 'balanced' national and local development strategy, including nurturing regional growth and creating better housing, medical care, and education, according to the Ministry of Knowledge Economy and Korea Industrial Complex Corporation. As a result, STPs have expanded into more regions across the country with a focus on tasks such as promoting local growth and supporting SMEs. Currently, the country hosts 23 STPs, including five national innopolis, that focus on national economic development as well as 18 techno parks in each province that focus on regional economic development and regional issues.

Singapore

The Singapore Science Park is a specific state-driven exercise to bring R&D to Singapore. Singapore has invested significantly in R&D since the 1980s. Its national expenditure on R&D increased steadily from 0.54 per cent of GDP in 1984 to 1.47 per cent in 1997 and 1.89 per cent in 2000. Singapore's state philosophy was to prepare a conducive R&D environment that would help it to "maintain a competitive environment" in the light of increasing competition in the global economy.

In this national context of promoting research and innovation, the Singapore Science Park was set up in 1980 as a place where R&D could converge and create synergies with institutions and firms alike, and where researchers could work at any time, meet and share ideas. The park's establishment can be read as the "first positive indication" of the Government's recognition of linking R&D activities to its economic policy (Goh, 1998).

Thailand

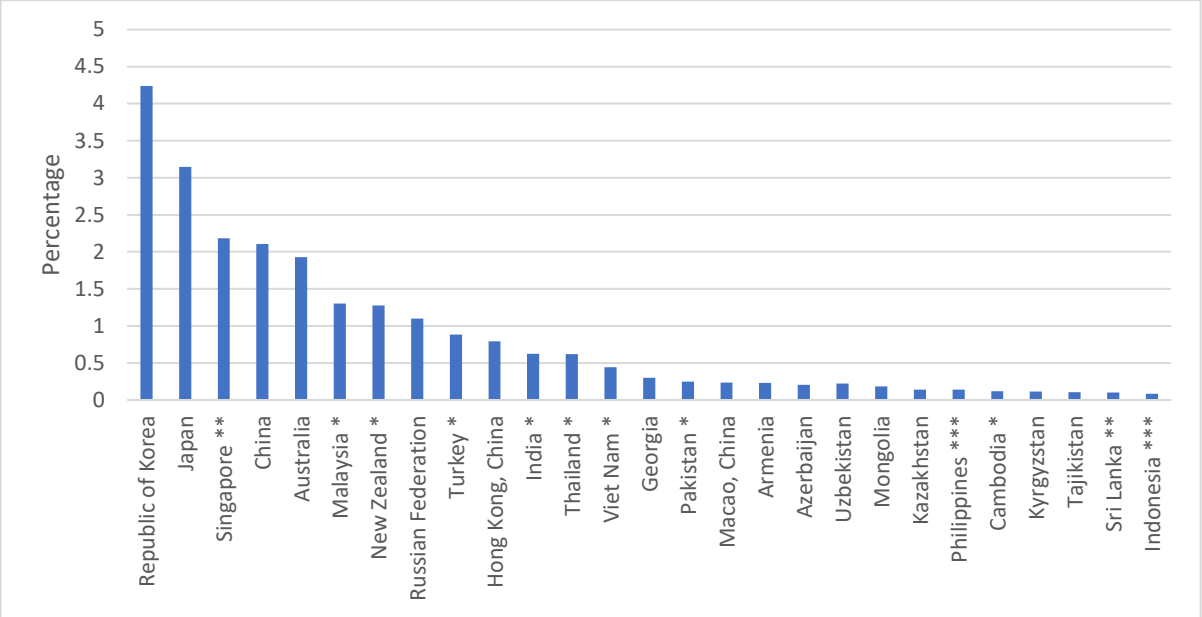
The Sixth National Economic and Social Development Plan, which was unveiled in 1989, incorporated the development of science and technology parks to be established by the Ministry of Science, Technology and Energy, the Ministry of University Affairs and the Ministry of Education. The plan for setting up the Thailand Science Park was approved by the Government and was carried out by the National Science and Technology Development Agency (NSTDA). The first phase of the Thailand Science Park was established in 2002.

3.2. Implications

The case studies in this chapter reveal that national Governments have played a key role in establishing major STPs in a few selected countries in the Asia-Pacific region, including China, Japan, the Republic of Korea, Singapore and Thailand. STPs are often treated as part of broader industrial, STI and trade policies. As an instrument, STPs were prescribed in government policies in order to boost technology innovation.

It is no coincidence that these countries also have made high expenditure on R&D in the region (figure 3.1). With the available financial resources for R&D, these countries are able to establish STPs as bases for R&D.

Figure 3.1. Gross domestic expenditure on research and development as a share of GDP in Asia and the Pacific, 2016 or latest available data



Source: ESCAP, based on data from http://data.uis.unesco.org/ (accessed 16 January 2019).
Note: (*) Data refer to 2015; (**) data refer to 2014; (***) data refer to 2013.

While the situation of these and many other countries in the region is different, their experiences may nevertheless provide the following references.

First, the timing for establishing science and technology parks fit into national industrial and STI policies and economic stage of development. The case studies of these countries echo the information in figure 3-1, which shows that countries have often started with industrial zones that do not contain many R&D components. Over time, these countries accumulated adequate manufacturing experience and, in order to achieve technological upgrading, the countries subsequently invested heavily in R&D. Establishing STPs provides a physical base for R&D.

Second was a gradual process in establishing STPs. In all the countries studied in this chapter, the first batch of STPs was established near a capital or other large city with advanced economic development. The rationale was that these cities often hosted research institutes and researchers. Many precursory conditions for developing STPs were already available, including a critical mass of highly trained workers and adequate infrastructure. When the economies developed in different parts of the country, establishment of STPs often came under the responsibility of local government.

For many developing countries, especially the least developed countries, it may not be feasible to establish STPs if no strong research institutes will be located in the STP. In addition, if there are not enough researchers who are willing to stay in the STP (or its surrounding areas), creating a successful STP is almost impossible. For a developing country, it is probably not a good strategy to establish a large number of STPs at the same time because there are not many research institutes or anchor companies that can become the main tenants of STPs.

Third, financial support from public sector on STPs was crucial. When an STP is to host R&D that is strategically important for a country, and when such R&D cannot be provided by the market, it is essential for a country to provide financial support for such R&D. Accordingly, if the key institutes in charge of R&D are located in STPs, it is important for country to support such STPs.

In such a case, fundamentally the country supports an STP because such an STP hosts R&D that is strategically important for that country. However, such support must be accompanied by accountability; therefore, an STP should provide key performance indicators for reporting to the public on the progress of its work and achievements in order to justify the social investment in the STPs.

The governance structure, financing arrangements, incentives offered, and the tenants and industries targeted will all have a significant impact on the success of STPs. Governments should be cautious when drawing direct parallels from the examples below, as the success of a park must be viewed in the context of that park's structural and organizational arrangements as well as the country in which it is located. Nevertheless, drawing from the experiences of other Asian STP success stories reveals many practical benefits and can help others to extract best practices for park planning and management.

This chapter primarily targets policymakers rather than the managers of STPs. Accordingly, the focus of discussion is mainly about the planning, success factors and lessons learnt from STPs. The discussion is largely at the macro level rather than the daily management of STPs.

4.1. Selected STPs in the Asia-Pacific region

Kanagawa Science Park, Japan[6]

(a) Planning factors and structure

In an effort to support local governments to develop regional innovation ecosystems, the Kawasaki City Government and Kanagawa Prefectural Government initiated the creation of the Kanagawa Science Park in 1984. In addition to the local government bodies, KSP Inc. and the Kanagawa Academy of Science and Technology (KAST) have played a significant role in shaping the park ecosystem. KSP Inc. handles the policy, business and operational components of the park, including coordinating workshops and seminars, managing incubation and investment as well as working with local governments to develop industrial policies. KSP Inc. also works on continuous education and adult training activities in the region. KAST works to support R&D activities, including assisting with patent and IPR activity, managing research projects and shaping local R&D programmes.

KSP is the largest in a network of three nearby parks, including also Shin-Kawasaki Science Park and Techno Hun Innovation Kawasaki. KSP operates on a public-private partnership model – including co-investment (about one third of its investment is from public funds while the remainder is from privately funding) and co-management (including local actors integrated into the system). At the national level, the Ministry of Economy, Trade and Industry has contributed to KSP through continuous funding for industrial activity and support from the national economic promotion office.

[6] The discussion in this section is derived from Launonen and Viitanen, 2011, and further information on the website of Kanagawa Science Park (http://www.ksp.or.jp/).

KSP offers high-tech infrastructure and R&D facilities (laboratories, data warehousing, high-speed fibre etc.); knowledge-intensive business services (consulting, design/PR, accounting etc.); and incubation and growth entities (including an SME development support centre).

(b) Success factors and lessons learnt

Kanagawa prefecture, where KSP is located, has approximately 63,000 people working at academic and R&D institutions, the highest number in Japan. It also hosts the second-largest number of R&D labs and offices in the nation. KSP has benefitted from being located close to Tokyo, a dense urban population, high-performance universities and major seaports. In addition to its strategic location, the successful development of KSP can also be accredited to its well-known domestic tenants, such as Hitachi and Fujitsu. These companies brought in top-tier R&D facilities and laid the foundation for prosperous incubation activity by motivating local innovation activities. KSP has incubated more than 500 companies, including 11 listed on the Tokyo Stock Exchange.

The 2008 intellectual property policy initiative was also a significant driver in attracting major foreign companies to KSP, through providing a transparent and predictable innovation environment for them to engage in R&D and IP activities. However, despite the positive effects, IPR protection and the fear of trade secrets being leaked have contributed to a "closing off" of private companies and a reduction in their participation in collaborative park projects and initiatives over time.

At the policy level, local governments have played a crucial role in building active networks and links between actors, allocating infrastructure resources, and promoting coordinated and strategic local industrial policies that are both directive and supportive of park activity and development. Local governments have incorporated local actors in the park and actively informed the public about KSP activities, updates and developments. The level of local government involvement and policies have allowed the growth of indigenous innovation in a local context as well as contributing to the continuous positive support from the community.

Zhangjiang High-tech Park, China[7]

(a) Planning factors and structure

In 1992, the Zhangjiang High-tech Park was established in Shanghai, China. Zhangjiang was originally identified as a strategic port location for economic development and high-tech industrial development. However, in 1999, the Shanghai Municipal Government issued a policy document reformulating Zhangjiang into a pilot zone, thus enabling reform and science and technology R&D development in the park. From 2011, through the central Government's initiatives and with the support of the Shanghai Municipal Government, Zhangjiang moved away from high-tech manufacturing towards an innovation-oriented model that focused on developing indigenous technology rather than relying solely on foreign companies. Today, Zhangjiang is an international innovation

[7] The discussion in this section is mainly based on Launonen and Viitanen, 2011, and further information on the website of Zhangjiang High-tech Park (https://www.zjpark.com/).

ecosystem inside China, supporting business incubation, R&D activities, production and high-tech industrial development.

Zhangjiang's development has been driven by active central and municipal government policy, management, and administrative and financial support. Zhangjiang is funded by the central Government, based on its status as a special economic development zone, and companies in the park benefit from a well-developed banking and financial system, access to venture capital companies and proximity to the Shanghai Stock Exchange.

The Shanghai Zhangjiang High-tech Park Development Company (ZHPDC) is responsible for the park's management, land development and operational development. Under the direct supervision of the central and municipal Governments, ZHPDC also facilitates the tenant firms' use of park services. The central Government provides support for specifically targeted industries in Zhangjiang, including biotech, software, integrated circuits and digital culture. Each industry is clustered into a full-value system that integrates research with private sector actors and includes R&D, active commercialization of related research, training facilities, related business incubation centres, production, manufacturing and marketing.

Today, Zhangjiang hosts 70 regional research centres, 149 foreign R&D centres, 19 business incubation centres, 15 universities and more than 3,500 companies – including 300 top-tier, high-tech companies such as Qualcomm, Baoxin Software and IBM.

(b) Success factors and lessons learnt

The development of Zhangjiang can be attributed (in part) to the provision of significant central and municipal government policy and financial support – with strategic and special attention given to key industries that were targeted for development and clustered inside the park.

Zhangjiang focused on attracting private companies with favourable tax and customs policies as well as preferential business procedures that include streamlined visa and product certification processes. The combination of the opening of the Chinese market with foreign multinational enterprises recognizing the untapped potential of the Asian market has also contributed to the high number of tenant companies. Attracting foreign direct investment, foreign companies and foreign research centres at an early stage was a strategic priority that contributed significantly to the development of the park.

Skolkovo Innovation Center, Russian Federation[8]

(a) Planning factors and structure

Skolkovo Innovation Center (Skolkovo) was established in 2010 by federal law. The park was created around a newly-built Skolkovo Technopark and a new research university (Skolkovo Institute of Science and Technology, Skoltech) – built for the purpose of transforming the technologies created in Skolkovo and by Skolkovo residents into products for the market place. The mission of Skolkovo is to commercialize technologies into the Russian economy. Tasked with providing a catalyst to help diversify the Russian economy, Skolkovo's goals are to create a sustainable ecosystem of entrepreneurship and innovation, engender a startup culture and encourage venture capitalism.

Skolkovo was established and funded with the federal budget and by private investors. The construction of two major buildings, Skoltech and Technopark, was fully sponsored by the federal Government. The remaining buildings were funded by private investors.

[8] This section was prepared by Ivan Bogdanov.

Skolkovo is composed of companies and startups, a Technopark, Skoltech and Skolkovo city – all of which are located near Moscow. The city includes apartments with smart home technologies, a gymnasium, transportation hub, sports centre and hotel. The unmanned taxi system, "Yandex", is also operating in a test mode in Skolkovo city. Skolkovo identified four key areas of potential growth – IT, energy efficiency, biomedicine and advanced manufacturing technologies. Modern hi-tech equipment for scientific research is concentrated in the laboratories of Skoltech, located on 400 hectares in the Skolkovo Technopark, and inside the R&D centres of large companies and other Skolkovo tenants.

The Skolkovo ecosystem supports tenants and creates projects from R&D, through incubation and all the way to industrialization. A variety of business services are provided for tenants, including legal, IPR, certification and standardization, accounting and finance, and customs facilitation services. In November 2018, the Center for Certification and Standardization moved into Skolkovo. It advises Skolkovo firms on the national and international certification and testing procedures in order to streamline the processes and help firms to quickly place their new products on the market. In the future, the goal is to create a Skolkovo certification body where foreign laboratories can receive the necessary accreditation.

Since its inception, Skoltech has created 75 startups – 20 of which later became Skolkovo residents. The Skoltech Translational Research and Innovation Program supports research teams at Skoltech in establishing proof of concept and in advancing their technology towards commercialization, including pre-startup identification of high potential market opportunities, intellectual property management and team development. Access to the Skolkovo ecosystem extends to businesses outside of Skoltech and even to those located outside of Moscow. In 2017, active regional development began, which allows regional startups to also become Skolkovo residents and enjoy the advantages of park status including incubation and business support.

In the acceleration stage, a company develops its product and creates a prototype. The Skolkovo residents have access to the entire arsenal of support tools – both monetary (tax breaks and grants) and non-monetary (access to infrastructure and partner networks) – which work towards attracting investment.

In the industrialization phase, finished products are launched on the Russian and/or international markets. Skolkovo is involved in a consulting capacity by helping to prepare presentations and pitches as well as searches for customers and investors. Skolkovo residents can also submit applications to Skolkovo Ventures, an investment platform in the Skolkovo ecosystem that manages three funds created together with the Russian Venture Company and private partners and helps to attract external financing. At the end of 2017, Skolkovo Ventures accounted for 40 per cent of all venture capital deals in the Russian Federation. In 2018, the total

revenue of 1,900 start-ups (residents of Skolkovo) exceeded $800 million, with a significant amount of that revenue being generated by 300-400 companies that already had a finished product.

(b) Success factors and lessons learnt

Skoltech plays a key role in the life of the Skolkovo innovation Center. Skoltech is a private Russian graduate university that was specially created for Skolkovo and built on the principles of the Massachusetts Institute of Technology. Skoltech has 14 laboratories working in the areas of artificial intelligence, data science, the Internet of Things, advanced manufacturing, photonics, hydrocarbon recovery, smart energy systems, space engineering and biotechnology. The mission of Skoltech is to create and commercialize technology by creating startups and boosting joint research with industry. In this context, Skoltech focuses heavily on envisioning a market and an implementation model for the technology being created, a philosophy of commercialization that is emphasized and supported throughout the Skolkovo ecosystem.

Skoltech works specifically to facilitate university-industry relationships. For example, the Skoltech Industrial Advisory Groups comprise representatives of hi-tech companies and industry professionals with a clear understanding of the market needs in various fields. These groups work with Skoltech professors to create priority areas of development for Skoltech, including research areas, training directions of future students and laboratory facilities.

In order to attract industrial partners to Skolkovo, Skoltech university provides a number of free-of-charge services for industry. The Skoltech Master's Programme allows students to spend some time working on projects with industry professionals, such as through a summer internship programme. In addition, industry partners may attend most Skoltech seminars free-of-charge, including guest lectures, workshops and colloquiums, many of which are devoted to industrial technologies. Skoltech also publishes public analytical reports and white books on global science, industrial policy issues and upcoming trends that involve various high-tech industries, such as advanced manufacturing technologies, photonics and the Internet of Things. These publications attract the attention of industry, enticing many companies to engage Skoltech for consultation advice and research projects.

A key condition for commercializing research in Skolkovo was the creation of a specific culture of innovation within the ecosystem of the park, a key driver of which is the Skoltech Center for Entrepreneurship and Innovation (CEI). The CEI works to facilitate this culture by (a) linking research and education with innovation and entrepreneurship through extracurricular programmes as well as (b) linking commercialization and administrative services, in order to support knowledge and technology transfer within the community. On the education side, students gain a better understanding of the commercialization process through activities such as student/staff clubs, business planning and new venture competitions, and mentoring opportunities. In addition, the curriculum specifically incorporates entrepreneurial skills, which contributes to the innovation and commercialization culture within the park's ecosystem.

Skoltech laboratories recognize and emphasize basic research as an engine for innovation, and they provide opportunities for strategic cross-disciplinary research in key technology-themed areas. The CEI then utilizes innovation grants to translate that basic research into products that can address specific market opportunities. Additional Skoltech research is aimed at the management and practice of innovation and entrepreneurship in the Russian context, in order to understand and improve upon the regional business and social dynamics of entrepreneurship in the country.

For commercialization, the CEI provides an administrative framework for capturing and creating value arising from research. Their support includes: identifying, creating and protecting intellectual property; implementing best practices in technology transfer that are fair and transparent; providing guidelines for preventing conflict of interests; providing mentoring across the entire value chain from ideas to commercialization; and building and nurturing connections and networks in and outside the university.

CEI also includes a Knowledge Transfer Office (KTO), which is responsible for providing identification, analysis, protection and licensing services for Skoltech's intellectual property. KTO facilitates students by guiding them through the steps needed to commercialize their research results. The mission of KTO is to advance science and contribute to the beneficial effects on society by moving the benefits of the Skoltech research through the technology transfer process, consistent with rigorous academic and ethical standards, faculty and student welfare, and freedom of research.

Skolkovo and Skoltech represent a single system of instruments, working towards creating technologies and commercializing them. Skolkovo and Skoltech complement each other, making sure that efforts serve the common goals of Skolkovo development. Skoltech plays a critical role in the life of Skolkovo, making the park truly innovative.

Thailand Science Park, Thailand

(a) Planning factors and structure

To help stimulate economic growth and move Thailand towards becoming a knowledge-based economy, the Thailand Science Park (TSP) was initiated in 1993 and launched in 2002. Its mission was to promote innovation and R&D activity in the private sector, and to develop skilled R&D manpower for the country. The launch of TSP consisted of two development phases. The first phase was to build up a critical mass of R&D, including the relocation of the National Research Centers to the park in 2002, and attract more than 50 tenants by the end of 2007. The second development phase was aimed at encouraging more private sector companies to locate inside

the park – a process that is still ongoing. TSP is the first fully integrated hub of R&D in science and technology in Thailand, and functions as a way to foster tripartite collaboration between industry, academia and government.

The implementation of TSP was built and championed by a team inside the National Science and Technology Development Agency (NSTDA). TSP is under NSTDA's management and serves as the NSTDA headquarters. Apart from technical services, NSTDA provides financial support to encourage R&D in the private sector in the form of soft loans, R&D grants, innovation vouchers, startup vouchers and joint investment. In addition to financial support, TSP offers a variety of unique incentives for tenants, such as opportunities to collaborate on NSTDA research projects and becoming involved with the Innovation and Technology Assistance Programme, which focuses on supporting the growth of SMEs.

TSP covers four zones: (a) NSTDA and its research centres as well as the Technology Management Centre; (b) an incubation space; (c) a rental space for technology-based firms; and (d) land for renting to companies to construct their own R&D centres. TSP focuses on a variety of research sectors including agriculture and food, materials science and chemicals, and electronics, robotics and automation. TSP is home to four national R&D centres as well as foreign R&D centres, dozens of corporate firms and the Food Innopolis.[9]

TSP provides many facilities for tenant firms including laboratories, equipment, and hard facilities such as pilot plants, greenhouses and soft services through NSTDA. In addition, TSP functions as a service centre for technology transfer and technology commercialization, and as an incubator for Thai SMEs and start-ups.

(b) Success factors and lessons learnt

Many factors have contributed to the success of the Thailand Science Park. Among others, TSP's special status as the headquarters of NSTDA has created an environment conducive to R&D cooperation and commercialization. TSP's active promotion of the shared use of laboratories and high-tech equipment has provided support for R&D activity in local business endeavours.

Daedeok Innopolis, Republic of Korea

(a) Background

In 1973, the Republic of Korea initiated its first STP, Daedeok Science Town, in Daejeon City. Daedeok Science Town originally focused on promoting domestic science and technology development and enhancing the international competitiveness of the Republic of Korea by providing modern infrastructure for research institutions. In 2005, the area was redesigned as a special R&D zone and was renamed Daedeok Innopolis (hereinafter Daedeok) – focusing more on commercializing research by connecting R&D with private firms and production facilities. Today, Daedeok is a 'full service' park and a hub for global technology commercialization by combining R&D, business and production.

(b) Planning factors and structure

The central and regional Governments have played a major role in the planning and development of Daedeok. The central Government has facilitated both R&D and commercialization in targeted industries through supportive regulation and policies for park activities as well as through billions of United States dollars in public

[9] Details of Food Innopolis are available at http://foodinnopolis.or.th/en/home/.

investment.[10] Daedeok is financed almost exclusively through public funding, which also functions as a way to entice the private sector to collaborate and join projects within the park by giving them access to research facilities. In addition, more than 20 venture capital funds are operating in the Daedeok ecosystem to support business incubation. These venture funds are also actively supported by the public sector.

The Innopolis Foundation is a public sector entity that manages and coordinates Daedeok's operational activity and development under the direction of the central Government and the Ministry Knowledge Economy. Daedeok residents include universities and higher education entities, government-sponsored institutes (including government research facilities), government agencies, public institutions, non-profit institutions, and private enterprises. Daedeok focuses on information technology, nanotechnology, biotechnology, energy and environmental technology, and space technology industries.

Daedeok offers many services for tenant firms, including R&D facilities, laboratories and production equipment that are clustered in the park and open for shared use. Other services include advisory services on attracting foreign investors, vertical integration services, research commercialization services, and various professional services (patenting, IPR protection, legal, consulting etc.). Daedeok functions heavily as a facilitator of research commercialization by identifying and targeting products and outputs and pairing together local actors on joint projects.[11]

(b) Success factors and lessons learnt

Daedeok has played an important role in driving national economic and industrial growth as well as creating indigenous intellectual property and patents. As of 2016, Daedeok housed 26 government research institutes, 7 universities, 1,669 firms (including 40 KOSDAQ-listed companies), and 33,138 researchers (including 15,269 PhDs).[12]

Many factors have contributed to Daedeok's development. Crucially, Daedeok has benefitted from the central Government's significant policy and financial support. Additionally, Daedeok's legal status as a special R&D zone and innovation cluster has allowed critical resources to be channelled into the park and has created a favourable business environment.[13] The shift from a predominately research-focused entity towards a collaborative organization that focused on commercializing research projects in the early 2000s also played an important role in overcoming Daedeok's early challenges and put it on track for its development. Finally, park plans, and activities have been tightly integrated with the regional and national innovation ecosystem, which allowed the Government to target strategic industries for development. As such, the park has been able to facilitate the collaboration of joint commercialization projects in those strategic industries between researchers and companies.

[10] Launonen and Viitanen, 2011.
[11] Launonen and Viitanen, 2011.
[12] Daedeok Innopolis, 2016, available at https://dd.innopolis.or.kr/; Launonen and Viitanen, 2011.
[13] Launonen and Viitanen, 2011.

Puspiptek, Indonesia

(a) Background

In 1976, Puspiptek was established by a Presidential Decree in Serpong District, about 30 km from Jakarta. Puspiptek was originally positioned as the Science and Technology Centre, which included a number of research institutes and was focused on national science and technology development. From 1980 to 1998, Puspiptek served as the backbone for strategic industries in Indonesia, such as aerospace, and hosted PT Dirgantara Indonesia (Indonesian Aerospace). From 1998 to 2014, Puspiptek was mainly focused on research and technology development. In 2014, Puspiptek was upgraded to a National Science Technology Park, expanding its role as a centre for quality research, development and technological innovation.

(a) Planning factors and structure

Puspiptek is funded by the central Government and administrated by the Ministry of Research, Technology and Higher Education. Puspiptek functions as a hub for national and regional innovation centres – connecting the Government, universities, R&D, high-tech industrial centres, and businesses or entrepreneurs in the area. Every year, the Government carries out an evaluation of the park based on various indicators.

All technology R&D and testing centres and laboratories in Puspiptek are affiliated to government research institutes or central government agencies. The R&D activity is diverse, covering many areas, including food and agriculture, health and medicine, renewable energy, ICT, transportation, security defence, advanced materials and maritime elements. The local government authorities are responsible for regulation, housing, and infrastructure outside the park. Private sector entities can use the facilities and laboratories as well as carry out joint research projects and utilize testing centres to develop products.

In Puspiptek, incentives, expertise and consultations are provided in order to support the innovation development process. For example, the technology business incubation centre carries out a co-incubation programme with incubator partners that is aimed at developing and multiplying technology-based entrepreneurs. The centre provides a variety of services and facilities during all stages of the incubation period

(b) Success factors and lessons learnt

Many factors have contributed to Puspiptek's development – most notably a strong government commitment to sustain Puspiptek over the years by mobilizing funds, providing infrastructure, and creating a supportive policy and regulatory environment. Additionally, quality human resources that are responsible for managing the science park and S&T activities, have also contributed to Puspiptek's development.

Pardis Technology Park, Islamic Republic of Iran[14]

(a) Background

In order to encourage and support hi-tech companies in increasing their ability to compete in the international world market, the Pardis Technology Park (PTP) architecture committee began planning the development of PTP in 2002. Prior to construction, the Government conducted preliminary studies on location selection and a national PTP model. PTP is located on an area measuring 60 hectares (expandable to 1,000 hectares) situated 20 km north-east of the capital, Tehran. It is 93 km from the international airport and 2 km from a residential area known as Pardis New Town. Innovation Paradise (phase 1), Health Paradise (phase 2) and Entrepreneurship Paradise (phase 3) are the main existing phases in PTP. Other phases constitute the future stages in the PTP expansion plan, which will eventually expand up to 1,000 hectares. Its vision is to become the most important technology free-zone in the West Asia.

In 2016, around 240 high-technology companies were operating in PTP. These companies, which were rigidly selected for membership, comprise many industries, including electronics and telecommunications, automation and new mechanics, and IT and ICT. PTP welcomes companies in any field of high-technology, including IT, electronics, biotechnology, nanotechnology, advance materials, telecommunication, medical equipment, and mechanics and automation.

(b) Planning factors and structure

The Government acts as the administrator of the park and a facilitator of tenant activities. The Board of Trustees is its highest level of administration and is composed of 14 members, including the First Vice-President of the Islamic Republic of Iran as the head of the board. Other board members are from government ministries, science centres and academia. The tenants also have representatives on other boards and councils in the park.

Government support includes incentives (tax exemption), deregulation (including labour, importing and FDI), and financial support (including bank loans and government supportive programmes). PTP is under the auspices of the Ministry of Higher Education and the Ministry of Science, Research and Technology. The private sector also plays an important role in PTP. Government funding is used for the construction of infrastructure and urban facilities, payment of the managerial team and maintenance of the central complex. Private sector funds are used for elements such as building R&D centres and buying land .

Multi-tenant buildings and land plots as well as a technology incubator are available at PTP, which provide various functional services for companies at different stages of development. Additionally, PTP offers many business support services, including marketing, IP services and accounting, to help promote the commercialization of research and technology transfer inside the park.

(c) Success factors and lessons learnt

The success of PTP and its tenants is due to their cooperation and collaboration, which has contributed to the development of advanced technology and acted as a gateway to the international marketplace. In 2014, through hi-tech products markets, PTP generated $666 million through the domestic market and contracts with 38 countries. PTP is a member of international science park associations, such as the International Association of Science Parks and World Technopolis Association, and it cooperates with entities around the world, including STPs, scientific research centres and industrial centres.

[14] This section is derived from the Pardis Technology Park brochure, 2017

4.2. Implications

Among the seven case studies in this chapter, five STPs were established before the year 2000 (Skolkovo and Pardis are relatively young compared with other STPs). In other words, these parks have existed for more than 30 years, which in itself probably illustrates their success.

Many factors underpin the successes of these STPs. Two common factors in particular need to be highlighted. First and foremost, financial support or supporting policy (such as tax incentives) have played an important role in establishing the STPs. In fact, for all the STPs listed in this chapter, the Governments concerned provided financial incentives.

Second, the locations of these STPs mean they are able to attract important tenants. All are close to the capital, Tehran, or large cities that already have universities, research institutes and researchers. In addition, the fact that these STPs are located in large cities makes them attractive to international companies eager to enter the market. The locations also mean these STPs attract professional talent.

It is important for these factors to be interpreted carefully. First, as discussed in the following chapter, government support for STPs needs to be securitized. Second, both factors should be treated as necessary conditions for the success of STPs. However, these two factors alone cannot guarantee the success of STPs, as many other factors exist that underpin the success of STPs. For example, effective management is essential in order for the STPs to adapt to the ever-changing market situations. The management team is often responsible for managing multiple tasks such as coordination and communication among various stakeholders, R&D, talent, capital, infrastructure and other activities and construction works. In order to fulfil such management tasks, the management team needs to have expertise in not only R&D, but also business, marketing, negotiations and communications skills. Furthermore, the management team must be able to adjust its strategy in an ever-changing environment.

CHAPTER 5

ADJUSTMENT OF SCIENCE AND TECHNOLOGY PARKS TO THE DIGITAL WORLD

In an era of digital technology, there are new opportunities and challenges for STPs. ICT and communication technologies will create new opportunities for cooperation among the partners within and beyond STPs. On the other hand, as digital technology may mean the physical presence in the same park may not be necessary and undermine the raison d'être of STPs.

How can STPs adjust to these new challenges and capitalize on the opportunities of technology? While there is no one size-fits-all solution, the general recommendations in this guidebook can be summarized as the five "Cs", i.e., Capacity, Collaboration, Content, Capital and Communication.

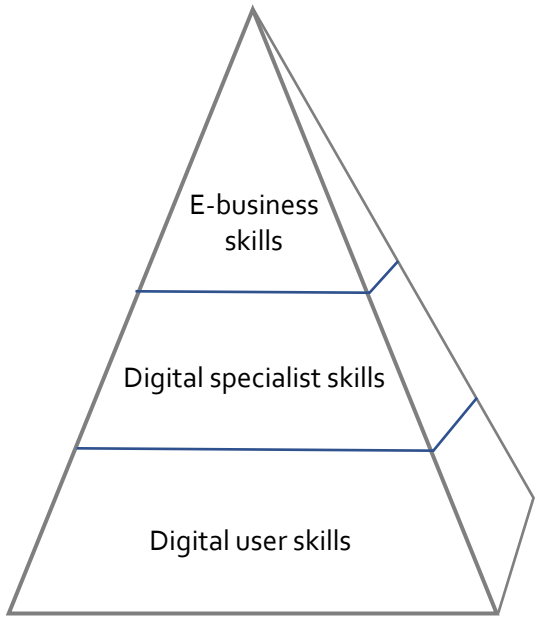
- **Capacity**

The capacity of policymakers in charge of planning and developing STPs, the managers and tenants are fundamentally important for the success of STPs. Government officials do not need to have full knowledge and expertise related to day-to-day management of STPs. However, they need to have adequate knowledge of the key features of STPs, which is essential to making relevant policies for deciding whether STPs in a country should be developed or supported.

The management team of STPs is a key to success. To embrace the opportunities brought about by digital technologies, the management team needs to have at least a broad and basic level of digital literacy and competency, and a basic level of e-business skills. A pyramid of skills is shown in figure 5.1. Clearly, the more skills the management team has, the more likely the STP may utilize digital technologies.

The tenants of STPs need to master digital specialist skills and e-business skills. The specialized skills will ensure that quality products will be produced by utilizing alternative digital technology. Furthermore, e-business skills are required in order to move the products from laboratory or factory to the market.

Figure 5.1. The digital skills pyramid for management team and tenants of an STP



E-Business, e-leadership, digital entrepreneurship skills: Being able to identify how technologies can create new business opportunities, new business models, new ways of doing existing things; being able to communicate a business case to banks and investors in order to raise finance; and innovate, embrace and manage through change.
Digital specialist skills: The skills required for researching, developing, designing, strategic planning, managing, producing, consulting, marketing, selling, integrating, installing, administering, maintaining, supporting and servicing ICT software and systems.
Digital user skills – basic to advanced: The skills required for the effective use of ICT tools, systems and devices to support non-ICT tasks/functions. User skills cover use of the Internet, apps, basic and advanced software, and specialized tools supporting business particular functions. Basic digital literacy and digital information literacy are also included.

Note: The idea of the pyramid of skills for an STP was inspired by UNCTAD, 2017 (p. 66).

- ## Collaboration

While collaboration is probably one of the main ideas why firms (or tenants) co-locate in an STP. However, as argued in Chapter 2, In practice, success stories of collaboration are far less frequent than what is theorized.

To promote collaboration among the players within and beyond an STP, ICT and digital solutions to connecting parks internally and externally should be explored. Furthermore, collaboration should be looked at beyond an STP. A few good examples of this are available. The Hong Kong Science Park indicates that its international collaboration and business development team "aims to build up and foster the international community at Hong Kong Science Park, by reaching out to connect, building relationships for collaboration, and realizing results to catalyze values".[15] In Thailand, Tokyo Tech was invited to open its office in the Thailand Science Park to support the development of specific areas of science and technology personnel in Thailand.[16]

To deepen the collaboration, experts or managers from other countries may be invited to join the board or management team of science parks. The rationale is that these experts or managers may bring new ideas and management expertise. ICT and communication technology make it much easier for these experts or managers to participate in meeting virtually, especially if physical travel is a challenge for these experts.

[15] Additional details are available at https://www.hkstp.org/en/how-we-serve/market-and-industry-adoption/international-collaboration/.
[16] Additional details are available at https://www.nstda.or.th/en/index.php/linkages/international-collaboration/nstda-and-japan.

- **Content**

The industries and sectors developed in STPs should be organized according to the national plans and strengths of each country or economy. For example, as part of the efforts to turn the city into an innovation and technology (I&T) hub, the Government of Hong Kong, China allocated HK$10 billion for funding world-renowned research institutes or tech enterprises to conduct midstream and downstream research and development projects in the areas of biotechnology, artificial intelligence and robotics technologies in Hong Kong Science Park.[17]

Of course, not every STP should be focused on frontier technologies such as artificial intelligence. The focus sector or industries of an STP should be compatible with the foundation of science, technology and innovation in a country. In some cases, an STP may focus on a niche area that draws on the local strengths or priorities. For instance, Software Park Thailand, under the auspices of the National Science and Technology Development Agency, Thailand, is specialized in supporting and strengthening software industry development in the country.[18]

While an STP exists in a local context, it has to think globally. Digital technology and the Internet provide numerous opportunities for a local entrepreneur to search for global innovative areas or solutions. For example, where a technology may not be globally new but is new to a country or an area in a country, the entrepreneur may explore the possibility of adopting or adapting such technologies in a local context.

- **Capital**

As discussed above, an STP may not be fit for incubation or a start-up programme. Venture capital may provide a solution for the start-up programme in an STP. Indeed, available data show that venture capital is very effective in boosting start-ups. One study showed that Silicon Valley attracts 27 per cent of the total venture capital invested in the United States of America. Another study showed that on average a United States dollar of venture capital appears to be three to four times more potent in stimulating innovation than a United States dollar of traditional corporate R&D (Lerner, 2002).

Some STPs have established their own venture capital programmes. Nevertheless, it is always useful for the firms within STPs to look at the opportunities for collaborating with external or overseas venture capital. This is because such venture capital may bring further insights into broad or international markets, or skills and experiences to work with start-ups.

- **Communication**

When an STP is funded by a Government, whether national or local, it is important to communicate with the country or the region concerned on what an STP has contributed to the local or national economy. It is not uncommon for STPs to be labelled "white elephants".[19] Therefore, every STP should endeavour to utilize every possible communication channel to showcase its merits and social contributions. Ideally, the achievement of an STP needs to be reflected by Key Performance Indicators and published.

[17] Additional details are available at https://www.scmp.com/news/hong-kong/economy/article/2135332/all-eyes-hong-kongs-science-park-after-massive-hk40-billion.
[18] More details are available from http://www.swpark.or.th/index.php.
[19] See for example, https://www.scmp.com/lifestyle/arts-culture/article/1556997/just-how-useful-have-cyberport-and-science-park-been.

CHAPTER 6

CONCLUSION

After reviewing the national policies on STPs and the case studies of five STPs in the region, this chapter discusses a few questions related to policymaking. This chapter is also forward-looking, as it discusses how STPs should embrace the new opportunities provided by this era of digital economy. Conclusions are also provided.

6.1. Should Governments financially support or provide financial incentives for STPs?

The review of the national policies on STPs and case studies of several STPs in the region show that national support – financially or through tax incentives – is essential for the success of STPs. This may give some policymakers the impression that a country should financially support STPs.

To discuss the question on whether a Government should provide financial support or financial incentives for STPs, it is important to divide the question into two parts: (a) what is the main purpose of establishing an STP; and (b) is an STP the most effective solution for achieving such a purpose?

The main purpose of establishing an STP is an important factor in considering whether a Government should financially support an STP. The assumptions behind government support for STPs are that the social investments will produce social benefits. In other words, support for STPs should not be treated as unconditional. The STPs need to demonstrate that they make a substantial contribution to national STI or contribute greatly to either the national or the local economy. It will be a mistake to use government funding to benefit only a few companies or other tenants within the STP or protect the vested interest.

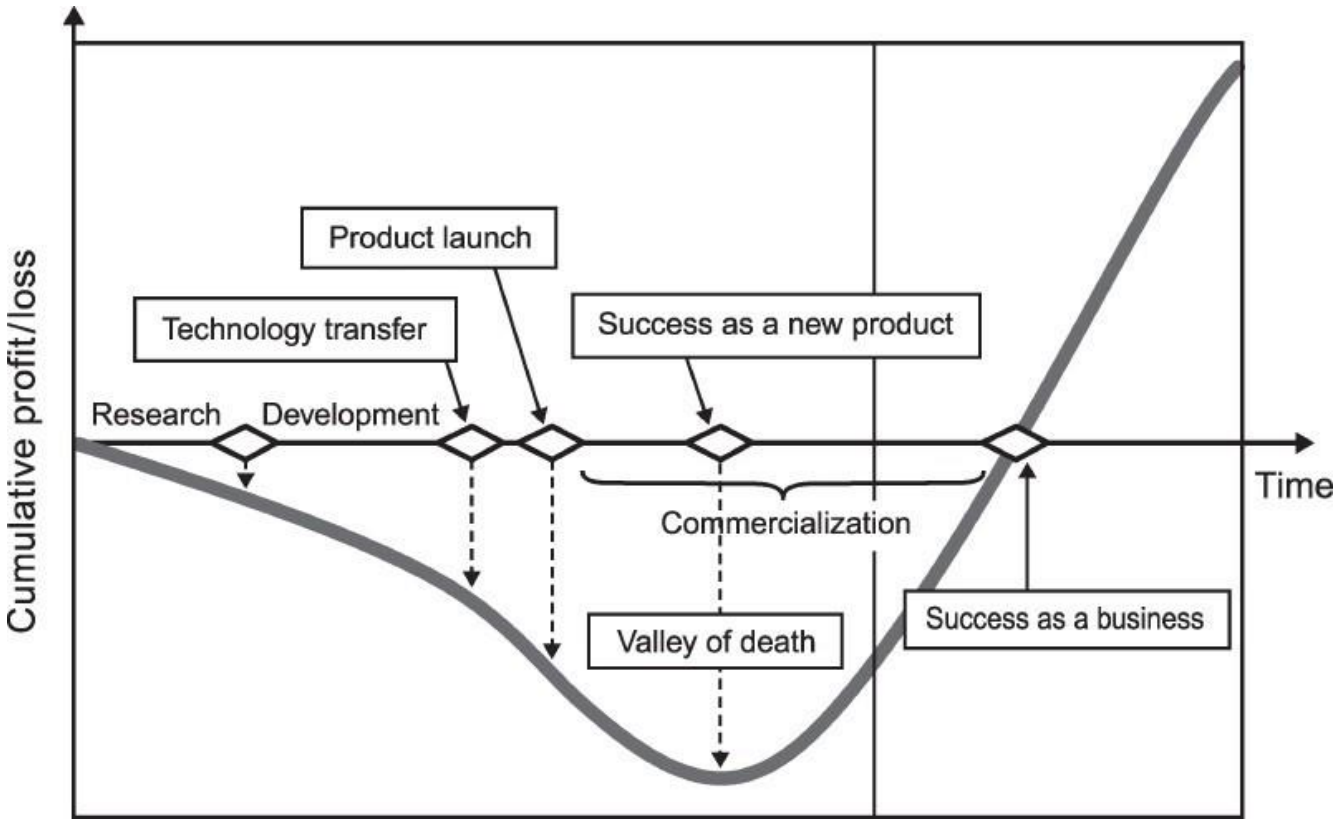
In this sense, it may be argued that if an STP is part of a major plan for national R&D – for example, to provide a physical space for R&D – a Government may consider supporting such STPs. In many cases, investment in R&D cannot be solved by the market because the returns on R&D may be long-term and there is lack of incentive or interest in investing by the private sector. Government intervention may be essential to overcoming such market failure.

However, when R&D is the key objective of an STP, it is important that a Government monitors whether the tenants inside the park are really delivering R&D. Some firms, including multinational companies, may be located in an STP but their key R&D may be carried out in other places, rather than in the STP. Alternatively, if R&Ds in these firms cannot bring any tangible benefits to the local economy, it is questionable whether public subsidies should be provided to them.

Should a Government finance an STP if its main purpose is to nurture start-ups and innovation? The answer to this depends on a few related conditions. First, an STP may not be in the best position to provide such a service. The assumption that an STP is helpful for start-ups and innovation is often based on a linear innovation model that emphasizes an invention->innovation->diffusion approach. However, innovation may stem from customers' needs and the market, but is not necessarily based on the latest technology. If an STP is located far from the market or cities or managed by technical experts rather than by experts who have a deep understanding of the market, such an STP may not be in a good position to provide training to start-ups or innovation.

Second, an STP may be not compatible with start-ups and innovation. While an STP may be a risk aversion, especially when the investment of STPs comes from public sector, start-ups often experience a high rate of failure, as described by the term "the valley of death" (see Figure 6.1). It is questionable whether STPs and start-ups are compatible. Furthermore,

Figure 6.1. The Valley of Death for Startups



Source: Osawa and Miyazaki, 2006

Finally, policymakers need to be aware that there is a whole range of policy instruments available for supporting firms' innovation. Table 6.1 shows that a variety of actors, including STPs, may contribute to different factors in an innovation system or meet certain policy aims. In a local or national context, policymakers need to be clear about what gaps in the innovation system need to be filled, and then identify the best actors to fill in the gaps. For example, if the purpose is to develop a strong knowledge base, universities and research institutes are probably the most suitable candidates for getting the job done. For policy makers, before a decision is made to support establishment of STP, they need to know whether there are more effective solution for achieving such a purpose.

Table 6.1. Policy instruments available for supporting firms' innovation

Policy instruments	Principal providers for stimulating improvement	Other providers
A strong knowledge base	Research-intensive universities, technical universities, industry focused research institutes	Corporate R&D centres
A good culture of SME enterprises and entrepreneurship	**STPs**, business innovation centres, other innovation centres	Chambers of Commerce, universities
Good knowledge transfer actors	Universities working from the knowledge base in industry. **STPs**, institutes, consultants working from the business base into the knowledge base.	Private sector technology transfer operators and other professional services
A versatile and proficient knowledge management capability	Intellectual property consultants, lawyers and other professional services	**STPs,** business and innovation centres and universities
Diverse and rich sources of risk finance to support entrepreneurs and SMEs undertaking innovation	Banks, venture capital organisations, Business Angel Networks (BANs), public sector funds	**STPs** and business and innovation centres acting as investment readiness actors and, in some cases, as fund managers.
Highly-skilled people and suppliers who can upgrade skills and supply the needs of knowledge-based sector companies.	Universities and other higher education institutes	**STPs,** through the provision of student project internship programmes in knowledge-based companies
Services capable of supporting knowledge-based start-ups and the growth of SME companies	Private sector professional services, STPs and business and innovation centres	Universities – particularly for spinouts
Services to assist the formation and development of knowledge-based business clusters	Universities, **STPs** and business and innovation centres, Chambers of Commerce	Chambers of Commerce
Services to signpost and draw together suppliers of innovation competencies and companies	**STPs**, business and innovation centres, incubators, business parks	Industrial Parks

Collaboration spaces and shared specialist facilities and equipment	Campus-based businesses, university institutes, other research institutes and special equipment facilities operated by these organizations for business benefits	**STP**-located university and research organization collaboration projects

Source: European Commission, 2013.

6.2. Checklists for establishing STPs

Should a country or a region establish an STP? To answer this question, the following factors need to be considered.

First, a decision on establishment of an STP should be assessed in a broad national or local economic context. It is important to note that to develop an STP is never an end in itself; it is a means to an end. Therefore, it is important to understand: (a) what can be achieved by establishing an STP (e.g., to enhancing national R&D or promote economic development in a particular city or region of a country); and (b) whether there are better alternative solutions to achieving that goal. The case studies in this guidebook show that the establishment of STPs in China, Indonesia, the Islamic Republic of Iran, Japan, Republic of Korea, Russian Federation, Singapore and Thailand are part of national plans or strategies for boosting the development of science, technology and innovation, and/or moving products from laboratory to market.

Second, before an STP is developed, it is essential to check whether the precursory conditions are in place. These precursor conditions may include, among others, that:

(a) The key tenants or the anchor tenants – such as national research institutes – are committed to staying in the STP. Such anchor tenants are crucial to ensuring that an STP is not empty. Also, such anchor tenants may be useful in attracting other firms to locate in the STP;

(b) A management team with all the skills necessary for managing the STP can be assembled. The management team is often responsible for managing multiple tasks such as coordination and communication among various stakeholders, R&D, talent, capital, infrastructure and other activities and construction work. To be able to fulfil such management tasks, the team needs to have expertise in not only R&D, but also business, marketing, negotiation and communication skills. Furthermore, the management team must be able to adjust its strategy to an ever-changing environment. Such multiple tasks mean, for many developing countries, that assembling an effective management team is a real challenge;

(c) A strong science base in the surrounding areas of the STP is already available. This factor is important because a science base in the surrounding area will provide potential tenants of the STP. In addition, this will ensure that the firms within the STP can easily communicate with external firms;

(d) The city or area where an STP is located is attractive to talented people and students. Researchers and talented staff are crucial for R&D in STPs. Some factors for living need to be taken into consideration. For example, does the city have good schools for the children? Can the city provide good medical care? These factors, which are often beyond the control of an STP, have huge impacts on whether an STP can attract the required talent;

(e) An entrepreneurial culture is available in the city or country where an STP is to be located. This factor is particularly important if the key objective of an STP is to foster start-ups and entrepreneurs. While an STP may not be the best place for start-up or entrepreneurship, as discussed above, it can nevertheless help start-ups or entrepreneurs to identity technology solutions;

(f) Finance, especially seed and venture capital, is available in the city or country where an STP is to be located. Again, this is particularly important if the key objective of an STP is to foster start-ups and entrepreneurs. As already discussed in this chapter, available data show that venture capital is very effective in boosting start-ups.

Without checking these precursory conditions, it is very risky to develop an STP based on the mindset that "if you build it, they will come". If these precursory conditions cannot be met, at least some mitigatory solutions need to be identified.

Third, the social investment in an STP needs to be justified by its social benefits. This guidebook shows that the success of STPs in the Asia-Pacific region has often been due to direct investment or support from the national or local government sources. If a Government or public sector finances the development of an STP or provides other incentives such as tax exemption or reduction, it is imperative that the STP provides social benefits such as advanced R&D or boosts economic development in the region. In this regard, the economic or social contribution of an STP to a country should be measured and monitored.

Fourth, the effectiveness of the incubation and innovation programme offered by an STP needs to be carefully scrutinized. Innovative business ideas, as directly associated with entrepreneurial spirit, are often drawn from, and are a response to market demand. In contrast, many STPs are designed in a predictable and mechanistic manner, which is inherently incompatible with this spirit of entrepreneurship. In this regard, policymakers need to weigh the pros and cons of all available policy tools before selecting a best solution.

If a less developed or small economy is contemplating the establishment of an STP, the following factors may be considered as entry points.

First, to mitigate risk, it is essential to identify the key anchor tenants of the STP. For example, if a new research institute needs to be set up, it may be useful to place it next to a university or other established research institutes. Such clusters of research institutes may constitute the backbone of the STP. Over time, as the other functions of the STP may increase, such a backbone will play a major role in ensuring that the STP can deliver its most important designated functions.

Second, developing countries often have limited resources and research capacity. It may not be realistic to set up multiple STPs at the same time. Instead, a country could consider establishing an STP in its most economically advanced city that also hosts some research institutes and universities. Often, such cities host the national talent in the country, who could work for STPs. In so doing, that country may pilot the STP projects. This will also enable testing whether an STP can work in the country; if the STP does not succeed in the most economically advanced cities or areas, it probably will not succeed in other parts of the country.

Third, a developing country could encourage a few national universities, whenever ready, to set up spin-offs as mini-STPs. This will encourage academics to look at the possibility of adapting products from the laboratory to be placed in the market. This may also help a country to enhance its adoption or even adaption capacities.

While the discussion in this guidebook is generally focused on traditional STPs, it is also forward-looking. In the era of the digital economy, there are new opportunities for STPs. ICT will facilitate cooperation among the partners within and beyond the parks. While this is not a one size-fits-all solution, the general recommendations in this guidebook can be summarized as five "Cs" – Capacity, Collaboration, Content, Capital and Communication. Capacity emphasizes the digital and business skills of all stakeholders in an STP, such as policymakers, the STP management team and tenants. Collaboration refers to how ICT can be utilized to

promote greater in-depth collaboration within and beyond an STP. Content places emphasis on the local niche market on which an STP should focus. Capital refers to venture capital that a start-up within an STP should utilize. Finally, Communication emphasizes the fact that an STP should communicate effectively with the public about its contribution to the local and national economy.

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