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Lessons from East-Asian Science and Technology Parks: Preparing the Take-Off in Next Generation Involved Countries

Eryda Listyaningrum[1], Marina Van Geenhuizen[2]

ABSTRACT

The number of Science and Technology Parks (STPs) is still growing fast in some parts in Europe but also in Asia. Policy makers tend to see STPs as an effective tool in enhancing knowledge-based local/regional growth, though there are some doubts on positive impacts of STPs in developed countries, while countries may also differ in institutional context of STPs influencing growth. The paper contributes to the literature by increasing understanding of STPs' impacts in Asian, with regard to how the concept is elaborated in practice and which factors influence differences in growth of STPs. First, the concept of STPs and how it has been used in the recent will be analysed. Next, a framework (input-outcome) will be developed of factors determining STPs performance. The framework includes among others physical infrastructure factors, and institutional and social capital factors. A data base of 41 Asian STPs will be used to explore the influence of these factors on firm growth of STPs while applying regression analysis. Our preliminary results indicate a positive influence on STP growth of size of STPs (land), proximity to international airports, networking of STP actors over larger distances, and public management of the STP, as opposed to private or public-private management. Remarkably, the distance to university and regional location tend not to matter.

Keywords: Science and technology parks, input, outcomes, physical infrastructure factors, institutional and social capital factors, Asia, Indonesia.

1. INTRODUCTION

The concept of science and technology park (STP) has been recognised worldwide, as an instrument for developing technology and contributing to (regional) economic growth and innovation (Audretsch and Link, 2012; Hobbs et al., 2017). In this context, the number of STPs increased significantly around the world (Phan et al., 2005) and this motivated many policy makers to establish them, such as in continental Europe and Asia. Particularly in Asia, the establishment of STPs started in the early 1980s, for example in Japan, Taiwan and Singapore, while other countries following later on, such as Korea, China, India, Indonesia, Philippines, etc.

The establishment of STPs in the US and the UK started in 1960s and 1970s, and their results inspired policy makers to adopt them in continental Europe, such as in Germany, Sweden, France, the Netherlands, and more recently in Southern Europe and Eastern Europe (e.g. Sofouli and Vonortas, 2007; Ratino and Henriques, 2010). Since the early 1980s, Asian

[1] Ph.D Candidate; Faculty of Technology, Policy, and Management Delft University of Technology; email: E.Listyaningrum-2@tudelft.nl.
[2] Professor of Innovation and Innovation Policy in the Urban Economy; Faculty of Technology, Policy, and Management Delft University of Technology; email: M.S.vanGeenhuizen@tudelft.nl.

governments also adopted STPs, particularly in quickly innovating countries followed by less innovative countries, and the number of STPs in Asia today is estimated around 160 (e.g. UNESCO, 2016). However, there is no consensus regarding the concept of STPs, STPs have become more diverse concerning their aims and the infrastructure capital, institutional and social capital used to reach these aims.

Many STPs are funded by public investment while being expected to nurture new companies, collaboration and innovation and contribute to economic growth in the region (Schiavone, 2014). This situation requires a better understanding of the performance of STPs, particularly firm growth (Van Geenhuizen and Soetanto, 2008). Several studies have investigated STP development by assessing the on-site firms' performance (growth of sales, profitability, and employment), output of R&D (patent, number of new product launched in the market), and the relationship with universities (Schiavone, 2014; Löfsten and Lindelöf, 2002; Colombo and Delmastro, 2002; Wallsten, 2004 and Yang et al., 2009).

Some authors emphasize positive impacts of STPs such as increasing firm's performance, intensifying R&D, improving innovative output, and encouraging collaboration with universities (Felsenstein, 1994; Vedovello, 1997; Löfsten and Lindelöf, 2002; Colombo and Delmastro, 2002; Ferguson and Olofsson, 2004; Fukugawa, 2006; Leyden et al., 2008; Squicciarini (2008, 2009) and Schiavone, 2014). While other authors state that there is no significant contribution from STP to firms' performance or innovation (Westhead, 1997; Colombo and Delmastro, 2002). In this context, it is also argued that STP firms grow quicker than similar firms outside STPs just because of the positive selection of well-growing firms in giving access to STPs.

Despite debates, the number of STPs is still growing particularly in Asia, and one of the countries involved in the next generation of STP development is Indonesia. Indonesia Government will build 100 STPs in the period 2015-2019. Already existing STPs in Indonesia are Puspiptek, Cibinong Science Center, Solo Technopark, Bandung Technopark, Cikarang Technopark, and Batam Technopark (Soenarso, 2015). However, there is a lack of studies which give further information about STPs' performance in Indonesia.

Given the doubtful situation and the fact that the number of STPs is still increasing, the current study addresses how existing STPs have performed in the past years and how that can be understood, particularly in Asia. There is no uniform model for assessing STPs performance. For instance, European Commission (2014) set up various criteria for assessing based on proximity to the knowledge base; visibility; accessibility; age; science park purposes; landscaping; and value and price. Besides, Dabrowska (2011) has developed a set of key performance indicator for measuring the impact of European STPs, which consists of commercial, stakeholders perspective, brand reputation, and internal business process. However, in practice, studies of STP performance (or their impact) suffer from manifold shortages in data on these indicators. Against this background, the following main question is addressed: What can be learned from current Asian STPs to prepare next generation STPs in Asia? We divide this into the following sub-question: (1) How are STPs conceptualized and

which input and outcomes of STPs can be distinguished and can be used for understanding of STPs' performance? (2) What is the pattern of performance of Asian STPs and which factors do influence this performance?

2. THEORETICAL FRAMEWORK

2.1 Conceptualization of STPs

Despite many scholars and policy makers discuss and employ Science and Technology Parks (STPs), there is no consensus and no universally accepted definition of what STPs constitute (Moreno et al., 2013).This situation is a logical result of application of STPs in different economic systems and cultures, but also of a changing understanding of what tends to be important in developing STPs and making them growing. In this section, we explore various important concepts that have been used since the early 1980s (Table 1), identify the differences and changes that have developed in conceptualization, and argue which conceptualization we would prefer given the context of Indonesia.

Three organizations have been engaged in defining what STPs are, American Association of University Research Parks (AAURP) in 1981, and United Kingdom Science Park Association (UKSPA) in 1984, and International Association of Science Parks (IASP) in 2002. For the purpose of comparison, we present also various definitions from scholars in the 1990s and 2000s. With regard to changes over time, STP's in the 2000s tend to be stronger viewed as an organization, for example IASP defined STP as an organization managed by professionals, while Link and Scott (2007) see STPs as a public-private partnership. In other words, there has been a shift in paradigm from STPs as property-based to STPs as organization- or institution-based.

The second, and related, difference in conceptualization of STPs between the 1990s and 2000s is concerned with involvement of the community, development of innovation culture, attention to regional wealth and competitiveness, in particular management of flows of knowledge. The earlier definitions did not address culture, community and management of knowledge flows. By introducing interaction with the community and knowledge flows, STPs are not necessarily part of a model of linear value creation (from university to business, via the 'catalytic action on STPs) as they have long been seen (Westhead, 1997; Hanson et al., 2005), but are part of knowledge circulation with more than one direction.

Note, that in practice, STPs in Asia have been and are used at least in part to attract foreign direct investment (FDI) through multinational companies (MNCs). In these cases, additional instruments are financial incentives and land support, like in China (Guo and Verdini, 2015). Also, Taiwan, Malaysia, and Singapore have shown a strong ability to attract FDI through MNCs. In these cases, the development of domestic market firms and use of local high-tech talents tends to be relatively weak (Lai and Yap, 2004; Wang, 2000), particularly if the MNCs are disconnected from local value chains and are also weakly locally embedded in other regards.

Source	Concept of Science Park
American Association of University Research Parks/ AAURP (1981)	Master planned property and buildings designed primarily for private/public R&D facilities, high technology and science based companies, and support services. The park also (1) has contractual, formal or operational relationship with a university/research institution; (2) promoting university's R&D through industry partnerships, assisting in growth of new ventures (3) aiding transfer of technology and business skills between university and industry teams; (4) promoting technology-led economic development for the community/region
United Kingdom Science Park Association/UKSPA (1984)	Business support and technology transfer initiative that (1) encourages and supports start-up and incubation of knowledge-based businesses; (2) provides an environment where international businesses can develop close interaction with a center of knowledge for mutual benefit; (3) has formal and operational links with knowledge centers such as universities and research organizations.
Van Geenhuizen (2016), MacDonald (1987), Gower and Harris (1994)	Three attributes in common (1) property based initiative close to a university or research center, (2) supply of high-quality premises or units to businesses, and (3) a policy context of mixed public and private stakeholders with particular expectations on the knowledge-based economic results of the park.
Castells and Hall (1994)	A planned development of "innovation milieux", divided into three types: regional industrial complexes of high technology firms, science cities that are strictly research complexes, and intra-urban technology park.
Westhead and Batstone (1998)	The objectives include the formation of new firms, improve the performance of the local economy, favor e.g. the transfer of technology from universities to firms.
International Association of Science Parks/IASP (2002)	Managed by professionals, in order to increase the wealth of the community by promoting the culture of innovation and competitiveness of its businesses and knowledge-based institutions. Also, there is stimulation and managing knowledge flows amongst universities, R&D institutions, companies and markets; thereby facilitating creation and growth of innovation-based companies through incubation and spin-off processes; and providing value-added services together with high quality space.
Link and Scott (2007)	Sort of public–private partnerships that are designed to foster knowledge flows, mainly among park firms, as well as between these firms and external R&D institutions, and thus improve regional economic growth.
Zang and Wu (2012); Guo and Verdidi (2015)	STP (Asia) partly aim at attracting MNCs, mostly medium tech, by offering various incentives.
Hanson (2005)	Emphasis on social capital. If engaged with first stages of commercialization STPs could be integrated with faculty and campus.

Table 1. Definitions of STP

Finally, there is also a difference in scale and system in STPs conceptualization. Thus, while most definitions indicate relatively limited initiatives, including real-estate, Castells and Hall (1994) mention planned development of 'innovative milieux', ranging from industrial parks to regional high-tech complexes.

We perceive STPs as entities with physical as well as social and institutional characteristics, but we prefer to emphasize the last characteristics as our cases in Indonesia are established in different (regional) cultures and levels of technology development, where it is necessary to adapt the STP concept to regional specificities in institutions and social capital in order to link them with knowledge needs and supply of educational institutes and communities. Accordingly, we prefer using the IASP concept with regard to identifying the local/region potentials of STPs in countries like Indonesia, for the following reasons:

a. The STP is seen as a professional organization which is managed by a specialized person who has experience in innovation or science/technology parks[3]. In other words, the IASP considers STP as an organization or institutional entity.
b. The goal of STPs is increasing the wealth of regional or local community surrounding STP by promoting a culture of innovation, competitiveness, and knowledge-based institutions. The way in which the network and interaction (knowledge flows) between community or related stakeholder in STP are structured, refers to importance of social capital and allows for other models of value creation than the linear ones.
c. The concept also puts an emphasis on the actors involved in STP such as universities, R&D institutions, companies, incubators, and community, as particular institutional environments.

The above arguments indicate that STPs can be better understood using institutional and social capital notions. In brief, institutional approaches provide a lens to examine survival and legitimacy of organizational practices, including influence from culture, regulation (legal framework), tradition, as well as (economic) incentives and resources (Dimaggio and Powell, 1991). For example, it elucidates how organizations secure their positions and legitimacy by conforming to rules and norms (North 2009; Scott 2007). Social capital theory in general provides answers to the question of why people and organizations do better in the sphere of inter-organizational relations (Nahapiet, 2008). It helps to explain why and how organizations connect effectively, work cooperatively, and coordinate their activities to achieve a superior performance in the market. From this perspective, oriented toward strategic relatedness, firms are motivated to generate, develop, and maintain relationships with other organizations because relations ease the access to key resources, information, markets, technologies, advantages from knowledge and learning, scale and scope economies, as well as risk sharing (Moreno et al., 2013; Gulati et al, 2000). Some of the previous notions will be translated and included into an input-outcome model of STPs.

2.2 Input-Outcome Model

For exploration purposes, an extended input-outcome framework of STP performance is developed in this section. We explore the input-outcome framework based on Autio (1996). Then, we draw on several factors forwarded, for example, in European Commission Research (2014) and Dabrowska (2011), while paying attention to institutional and social capital notions. On the input side, we distinguish two categories of variables (Figure 1). The first category is physical infrastructure which is divided into sub-variables, namely, land-size, period of establishment, proximity, location, the presence of R&D facilities, the presence of incubator, and the availability of supporting facilities. Land-size is important for STPs to support their tenants and as a brand of their region (European Commission, 2014). Generally speaking, the largest the land, but also the longer the STPs operate, the greater number of firms will grow on STPs. In terms of proximity, some scholars argue that geographical

[3] IASP website : http://www.iasp.ws/web/guest/few-words retrieved on 28 November 2016.

proximity of STP and university has a positive impact on innovative performance (Wallsten, 2001). While others observe that geographical proximity in technology transfer has little or no contribution to performance (Quintas et al., 1992; Vedovello, 1997; Westhead and Storey, 1995). To clarify this matter, this study explores proximity between STP and university matters. In addition, we also explore proximity of STPs to international airports matter in STPs growth, on the basis of signs that MNCs prefer to locations with easy connections abroad. With regard to facilities, R&D facilities, incubator facilities, and business supporting facilities can be taken as input factors. The availability of R&D facilities connects to the technology focus of STPs. Incubator facilities which are present at many parks are vital for nurturing new firms/start-ups and increase their survival rate. In addition, supporting facilities such as land rent, administrative office, housing, *et cetera* will also attract young and incumbent firms to join STPs.

The second category of input factors is institutional and social capital, which encompasses type of management, compositions of stakeholders, availability of financial incentives for firms, technology focus (specialization) of STP, network collaboration, the last in terms of range (local-global) and type of networking activities in STPs. Commonly, STPs have diverse stakeholders such as government(s), universities, firms, venture capital companies, banks, real-estate owners, etc. With regard to management, this study differentiates STP in those managed by public organizations (government, university, or research institute) and otherwise, either private (industry) or a public-private partnership model. Further, technology focus can be taken as an input as the focus determines the sector of the firms that enter the STP. Some STPs have a focus such as ICT or biotechnology, or agricultural sciences (Malairaja and Zawdie, 2008). Financial incentives can also be seen as an input factor as it may attract additional tenants. And finally, social capital is regarded as part of input factors, in particular collaboration networks. Collaboration held by STPs can take different forms, like business matching/gathering, seminars, exhibition, forum discussion, and online interaction platform as a part of social capital, and the relationships may range from regional to international.

With regard to the outcome side, a whole set of factors can be taken into account(see the previously mentioned evaluation studies), like number of resident firms, firms' performance in terms of R&D, innovation outcomes like patents, and overall regional impact (e.g., Hu et al, 2005; Hansson, 2007, Löfsten and Lindelöf, 2001). In particular, regional impact is difficult to assess, because it encompasses different types of effects (direct, indirect, induced) and an appropriate assessment requires a control area (similar economic structure but without STP) and a certain time-span for the processes to evolve (Armstrong and Taylor, 2000; McCann, 2006). The extended framework is in Figure 1.

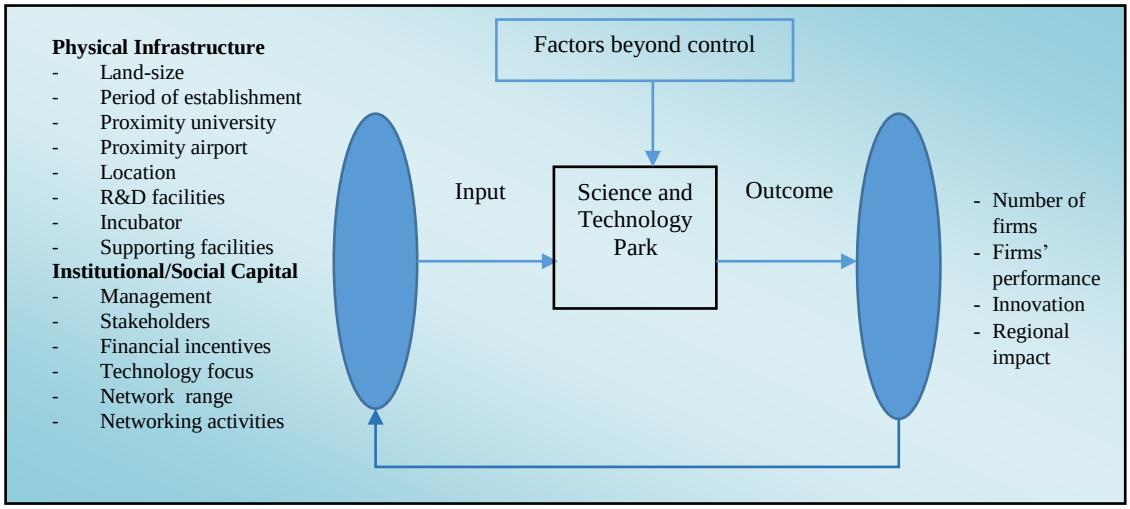

Figure 1. The Extended Framework of Input-Outcome of STP

Due to data limitations, we need to focus our study on growth in number of resident firms. In addition, we employ a selection of input variables to assess STPs' growth, namely land-size, period of establishment, proximity of STPs to international airport, proximity STPs to university, regional location, type of management, financial incentives to tenants, and network collaboration. Besides, in the current study we do not consider 'factors beyond control', namely political situation, crisis, and economic fluctuation, which might influence the number of firms growing in STPs.

At the end of this section it needs to be mentioned that selected STPs, also in Asia, are more recently used as places for experimentation, a role that is not included in the previous analysis. A main area of experimentation is energy savings, e.g. to connect on-site firms that produce excess of energy with others that have peak demand, and to build offices all over the STP that are energy neutral. One example is Hong Kong STP (HKSTP 2017).

3. METHODOLOGICAL ASPECTS

In order to explore the model of influences on STPs' growth, a database of 41 STPs in Asia is used. The database has been built using a variety of resources in desk-research: articles in journals, annual reports of STPs, STPs' website coverage, and conference proceedings. Besides, direct data collection has been undertaken among STP management, through email or phone (2017), thereby enabling triangulation of information. The STPs in our database are selected due to their presence in a set of (electronic) journals, on knowledge transfer, regional knowledge-economy and policy, science parks and incubators, etc.

Regression analysis is used, after having performed a standard set of tests (e.g. normal distribution, normality of residuals, heteroscedasticity, and multicollinearity (Hair et al. 2006) (see Appendix). None of the outcomes signalled serious concern. The type of regression analysis is stepwise regression. By first inserting the general variables, next steps can show increase in R^2 by separately inserting physical infrastructure variables and institutional-social

capital variables. In Table 2 the measurement of the model variables is given, as well as descriptive statistics.

4. RESULTS AND FINDINGS

4.1 Descriptive Analysis

The STPs in the sample are from eleven countries in Asia, with strong representation by Korea and Japan. Besides, most of the parks in this sample are in relatively high innovative countries. In addition, the sample parks are somewhat different in terms of park organisation and technology focus. In terms of park organisation, some parks are composite parks which employ sub-parks or other smaller parks in the region, for example, STP in China and Taiwan, but most are single parks. This difference becomes evident in annual numbers of growth of resident firms and land-size; some of STPs have a substantially larger land-size and firm growth compared to others parks. While, in terms of technology focus, a few STPs have a specific focus in attracting firms, such as biotechnology or life sciences (e.g. Zhang and Wu, 2012), while most have a diverse focus.

We are forced to keep the previous factors, except land-size, beyond our analysis as the differences deal with a very small minority of STPs and the number of model factors needs to be limited due to the small sample size. We now proceed with a description of the model variables. With regard to the dependent variable, average annual growth of firms on STPs varies, the smallest is 1 and the largest is 332, with an average of 26. A skewed distribution calls for log-transformation. Next we employ two 'general' variables, i.e. land-size and period of establishment (early generation parks as established before 2000 and younger ones). Land-size varies between 1 ha and 10.000 ha with an average of 750 ha, and there is an almost equal division into older parks (56.1 per cent) and younger ones (43.9 per cent).

In terms of physical infrastructure, particularly proximity of STPs with an international airport, 58.5 per cent of STPs can be reached in less than one hour by car. With regard to proximity to universities, 48.8 per cent of STPs are near to the university and can be reached by foot/bike in less in than 30 minutes. This study also shows that a small majority of STPs are located in core metropolitan areas, as evidenced by 51.2 per cent. Further, with regard to the institutional – social capital side, 53.7 per cent of STPs are managed by public sectors such as government, universities, or research institutes and the rest by private sector actors or public private partnership.

With regard to financial incentives to tenants, this study indicates that 56.1 per cent of STPs have budget allocation to attract tenants. Next, network collaboration indicates whether STP employs important networks and if so, how far these networks reach, just regional or even worldwide. Based on assessment, a small majority of STPs employ important network collaboration with regional or international partners, 51.2 per cent in total. Details of descriptive statistics are given in Table 2.

4.2 Regression results

Model 1 includes only land-size and period of establishment of STPs, and this leads to a rather weak result (Adjusted R^2 of 0.11) (Table 3), with the land-size coefficient positive and significant. The period of establishment of STPs, roughly indicating an older model compared to younger model, does not yield a significant result. Next, in Model 2, by inserting three variables on physical infrastructure, the model power significantly increases, namely to R^2 of 0.50. However, this increase is mainly due to a positive influence of physical proximity to an international airport. Remarkably, close proximity of STPs to university does not increase the probability of large growth. This could mean that the relationship with the university is weak and therefore physical proximity is not of interest. Alternatively, the relationship with university is relevant but physical proximity is not an issue in attracting firms. Equally remarkable is that a location in a metropolitan/core region does not increase the probability of growth.

In Model 3, three variables - indicating institutional and social capital characteristics - are added to the general variables, and this causes the model power to increase by 0.20 (compared to Model 1) to 0.31. Type of management and type of network collaboration (range) have a significant influence on STPs growth. Concerning the type of management of STPs, public management gives a high probability of growth, as opposed to private or public/private management. Similarly, networking of the STPs over larger distances (international) gives a high probability of growth. Remarkably, the coefficient of financial incentive to tenants is not significant. The last result could mean that financial incentives are not relevant at all in attracting larger numbers of firms, or that incentives are given in another form, namely land support (as could be the case with foreign firms). Next, Model 4 is the best model, in which all previously mentioned variables that are not significant are deleted. This leads to R^2 of 0.61, mainly derived from land-size, proximity to international airport and reach in network collaboration, and to a smaller extent to STPs' management model. The full model (Model 5) does not provide additional information.

The overall picture of important influences indicates a strong role of foreign direct investment (FDI) on the growth of STPs in Asia, because many Asian STPs attracted and hosted multi national companies (MNC), such as in China, Taiwan, Korea, and Malaysia (Kim and Jai S, 2009; Wu, 2008; Lai and Yap, 2004). Conversely, it may also indicate a still small embedding of STPs in and small interaction with local (scientific) communities which could be seen as a 'failed' opportunity.

Adopting an institutional or social capital perspective is, however, not totally absent on Asian STPs. For example, the Korean Government developed a policy in which STP perform a catalyst role in regional economic development, including a legal system to support this, thereby embedding the STPs stronger in regional actor networks. In addition, Korean STPs went through institution building processes in several fields such as technological innovation, knowledge creation and diffusion, networking of interaction, although not fully embedded (Seo, 2006). With regard to STPs in India, it is mentioned that the government acts as catalyst

to encourage collaboration between private, public, and foreign sector (Malairaja and Zawdie, 2008).

Category	Variable	Level of Measurement	Result
Dependent Variable	Average annual growth of resident firms	Ratio	Min: 1, Max: 332, Avg: 26; Std. Dev.: 55
Independent Variables			
General	Land-size	Ratio	Min: 1 ha, Mx: 10.000 ha, Avg: 705 ha, Std. Dev.: 1952 ha
	Period of establishment	Rank	Established 1970-1999: 56.1%
			Established 2000 - onward: 43.9%
Physical Infrastructure	Proximity STP to international airport	Rank	Travel time (by car) less than one hour: 58.5 %
			Travel time (by car) more than one hour: 41.5%
	Proximity STP to university	Rank	Travel time less than 30 minutes: 48.8%
			Travel time more than 30 minutes: 51.2%
	Location	Rank	Core region: 56.1%
			Adjacent to core: 43.9%
Institutional – Social capital	Type of Management	Rank	Public management: 53.7%
			Other type of management: 46.3%
	Network collaboration	Rank	No network collaboration / not mentioned: 48.8%
			Regional: 31.7%
			International: 19.5%
	Financial incentive to tenant	Rank	No financial incentive to tenant/ not mentioned : 43.9%
			Having financial incentive to tenant : 56.1%

Table 2. Measurement and descriptive statistics

Variable	Model 1	Model 2	Model 3	Model 4	Model 5
	β-coefficient (s.e)	β-coefficient (s.e)	β-coefficient (s.e)	β-coefficient (s.e)	β-coefficient (s.e)
General					
Land-size	.40 (.00)***	.38 (.00)***	.26 (.00)*	.23 (.00)**	.26 (.00)**
Period of establishment	.02 (.16)	-.02 (.13)	.07 (.15)		.01 (.13)
Physical Infrastructure					
Proximity STP to international airport		.56 (.13)***		.54 (.11)***	.52 (.12)***
Proximity STP to university		.01 (.13)			.02 (.12)
Regional location		-.23 (.13)			-.11 (.13)
Institutional - Social Capital					
Type of management			.22 (.15)*	.18 (.11)*	.19 (.12)*
Network collaboration			.36 (.10)***	.28 (.07)***	.24 (.08)**
Financial incentive to tenant			.15 (.15)		.13 (.12)
N	41	41	41	41	41
F	3.56	8.99	4.53	16.57	8.18
R	.40	.75	.63	.81	.82
R^2	.16	.56	.40	.65	.67
Adj R^2	.11	.50	.31	.61	.59
Δ Adj.R^2		+ .39	+ .20	+ .50	+ .48

*p<0.1; **p<0.05; ***p<0.01

Table 3. Regression Analysis of STPs' firm growth

5. CONCLUSION

Policy makers tend to see STPs as an effective tool in enhancing knowledge-based local/regional growth, though there are some doubts on positive impacts of STPs in developed countries. The paper sought to contribute to the literature by increasing understanding of STPs' performance in Asia, with regard to how STPs have been conceptualized over time and which factors influence differences in growth of STPs, particularly in Asia. Older conceptualizations of STPs differ significantly from newer ones. There has been a paradigm shift from STPs as property-based to STPs as organization-based initiatives, and to a stronger concern on involvement of the local community and development of local/regional innovation culture. This also allows for enhancing interaction and knowledge flow between different firms and organizations, indicating that models of value creation could also be non-linear. In fact, in newer conceptualizations, mainly in Europe, there is more attention to institutional and social capital factors.

Next, a framework (input-outcome) has been developed of factors influencing STPs performance. The framework including among others physical infrastructure factors, and institutional and social capital factors, was explored using a database of 41 Asian STPs. This exploration had to be limited to parts of the framework. Our preliminary results indicate a positive influence on STP growth of size of STPs (land), proximity to international airports, networking of STP actors over larger distances, and public management of the STP. Remarkably, the distance to university and regional location tend not to matter. Overall, the picture has emerged that Asian STPs are still close to the early conceptualizations of STP, with small attention for local social capital and local institutional embedding of STPs, though there are positive examples of improvement.

Future research could respond to some shortcomings in the design of the current study. The small sample size has limited the number of model factors we could explore simultaneously. Future research could develop larger samples, these not only allow for testing an extended model, they could also be used to achieve more solid statistically generalizable results. Our sample was derived from presence in particular publication channels and this may have caused a slight bias towards pronounced results in STPs performance that has attracted (scientific) attention. Also, due to data limitations, the only outcome factor we could study, is STPs growth through resident firms. This again pleas for extension of the study in future research regarding the size of the sample and data coverage. However, there is also another type of future research that attracts attention on the basis of the current results.

With regard to 'preparing the take-off of next-generation STPs', it would be a challenging to study how the feasibility of STP types that are firmly rooted in local/regional scientific communities, matching local cultures and institutional-organizational rules, can be increased. This challenge is also faced by Indonesia because in its plan to build 100 STPs. The National Indonesia Government Report (MoRTHE, 2017) mentions three major technology specializations of STPs in Indonesia based on local resources and local economic activity, namely, food and agriculture, ICT, and medical substances from marine origin. Examples are

innovative tea from agar wood and leaves in treatment of mental depression and diabetes, liquid smoke (non-carcinogen) for fish preservation, and substance derived from shrimp and crab shell for medical purpose.

In the early stage of development of Indonesia STPs, the national government plays an important role in providing multi-faceted support, for instance, creating a master plan STPs, allocating budget for empowering STPs' management and tenants through capacity building, and establishing physical infrastructure and facilities. Besides, the national government collaborates with local partners (regional government, local universities, local research centres, etc.) in attempts to harmonizing, coordinating, and building networks between them and also determining the role/function of the STP itself. It appears, however, that more support is needed, for example, in developing a common vision between the different actors involved (Fikirkoca and Saritas, 2012), including local industry and to a limited extent maybe MNC. This includes various boundary spanning activity such that steps can be taken to reach common goals, of which local embeddedness and a favourable value chain position are important ones. This requires local in-depth studies and local workshops on challenges that release social capital and removes institutional barriers to implementation of a more modern conceptualization STPs, which can be adapted to different local/regional circumstances and aims. To design a methodology for creating the required approach and processes would be another research path ahead of us.

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APPENDICES

Appendix 1. Correlation Matrix

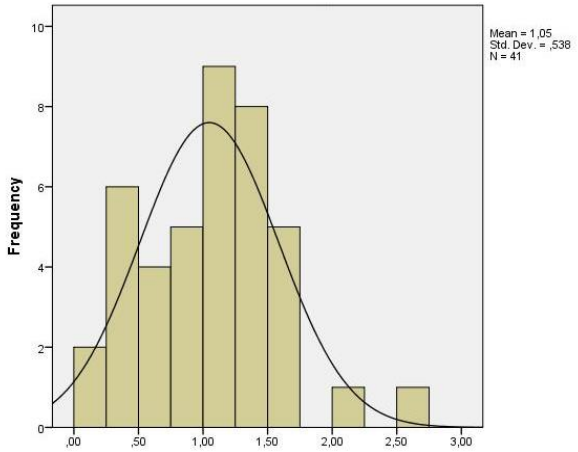
Variable	1	2	3	4	5	6	7	8	9
1. Average annual growth of firms (a)	1								
2. Land size	.40*	1							
3. Periode of establishment	.11	.23	1						
4. Proximity STP to international airport	.65 **	.15	.15	1					
5. Proximity STP to university	.01	-.28	-.32	.13	1				
6. Location	-.21	.27	. 21	-.15	-.12	1			
7. Type of management	.37*	.13	.16	.11	-.07	-.23	1		
8. Financial incentive to tenant	.17	.17	-.19	.05	-.02	.11	-.13	1	
9. Network collaboration	.49**	.20	-.08	.19	-.01	-.27	.34*	.05	1

* Correlation is significant at 0.05 level (2-tailed);

** Correlation is significant at 0.01 level (2-tailed).

(a): log 10

Appendix 2. Normality Distribution of Dependent Variable (Average annual growth of firms)



One-Sample Kolmogorov-Smirnov Test

		Average Annual Growth
N		41
Normal Parameters[a,b]	Mean	1,0476
	Std. Deviation	,53796
Most Extreme Differences	Absolute	,110
	Positive	,089
	Negative	-,110
Test Statistic		,110
Asymp. Sig. (2-tailed)		,200[c,d]

a. Test distribution is Normal.

b. Calculated from data.

c. Lilliefors Significance Correction.

d. This is a lower bound of the true significance.

Appendix 3. Multi-Collinearity check

Variable	Collinearity Statistics	
	Tolerance	VIF
(Constant)		
Land size	0,73	1,369
Period of establishment	0,729	1,371
Proximity STP to international airport	0,846	1,182
Proximity STP to university	0,806	1,240
Location	0,739	1,352
Type of Management	0,794	1,259
Financial Incentive to Tenant	0,886	1,129
Network Collaboration	0,763	1,311

Appendix 4. Heteroscedasticity check using Glejser Test

Variable	Sig.	Conclusion
(Constant)	0,042	No heteroscedasticity since all variables have sig. value higher than 0.05
Land size	0,574	
Period of establishment	0,914	
Proximity STP to international airport	0,447	
Proximity to university	0,69	
Location	0,631	
Type of Management	0,708	
Financial Incentive to Tenant	0,408	
Network Collaboration	0,625	