TALLINN UNIVERSITY OF TECHNOLOGY

FACULTY OF SOCIAL SCIENCES

RAGNAR NURKSE SCHOOL OF INNOVATION AND GOVERNANCE

Unggul Sagena

Success Factors of Science & Technology Parks Development in Indonesia

Thesis in Partial Fulfilment for the Master of Arts Degree in Technology Governance

Supervisor: Dr. Tarmo Kalvet

Tallinn 2016

I hereby declare that the current Master Thesis is the outcome of my independent study and has been submitted to Tallinn University of Technology only.

No degree has been obtained previously with this research.

Author Unggul Sagena

..... 2016

The Master's thesis meets the established criteria.

Supervisor Dr Tarmo Kalvet

..... 2016

Accepted for defense " ..... " 2016

The Chair of the Defense Committee of Master's Theses,

Professor Dr Rainer Kattel

Table of Contents

Acknowledgments

Firstly, I would like to express my sincere gratitude to my advisor Dr Tarmo Kalvet for the continuous support of my Master study and related research, for his patience, motivation, and immense knowledge. His guidance helped me in all the time of research and writing of this thesis. I could not have imagined having a better advisor and mentor for my Master study.

Besides my advisor, I would like to thank the rest of my thesis committee: Prof. _____, Prof. _____, and Dr. _____, for their insightful comments and encouragement, but also for the hard question which incented me to widen my research from various perspectives.

My sincere thanks also goes to all Ragnar Nurkse School of Governance & Innovation staffs who had been helpful during my thesis writing, especially Egert Juuse.

To all friends, colleagues and everyone that without them it would not be possible to conduct this research.

Abstract

Development of Science & Technology Parks (STPs) is crucial to enhance economic development. Indonesia has established several STPs since 1970s. However, their performances are far from the desirable results. New phase of STPs development in Indonesia are the goal to reach "100 STPs" in 2019 by the Government of Indonesia (GoI). Lesson learned from various successful STPs and recipes for success is the utmost that Indonesia should learn to make STPs performance impactful to enhance economic development through innovation. Therefore, success factors of STPs development should be further theorized and organized into success factors model in local context. This thesis considers the inadequacy of existing theories of success factors of Science & Technology Parks in its contextual connection to developing countries, particularly in Indonesia. Boundaries and levels of factors and its state of urgency and importance which influence the performance of STPs in Indonesia are analysed using micro, meso and macro factor model as framework of analysis. Success factors set out by experts such as Commins & Rowe (2009), Mian, Dioutriaux and Corona (2007), Luger & Goldstein (2006), Wessner (2009), and Wasim (2014) should be enhanced by boundaries and levels of STPs success factors. Hence the adjusted model and implementation of STP success factors in Indonesia should add valuable insight for the future STPs performance in Indonesia.

Keywords: Success Factors, Science & Technology Parks

Lühikokkuvõte

1. INTRODUCTION

1.1. Background to the study

Science & Technology Parks (STPs) is perceived to be a vehicle in promoting innovation-based economic growth (Soenarso, Nugraha & Listyaningrum, 2013) within the framework of innovation system (IS) in a competitive and innovative world. The availability of STPs has been important agenda to many countries in fostering their economy through innovation in competitive global world. In Asian context, many studies on emerging economies suggest significant contribution of STPs performance to provide innovative products and services, such as Taiwan, Singapore, South Korea and China (see Tsai & Chang (2015) for Taiwan, Phan (2005) for Singapore, Jung (2014) for South Korea, Poon (2006), Zhang & Sonobe (2011), Zhang (2013), Sun, Ni & Leung (2007), Jolly & Zhu (2016) for China).

STPs was pioneered by the United States after the World War II. The rationales according to Castells & Hall (1994) in Ben Youssef, Elaheebocus, & Ragni (2013) are (re) industrialization, regional development, and creation of synergies. STP also constitutes a physical implementation and appearance of the national and regional innovation based policies and program in some countries who adopt science, technology and innovation (STI) policies to enhance their economic performance. Since most countries face strong concerns with industrialization and regional development, the establishment of STPs becomes a common answer to these problems.

Amongst first established parks was Menlo Park and Stanford University's Science Park in 1950. Then, Research Triangle Park based in North Carolina in year 1959 was built. New proposals soon came up all over the United States (Villa & Pages, 2008). European Parks emerged soon after in the late 60s-70s in France (Sophia-Antipolis) in 1969 and also Cambridge Science Park around Cambridge University in 1972. Since then, several parks around the world have been created, especially in emerging countries aiming at technological catch-up and enabling their local universities to compete in the global innovation market. (Youssef, Elaheebocus & Ragni, 2013).

In Asia, Tsukuba Science City was the first STPs ever noticed, built in Japan in the early 1970s and followed by other Asian countries in the mid-1980. (Phan, et.al., 2005). Today, there are more than 200 STPs in Asia and still growing, with Japan the first on the table and followed by China which established its first STP in mid-1980. While India has established few parks in late 1980s, none but Bangalore, India's Silicon Valley, ever succeeded (Phan, et.al. 2005).

1.2. Best Practices of STPs

It raised questions what kind of best practices that could be identified and to be lesson-learned for Indonesia to establish a successful STPs. This is closely connected to the policy making and strategy formulation by organizations that manage STPs to successfully deliver output and outcome expected by the stakeholders of STPs. Unfortunately, few academic studies address such issues (Link and Scott, 2007).

However, researches evolving around STPs performance evaluation have record the failure and the success of STPs. The hypothesis that STPs have been successful and effective cannot be proved or disapproved (Dabrowski, 2011). There is no consensus to define the success of STPs (Villa & Pages, 2008). Criteria such as financial (investment, turnover, etc.), and/or indicators related to innovation patterns (such as number of start-ups, patents, networked institutions), also benefits such as STPs income and its contribution to local and regional economy, are used in different ways among authors in measuring the success of STPs. STPs ultimate model is none to exist, because STPs deals with its environment and specific factors to make them success, and the criteria used to be a successful also differ between STP evaluations from different stakeholders.

To sum up, there is no *one-size-fits-all* model for STPs to be successful. Framework conditions for STPs differ considerably between countries and even within country. Specific needs-assessments and adapt the STP to the social, economic, cultural and environmental characteristics of each region and community are necessary and mandatory to enable it to foster the economic development of specific region. STPs performance can only be evaluated through series of intensive studies and measurements. A reference framework i.e. a set of goals is necessary to establish to measure it (Luger & Goldstein, 1991). Given this facts, it is difficult to design general guidelines on how to develop STP. Indeed, STPs experiences in different country and different region are not directly comparable to one another, even if the country, where STP exists, shares the same geographical region. The contextual level on social economic political and cultural environment shares specific features

and factors on input process and output and outcome of the successful of STPs in certain area.

1.3.Problem Statements

One of newly established Government of Indonesia (GoI) missions in 2014-2019 five years plan from the president and his cabinet is to build “100 STPs in 5 years”. Since then, GoI has been searching for ideal STP development while establishing many STPs in diverse region in the country. GoI foresees the successful of the research, development and innovation programs, and develops national and regional innovation systems, learns from regional and global innovative nations. GoI already implements innovation policies through several regulations and joint regulations to strengthen the innovation in regional autonomous provinces, and STP development across the country already begins, with new establishment of STPs and/or revitalization of old STP-like facilities.

However, STPs success story emerged from a very specific context and its success is due to many specific factors. Therefore, this thesis is trying to extract and analyse the success (and failure) factors of STPs from several authors based on previous researches, argues that these factors are not all applicable in every STP development. Instead, STPs should learn from it. Therefore, this thesis also analyses and recommends the model of STPs success factors to adjust to the local STPs experiences. This research also discusses the possibility to apply the success factor findings to the current condition of Indonesia’s STPs development scenario.

2. THEORETICAL FRAMEWORK

2.1. STP Definition

Terminology of "research park" is more common in the United States, and the term of "science park" is more common in Europe, while the term of "technology park" is more common in Asia (Link & Scott, 2007). These terms are also enriched by the term and names of innovation parks, bio parks, bioscience parks, and recently, science, technology, and innovation parks (STI parks). The selected term usually depends on the type of affiliation of the parks to engage institutions of research & development. In the literature, a distinction is sometime made between science parks and technology parks, with the main difference being the larger size of the latter (see for instance OECD, 1997) also the closer the activities to the basic research for science parks and commercialization and business for technology parks. Some countries accommodate different definitions for the concepts and also differentiate it. For example in Indonesia, Government of Indonesia (GoI) has dichotomy of science park and techno park with different level and focus of development, also different naming on the level of regions and scope of the parks in which become national parks, regional parks.

Colombo & Delmastro (2012) defined a "science park" as a property-based initiative which (i) has formal operational links with centres of knowledge creation, such as universities and (public and/or private) research centres, (ii) is designed to encourage the formation and growth of innovative (generally science-based)

businesses, and (iii) has a management function which is actively engaged in the transfer of technology and business skills to "customer" organizations.

Link & Scott (2007) proposed definition that a university research park is a cluster of technology-based organizations that locate on or near a university or campus in order to benefit from the university's knowledge base and ongoing research. The university not only transfers knowledge but expects to develop knowledge more effectively given the association with the tenants in the research park. University usually has incubation program as their major policy mechanisms to support innovation and should act as an intermediary between the spheres of university and industry to provide interactive linkages and promote effective utilization of university research (Wonglimpiyarat, 2014).

International Association of Science Park, IASP (2002) defined STP as an organization managed by specialized professionals whose main aim is to increase the wealth of its community by promoting the culture of innovation and competitiveness of its associated businesses and knowledge based institutions. To enable these goals be met, a science park stimulates and manages the flow of knowledge and technology amongst universities, R&D institutions, companies and markets; it also facilitates the creation and growth of innovation-based companies through incubation and spin-off processes; and it provides other value-added services together with high quality space and facilities. The IASP definition also encompasses other terms and expressions such as "technology park", "technopole", "tehcnopolis", "technology precinct", "research park" (see httpp://www.iasp.org). STPs has given hopes to policy-makers in many countries to boost regional

technology transfer, innovativeness and hence competitiveness. Any label of a park, shares many goals and elements and methodology, has innovation at the core of their business, and collaboration as key feature of innovation system (UNCTAD, 2014). The parks offer a number of shared resources, such as business incubators, programs and collaboration activities, facilities, incentives to attract firms, start-ups and researchers. In this thesis, I use term of "Science & Technology Park" (STP/STPs) to address all terminology for the parks.

Nelson & Kim (2000) showed evidences that how newly industrializing countries particularly those in East Asia, have transformed themselves from technologically backward and poor to relatively modern and affluent economies over the past thirty years. However, while Eastern Asian such as Taiwan, South Korean and relied on locally owned firms for their export-led industrial growth, Southeast Asia has depended largely on transnational corporations (TNCs).

Most of earlier STPs have been operated in 1980s and undergone a major impact to its regional and national economic development. The performance of an STP usually starts to have impact between years five and ten years (EU, 2014) and it is time to moderate public sector investment in favour of private funding. Immature and infant STP usually lead and direct its R&D and innovation focus and innovation on product and services by state/government, private sector and university in a triple helix manner.

Nowadays, the development of STPs has also evolved from property-based initiative of STPs into an urban development of technopolis (see Oh & Phillips, 2014). The maturity development with urban involvement has caught attention to

STPs creators and developers. Ladder to technopolis maturity according to Philips (2012) is in leveled and progressive ways. From university centres of excellence, research park, incubators, knowledge base industrial park, clusters, knowledge business ecosystem, superclusters, to a technopolis.

2.2. STPs Success Factors

STPs is regarded as a tool to encourage regional innovation and competitiveness in increasing contribution of science and technology in economic development (Soenarso, et.al. 2013). However, it has been acclaimed that there is no consensus about how to build a successful STPs around the world. The definition "success" is a normative criterion that every perspective has their views. It is also concerned by Luger & Goldstein (1991) that even though most commonly cited goals relate to economic development, but both the literature and data from interviews with park developers, elected officials, university administrators, business leaders, and others confirm the occurrence of "other goals", including technology transfer, land development, and enhancement of the research opportunities and capacities of affiliated universities.

Annerstedt (2006) found that among STPs around the world, most of them do not achieve goals that have been set when established the park. It also argues that many of parks are actually real estate projects branded as parks. EU (2014) distinguished EU STPs in the 21st century from just another good quality business park or other pure property investment, by having characteristics, such as selective on selection of its tenants and prioritizing the knowledge-based technology industry, engaging with knowledge base (university and public research institutions) and stakeholders,

internal-operated business incubation schemes, and professional business support and innovation services –which incorporate locality-based innovation and knowledge-based business within their park.

Yet, measuring successful of STPs is not a straightforward task (Dabrowska, 2011). However, evaluating the performance of science parks becomes a more and more important issue for the STP industry to support regional development. Especially, it is reported that, even in the US, more than 80 percent of research parks rely on government and/or university funds to develop park land and infrastructure. Given the size of this public expenditure, it is reasonable to expect that both "investors" and the local community will want accurate evaluations of parks (Wessen, 2009).

Comins & Rowe (2011) argued that STPs success and failure in USA, Canada and Mexico have some common essential ingredients contrasting to different regional environment such as UK, Russia and South Africa. To be able to predict the likely outcome from establishing an STP which particularly in the emerging economies, some criteria should be addressed. Based on Mian, Doutriaux & Corona (2007) research which compared the successes and failures of STPs in USA, Canada and Mexico, there are ingredients that are essential for success and it can be expected to occur in different regions and environments.

STPs are more likely to be successful if it is established in region that has a large, metropolitan, diverse and well established economy, has strong research base, a culture of entrepreneurship, stakeholders including university or research center that actively engage in providing resources to establish STPs, and proactive and entrepreneurial management. Key to STPs success is the provision of a non-

monetary value proposition related to R&D (proximity to a university or large research laboratories, presence of large anchor organizations or other local concentration of R&D activities) and to the availability of business services that enhances the development prospects of client companies (Mian, 2007 in EU, 2014).

UKSPA (1998), EU (2014) and UNIDO (2012) have codified some key success factors or STPs. Amongst other, UK Science Park Association (UKSPA, 1998, in Villa & Pages, 2008) identifies six success factors of STP; (1) accuracy and strict control over activities of park tenants, (2) accuracy in the design of buildings, (3) professional and effective management, (4) participation of a university with a solid research base, (5) availability of supporting and financial services and (6) availability of incubation spaces.

EU (2014) and UNIDO (2012) recognized essential components in the planning and development STPs venture. It concern of coherent policy and clear objectives to the STPs development rationale. Deciding best model of implementation and deciding clusters based on spatial proximity perspectives, and size and zoning of STPs must also be in accordance with business and market needs and expectations.

EU (2014) and UNIDO (2012) also identify factors that should be effective to influence the performance of STPs is at the engagement of knowledge base (stakeholders at STP) and its interactive learning and interactions, linkages and other growth targets, market identification for commercialization and all managerial matters. The success of STPs depends on efficient and responsive management. A park's managing company must provide guidance and support so that business planning is conducted smoothly, these include marketing,

information, procedural support, and trouble-shooting; quick and effective responses to customer demands are key. Therefore, EU (2014) suggested to select strong leadership based on a board / committee structure that has good connections into the local economy (private and public) and a CEO with appropriate sector experience and strong leadership and management skills.

Deciding the appropriate STP model in accordance to its future financial sustainability within a reasonable timescale is a factor that contributes to the performance of STPs. Therefore, as suggested by Luger & Goldstein (1991), return on public investments, direct expenditures by government on land acquisition and infrastructure development, financial inducements, and the opportunity cost of the land for research parks versus other types of uses can be compared against changes in the tax rolls and other measures of economic growth are also rationale to evaluate.

Other factors, according to Luger & Goldstein (1991) is meet the goals of legislation. One plausible way to measure the success of research parks is to assess their performance against stated goals, as written into legislation and found in documents and interviews. Enhancement on firm performance, university performance and government performance in STPs are subjected to evaluate and measurable. This can be measured in terms of the change in income and corporate taxes collected by local, state, and federal governments as the result of the growth of successful businesses inside and outside the park, as well as in terms of net gains in jobs.

Tenants/firms may also provide benefits to the host university by sponsoring laboratories and professorships, hiring students, or associating themselves with co-patenting activity. Thus, in this level, it is value of the park to tenants. Flow of knowledge between firms and universities, entrepreneur mobility and intellectual capital (brain gain) which likely to serve and works in successful STPs, may contribute to the successful itself.

I argue that based on literatures presented, there are important factors for STPs' success. First is **STP environment.** This environment is expanded from economy, politics, social and cultural and it has feature in shaping the development phase of STP. For example, clear strategy is one of the most important factors in development STP. STP should be designed by clear objectives and strategy. It is usually in accordance to the need of implementation of innovation system and innovation policy. Innovation policy, --whether it is incorporated into regional, sectorial, or national system of innovation, is *conditio sine-qua-non*.

However, different from North America and Europe experiences, innovation perspective in Schumpeterian traditions is much more beyond Asia's tradition. New industrializing countries such as Taiwan and South Korea are both considered as late-comers to the technological process. The process of learning, acquisition, re-innovation and knowledge sourcing than strictly innovating is the path of Asian. Poon et.al (2006) proposed that the spatial sense, geography of technological learning and knowledge acquisition among Asian firms is gained by process of international learning among these firms through their foreign direct investment in the United States (US).

In many STPs evaluations, the natural flow and technology transfer from academic and research institutions to the business world are identified as key factors. (Comins & Rowe, 2008). The availability of experienced investors capable of managing the risks related to emerging knowledge-based companies is a critical factor. The nature of business, the research cultures and experiences can have a profound effect on the rate developments of technology-based firms (TBF's) both individually and as a sector. Emerging economies that recognize this early in the development and build ameliorating features into their STP environments are more likely to have successful STP. (Comins & Rowe, 2008).

Second, the importance of **STP management** is also highlighted. Professional and effective management and park leadership are important factors in the internal-managerial of STP. EU (2014) has noted to select committee and parks managers that have appropriate sector experience in which specific STP focus on, and strong-professional leadership and effective management skills.

Actors in STP should also understand the innovation system approaches to their daily activities. A strong science and industry is based from firms and incubations in STP, praxis of culture of entrepreneurship that can be optimized in commercialization, stakeholders including university or research centre that actively engage in providing resources to establish STP, collaborative universities, businesses, and other organizations. In other words, it needs the presence of entrepreneurs and the presence of trust networks at an individual level.

Third, **STPs' infrastructure and facilities** also important feature for STPs. On-park firms should enjoy facilities and linkages to better output and outcome inside

STP facilitation. Incubation in STPs should provide incentive to firms to be tenants in STP. STP should differentiate its position in the innovation-based economies. It should generate values that most of firms do not have off-parks. Tax incentives, advanced and modern laboratories, networking and linkages university-industry, could generate values to the STPs. I strongly suggest that on-park tenants should enjoy differences of having finest inputs and facilities to productivity. STP should be able to provide much better services than off-park tenants. Therefore, STP should be promoted systematically by the government and academia to attract talents in form of start-ups, SMEs, firms, research entities and communities, to learn, and produce innovative products and services for competitive global market.

In many STP evaluations, the natural flow and technology transfer from academic and research institutions to the business world are identified as key factors. (Comins & Rowe, 2008). The availability of experienced investors capable of managing the risks related to emerging knowledge-based companies is a critical factor. The nature of business, the research cultures and experiences can have a profound effect on the rate developments of technology-based firms (TBF's) both individually and as a sector. Emerging economies that recognize this early in the development and build ameliorating features into their STP environments are more likely to have successful STP. (Comins & Rowe, 2008) Therefore, I argue that it is important that research parks are planned as part of a national strategy for global industrial competitiveness. Parks also have to promote. In the establishment, parks should employ cluster-based recruitment and marketing methods, including tax incentives, training programs, and other industry-targeted services.

Matthews (1996, p.4) concluded that in all countries in East Asia, the government has played a decisive role in shaping industry's development setting up condition within which companies will operate, and reducing and spreading the risks of investment in advanced technological activities (Nelson & Kim, 2000). East Asia has transformed from technologically backward and poor to relatively modern and affluent economies over the past thirty years through development and contribution of STPs.

Thus, to overcome the challenges and lack of entrepreneurial activities in which government generally takes role to establish rule and regulations and also initiate the development of parks, integration of focused-technological development at STP with academia-business-government should be implemented in an integrative way. R&D activities with focus on the goals of parks that have been setup earlier should be conducted, and to support the enhancement all the necessary facilities and R&D focus directed to serve the R&D activities. The integration of R&D activities in STP including government R&D agencies would harmonize with university research, and also with private firms namely tenants and have laboratories and incubator space in universities.

Furthermore, participation of actors also becomes value to the success of the park. While research universities or institutions as targets and objectives to produce innovative product and services, beyond that, local and regional technical school, community colleges, and skill-based educational activities could join the parks as human resources and participate actively in park daily activities as partners, tenants, and/or different cooperation to tie the upstream and downstream of the R&D

activities. From the clerical and administrative-engineering tasks, their role could be leveraged through experiences and involvement in basic R&D. It has been noted that there is a link between the apparent success of STPs and the strength and diversity of the local economies with good local innovation ecosystems tend to produce STPs that are generally regarded as amongst the more successful. (EU, 2014).

Other author worth to cite is Wasim (2014) that perhaps identified more comprehensive factors, but in contribution to factors that influence STP planning. They are domains of Governance, Growth, Sustainability, and Future Trends and External Factors. Governance factor includes Management, Stakeholders, Target Group, Capital, Technology Focus, Eco-Settings. Growth factor includes incentives, proximity, business support, infrastructure, networking, and culture, sustainability such as linkages, objectives, tenants, and marketing analytics. It also adds Future Trends and External Factors such as monetary environment, business environment, policy instruments, global economy, science & technology, innovation model. However, discussion about STPs success factors is lacking its time boundaries and level boundaries.

2.3. STPs Success Factors Levels and Boundaries

There are several literatures discussing about STPs success factors. UNIDO (2012), UKSPA (1998), EU (2014), Comin & Rowe (2008), Mian, Doutriaux & Corona. (2007), Luger & Goldstein (1991), Wessner (2009) and Wasim (2014) are the authors that sample the criteria or factors that lead to the success of STPs.

From those frameworks discussed, there are two issues. First, none mention about the time-conscious analysis of these factors. Factor of time boundaries is attached to the success factors. Long term goal, medium term goal and short term goal influence the STPs successful criteria. Identified success factors should also consider on which factor is the most urgent and important for the measurement of STPs successful criteria. Importance of factors and urgency of factors are necessary to add to the STPs success factors. Second, it also did not pay attention to the level boundaries of the factors. Factors that affecting the output and outcome of STPs are not vacuum. It is responsive to the environment and system boundaries. Strategic factors, such as STPs planning, goals, clear mission, in-line with innovation agenda of government, are in macro level of STPs boundaries. Inter-firm activities and management of STPs related to some factors in and out of STPs are meso level, while infrastructure and support services of STPs to the tenants and its activities in R&D are micro level.

Using onion diagram, the framework could be classified into macro, meso and micro level, adjusted to their boundaries. STPs as the core presence of innovation system is shaped by the correlation and interdependence boundaries of short, medium and long term goals of STP. The success factors also correlate in time, long term, medium term and short term factors. It is also correlated in level of factors, macro, meso or micro, to the external-internal level boundaries of environment, management and facilities. Therefore, STPs' important and urgent factors adjusted to its level and boundaries.

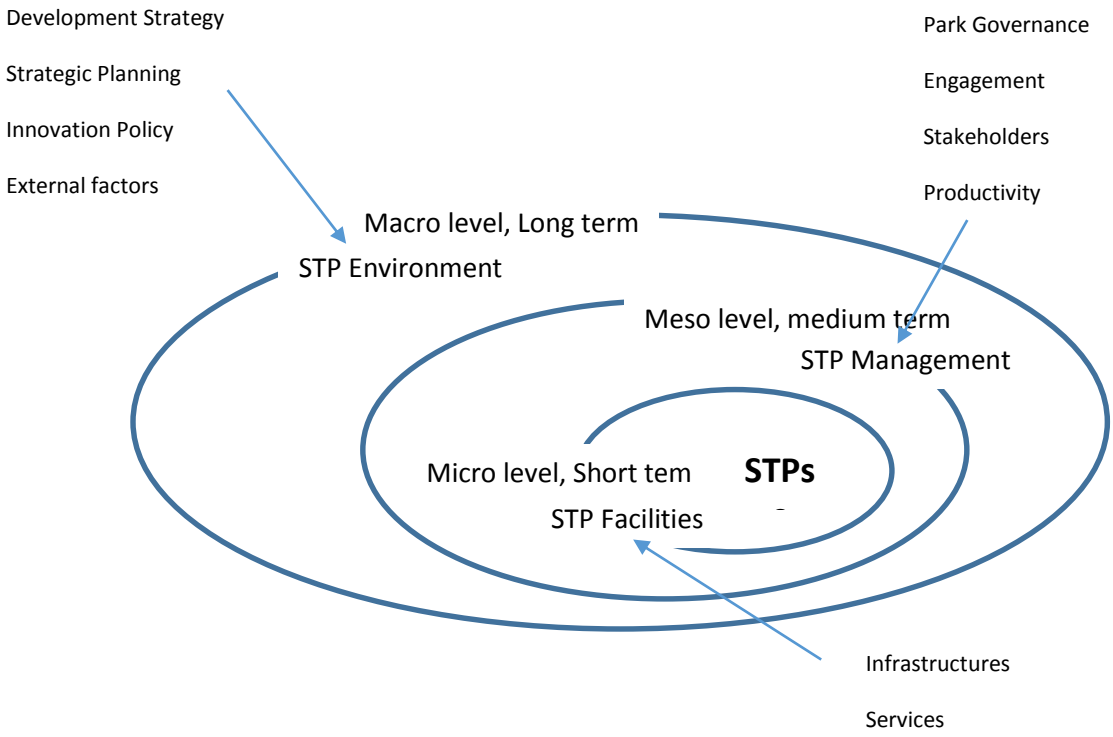


Diagram 1. Level and Boundaries of STPs Success Factors

Using matrix, level of urgency and importance of STPs success factors should be defined by stakeholders of STP. It includes factors perceived by stakeholders as factors that occur in planning phase and implementation phase of STP.

Although all of success factors identified are urgent and important matters for the STPs, it also has degree of urgency and degree of importance. For the STPs success factors, the matrix is developed with very important and very urgent to less important and less urgent. The difference is that urgent means that a task requires immediate attention. Urgent STPs success factors should be factors that directly involve to the immediate performance that should be "reactive" in a time conscious. Important STP factors mean that success factors that contribute to the long term

scenario of STPs and it goes back to the planning, development and output and impact expected by STP stakeholders. It relates to long-term mission, values, and goals of STP. It should be "responsive" in a time conscious.

Covey (1989) developed time matrix management, taken from Eisenhower's decision matrix. The quadrant of urgent and important also could be adjusted to STP success factors. Factors in Quadrant 1 should be the urgent and important factors. Quadrant 2 is filled with important but less urgent factors. Quadrant 3 is to keep less important but urgent factors. Quadrant 4 should contain less urgent and less important factors. Given this, matrix to stakeholders of STP would help to map the state of urgency and importance of success factors developed by several researches and how the factor is important and urgent for the selected STP.

Table 1. Urgent and Important Matrix

	VERY URGENT	LEAST URGENT
VERY MPORTANT	Quadrant I Very Important and Urgent Factors	Quadrant I Important Factors but Least Urgent
LEAST IMPORTANT	Quadran III Less Important, but Very Urgent factors	Quadrant IV Less important, less urgent factors

Source : Covey, 1989

The Framework is further developed into the concept of success factors identification in more empirical ways, and adjusted to the level of urgency and importance of STPs success factors and minimum functions of STP. The STP minimum function is developed through analysis in theoretical framework, where these functions become the necessity of STPs. Without these three functions, it is argued that STP is not properly functionable. These functions also could be incorporated into the model and support the model with the time boundary and level boundary the model has. Therefore, from the previous framework, model that is developed to analyse success factors in specific STP is further enhanced.

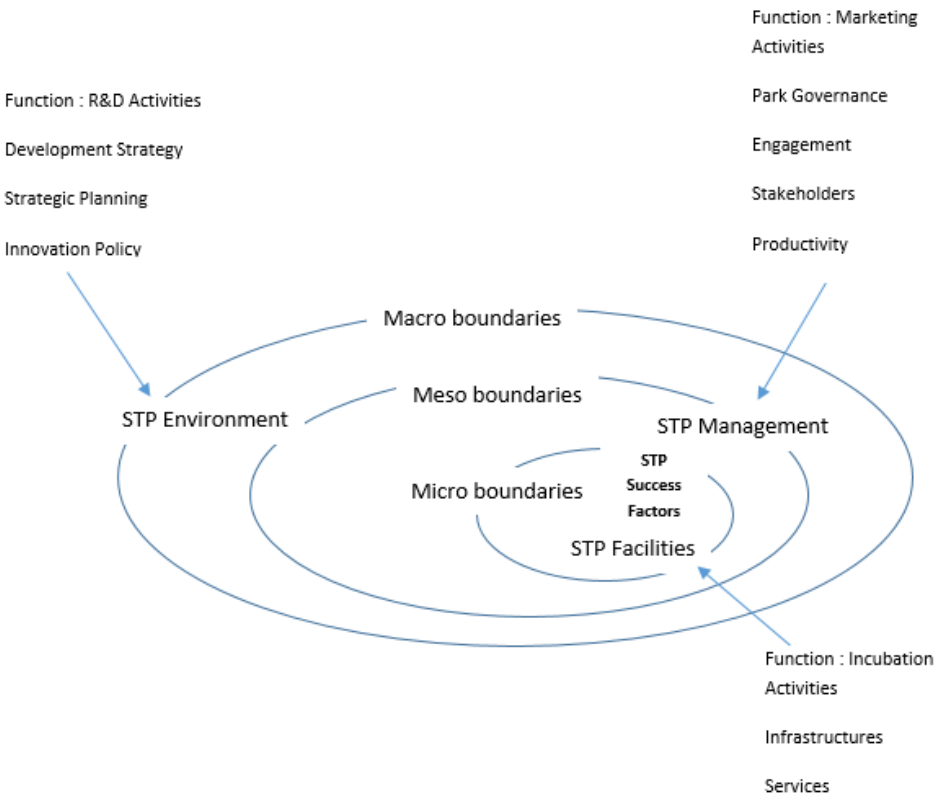


Diagram 2 STPs Success Factors adjusted to functions

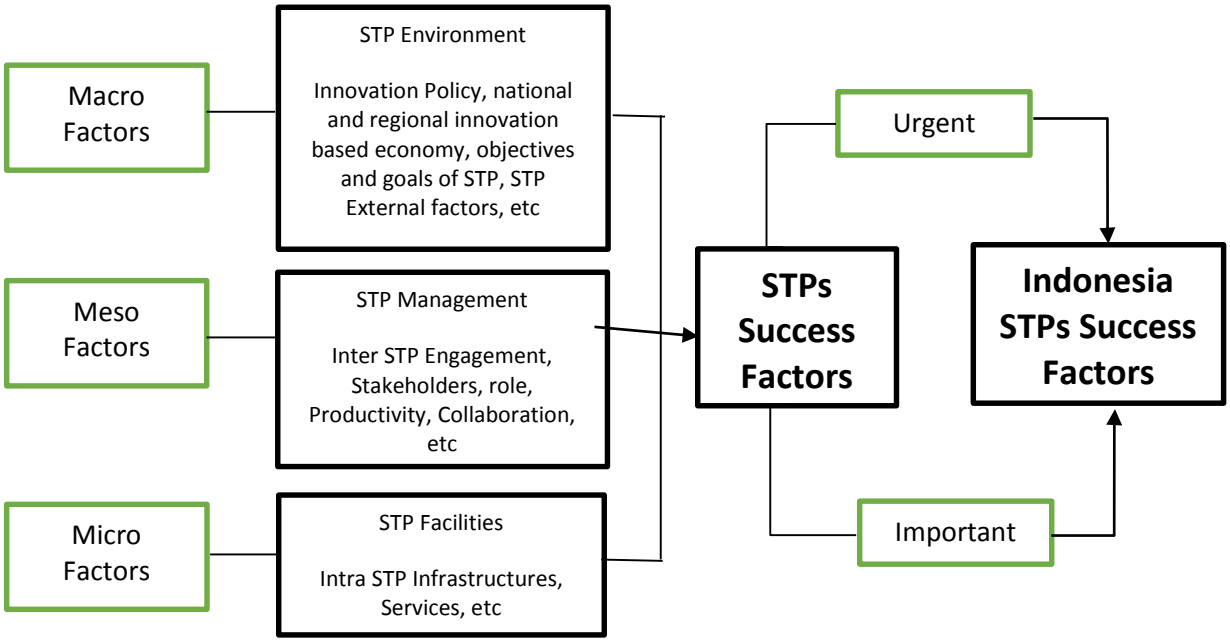


Diagram 3. STPs Success Factors Analytical Framework

All of factors in STPs from minimum functions and its environment, management, and infrastructure are adjusted to the level of Urgent and Important of STP success factors. The result of the matrix would be on empirical basis and it should be developed by conducting interview with actors and stakeholders in the STPs in focus.

3. PROFILE OF INDONESIA'S STPs & RESEARCH METHOD

3.1.Indonesia's STPs Profile

STPs in Indonesia actually has started since 1976, by the establishment of the Research Centre for Development of Science and Technology (Puspiptek) which is an area for government research institutions namely the Indonesian Institute of Sciences (LIPI), Agency for the Assessment and Application of Technology (BPPT), National Nuclear Energy Agency (BATAN), all of which are under the coordination of the Ministry of Research and Technology and Higher Education (RISTEKDIKTI). There are many structural and non-structural government agencies that have mandates and responsibility on S&T and innovation development in Indonesia. Legally, RISTEKDIKTI has clear mandate to formulate national R&D strategic policy and coordinate all institutions in conducting research, development, and application of technology (Law 18/2002, followed by President Instruction 4/2003).

Government-led STPs has been crucial because of its function as facilitator, intermediator and regulator of National Innovation System (Lakitan, 2011). Recently, the STP development in Indonesia has been encouraged. Puspiptek has become member of World Technopolis Association (WTA) in September 2010 after its major revitalization and deinstitutionalization into a modern and larger "national STP".

In 2015, there are already 65 government-led STPs operated under different ministries (Ristekdikti, 2015). These STPs have support from government funding and also under specific ministry/government agency's management and control. Contribution to STP development also derives from private sector-led and university research parks. Together with government-led STP in many ministries, the 100 STP development's targets in 2019 would be very feasible to accomplish. Focus of these STPs is different, usually in manufacture, food & agriculture, fisheries, energy, marine and ICT.

Focus of the STP also depends on their source of funding and their "umbrella". For example, Ministry of Industry has ICT based STP and Ministry of Agriculture has agriculture innovation based STP. Agro Techno Park (ATP), which the primary benefiter of innovation is agricultural society, has many ATPs and clustered in Sumatra corridors such as ATP Indralaya, Ogan Ilir, South Sumatra; and ATP Kaur regency, Bengkulu. Techno Park in ICT with examples of BandungTechno Park (BTP), Techno Park in the field of industrial machinery and mechanical with examples of Solo Techno Park (STP). Furthermore, university based research parks and business STPs are independently depended by their own goals and purpose to set up the STP. Various Indonesia's STP and their characteristics are listed in appendix.

In the National Medium Term Development Plan for Years 2015-2019, development has incorporated efforts for equitable distribution of development between group community and equity between regions. Balancing between regions by distributing centres growth, especially outside Java, through the construction of

Regions Industry, construction of Special Economic Zones, the development of cities new, and all necessary infrastructures. In addition, GoI also initiated the development of STP to grow the economy in a region. STP is planned to spread throughout Indonesia and covers all sectors of economic development.

For development of and implementation of STPs, Ministry of National Development Planning/BAPPENAS drafted official handbook on planning and development of STP, and to be used to prepare for the annual state budget. This budget will be distributed into government-led STP, and also from mechanism of R&D Fund for consortium of research and technology developed by collaboration of STP in private sectors and academia with government.

BAPPENAS (2014) distinguished the type of STP in Indonesia into three types. First is Science Parks (SPs), second is Technology Parks (TPs) and third is National Science & Techno Parks (N-STPs). Development of the N-STPs is directed to function as: 1) Centre for advanced science and technology development; 2) The growth of new entrepreneurship centre in the field of advanced technology; 3) Centre advanced technology services to business and industry. Indonesia's N-STP so far is PUSPIPTEK, the legendary STP that has been revitalized and still at its area in Serpong, near Jakarta capital city. An N-STP development could be constructed by three scenarios: 1). Revitalization Research towards N-STP advanced and modern (such as Puspiptek); 2). Construction of the new N-STP in leading sectors; and 3) Development of N-STP-based Universities.

The SPs and TPs are interesting because development of SP is in the province, while TP is in the regency/city. BAPPENAS guidance stated that SPs are directed to serve

as 1) Provider of the latest technological knowledge to the public; 2) Provider of technology solutions that is not resolved in the techno park; 3) As a centre of advanced technology application development for the economy local. SPs development is the responsibility of the Ministry of Research, Technology and Higher Education (RISTEKDIKTI) for the SPs that affiliated with the University; and correspondences ministries for SPs that already built and revitalized. On the other hand, the development of Techno Parks (TPs) in the District/City is directed to function as: 1) Centre application of technology to stimulate the economy in Regency/City; 2) Place the training, apprenticeship, technology dissemination centre, and centre of business advocacy to the general public. Its development is through the correspondence ministries by afiliating with university/polytechnic nearby. Empirical analysis on the STPs development in Indonesia should also shed light for the future development and appropriate model of success factors for the local context.

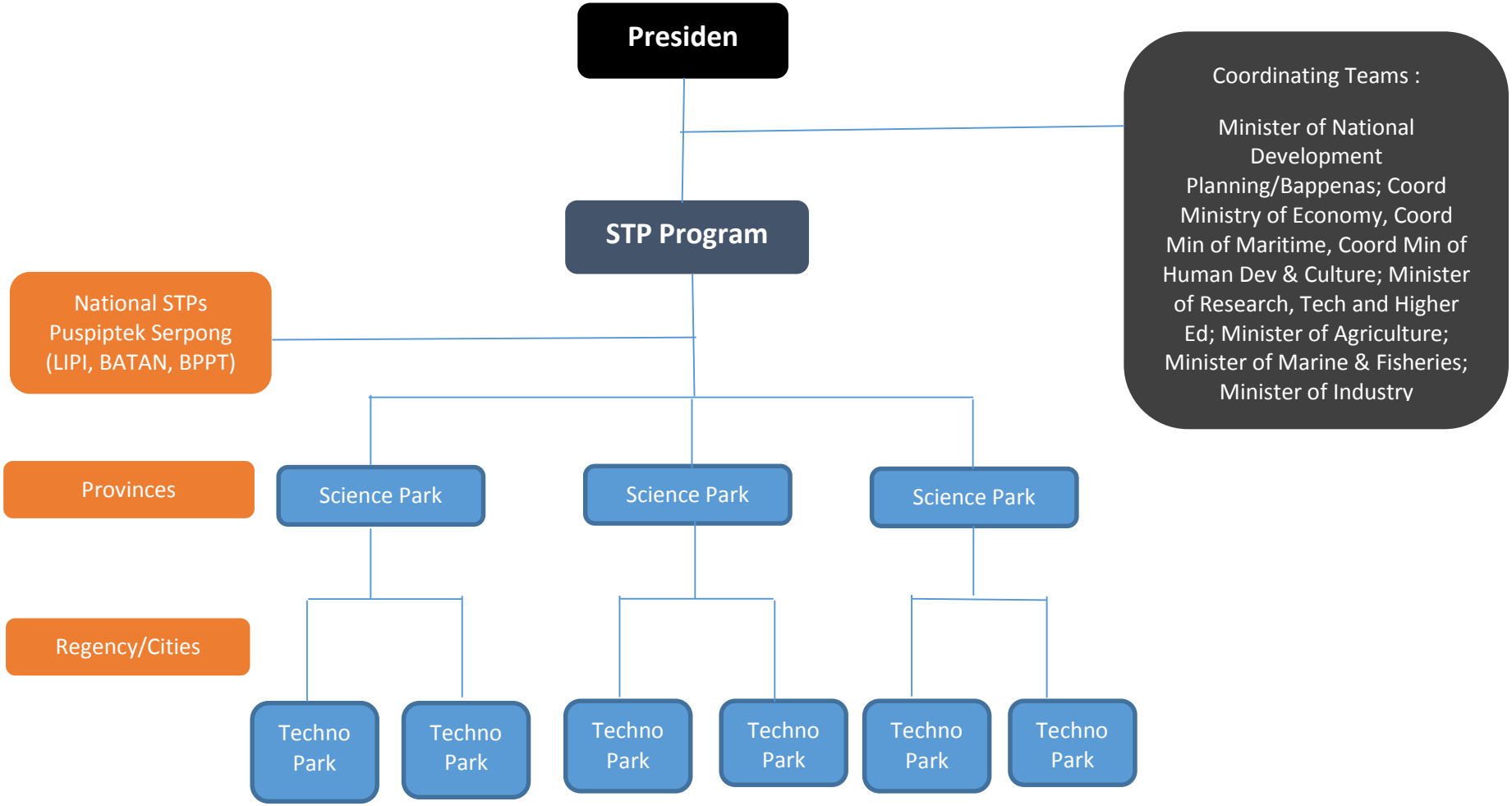


Diagram 4. Indonesian STP Model. Source : BAPPENAS (2014)

3.2. Research Method

This research epistemology is using interpretive paradigm to observe and solve a problem which emphasizes the socially constructed nature of reality. Qualitative research is the approach, analysing and attempting to uncover the deeper meaning and significance of human behaviour and experience, including contradictory beliefs, behaviours and emotions. The research combines primary data through In-depth Interview and Secondary data through literature study. For the purpose of the research, interviews have been conducted to several key persons. Science, Technology and Innovation (STI) policy experts, STPs managers/directors, and government officials.

3.2.1. Research Objectives

1. To develop STPs success factors model
2. To analyse STPs success factors in Indonesia
3. To provide recommendations for future STPs development in Indonesia

3.2.2. Research Questions

1. What model should be develop to analyse STPs success factors?
2. What are important and urgent STPs success factors of Indonesian STPs?
3. To what extend those STPs success factors influence the performance of Indonesia's STPs?

3.2.3. Research Limitation

Researcher limitation due to limited time and source of funding to conduct more comprehensive field research.

3.2.4. Analytical Framework

Based on several previous researches on STP success factors, onion diagram of STPs success factors model (Diagram 2, Diagram 3) have been developed for framework of analysis of Indonesia's STPs success factors.

4. DISCUSSION

4.1. Macro level and STP Environment

Before the reformation era, Indonesia's STPs development largely came from the initiative of academia. Government had only established Puspiptek (Science & Technology Development Centre) as their main STP from 1970s and the most of their output could not be commercialized because existing mismatch between research and development of innovative products and market demand. Academics have their own initiative in establishing several STPs such as in four largest state-owned universities, University of Indonesia, Bogor Agricultural University, Bandung Institute of Technology and Gadjah Mada University. These four are the main producers of start-ups. However, its activities are still limited to produce basic research, and there are no supportive policies to research and commercialize products from university's parks.

R&D Activities in most of STPs are based on the instruction of the initiator-founder which is also the financial bearer of STPs. Government-led STP has financial support from local and regional government budget or from their main organization such as the ministry, or through financing mechanism. Still, the low budget for R&D is the problem. However, there was a major change in budget allocation since the Fourth Amendment of the Indonesian Constitution was approved in 2002 which obligated government, through RISTEKDIKTI to allocate at least 20 percent of the total national budget for education (Lakitan, Hidayat & Herlinda, 2012). Even though this obligation is not directly for supporting R&D activities, yet it is

expected to have a positive influence on university based STP performance in R&D.

Private-led STPs have their corporation strategy for providing R&D and human resources to create skilful talent for the corporations or to partner corporations. For example, According to the interview with Cikarang Technopark director, they have their own STP serving as the "teaching factory" for their own expenses.

In term of strategic planning, some of STPs in Indonesia still have objective of innovative products as the output. Less STPs designed STPs productivity to produce products from market demand, and creates successful start-ups and spin-off companies. The condition is persistence since the first STP, Puspiptek as the national STP developed. PUSPIPTEK (Science & Technology Development Centre) was established by Indonesia Science Institute (LIPI) a government agency in science, not Ministry of Research & Technology or related (such as Ministry of Education on that era) therefore the culture of research is very high, however the weakness is it missed the commercialisation agenda.

Fortunately, GoI programme of 100 STPs Developments had also shifted the paradigm to the more downstream purpose, a market demand products and start-ups creation. According to the Interview with RISTEKDIKTI official, the goal of STPs is not to produce a research product (only), but it should produce new technology-based firms. RISTEKDIKTI under the new paradigm right now is heading toward the innovation system approach and support the accomplishment of 100 STPs in Indonesia in 2019.

The initiative from GoI is also to cooperate in term of funding for different STPs across Indonesia. RISTEKDIKTI has coordinated funding mechanism to support STPs by providing research grant and macro management and national guidance. Based on the interview with RISTEKDIKTI, they are optimists that through cooperation in the development of STPs, Indonesia can expect to produce entrepreneurs of technology-based specialized fields in different potential regions in Indonesia. For example, STPs that focuses on R&D in animal husbandry and agriculture in South Sumatra.

However, STPs clustering scheme into SPs and TPs is challenged by university's parks, espceially those located in city/regency not in province capital city. Bogor Agricultural University (IPB), in West Java is one of the example. IPB has recently established STP which has focus on agricultural and domestic plantations R&D and Innovation. According to the interview with IPB Science Park director, at the beginning of the policy, IPB Science Park is unfavourable for BAPPENAS direction concerning definiton and guidance of STPs development on the local STPs. Nevertheless, consensus had been made, since IPB is national university and therefore IPB Science Park is one of government classification of "national STP".

STPs in Indonesia is developed in two methods. First is revitalization of existing STPs. It provides lesson learned on why performance does not contribute to the enhancement of economy. Second is the new STPs development. STPs projects usually come from the national budget on the program of different ministries accordance to the local potential of product development. For example, agricultural STPs would be established by cooperation of central government (coordinating

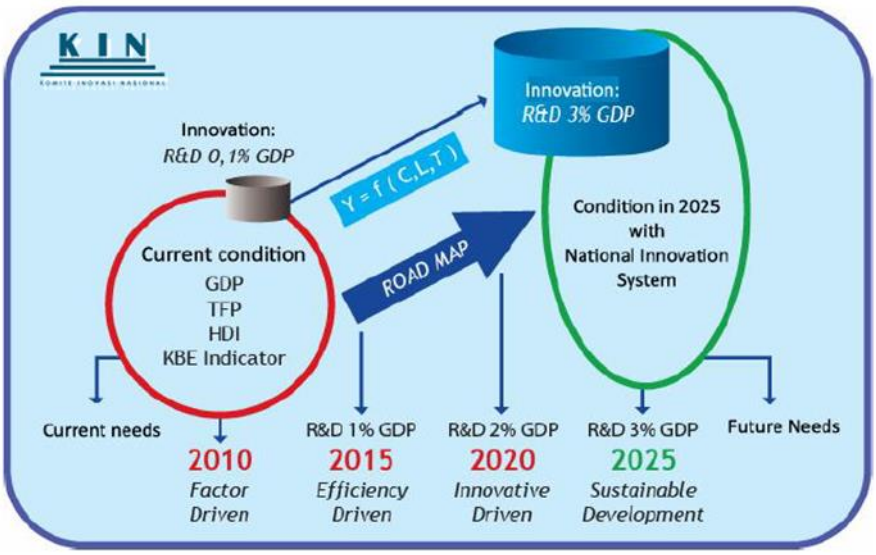
ministries) and local-regional government for the project of STPs development. ATP as STP in South Sumatra is the example of revitalizations of STPs. Before revitalization, the ATP has been designed to serve as the regional STP for agro technology products. Some R&D on agriculture and horticulture have been cultivated. However, the ATP only becomes large laboratory for researchers, students, and lecturers conducting their research. Now, ATP adopt new paradigm as a "real" STP on agriculture. The expected output is also shifted, from only producing innovation-based industrial products to producing new entrepreneur's spin-off company and start-ups from the parks, and more patent. In addition, the number and value of investments in science and technology-based industries increase, so that the added value of domestic production goes up. Development of STPs will also be adjusted with the potential to flourish in a province and regency/city. As in the province or urban focus on the industrial sector, district/city is directed to the agricultural sector and to focus on the coastal areas and fisheries sector.

In Innovation Policy, Government has initiated various policies to support the program of enhancing the economic development growth of the country. Act No.18/2002 on the National System of Research, Development, and Application of Science and Technology is the basis for Science, Technology and Innovation policy in Indonesia. Previously, research and development was carried under sectorial regulations. This act has been core policy to establish innovation institutions across local and national government. This act has been core policy to establish innovation institutions across local and national government. Later on, the existence of National Research Council (DRN) and Regional Research Council (DRD) in

provinces across Indonesia and National Innovation Committee (KIN) strengthens the innovation system paradigm in Indonesia and incorporates to the planning and development of STP across the country.

Joint regulations of Ministry of Research & Technology and Ministry of Interior were signed on April 25, 2012 with number 3 in 2012 and number 36 in 2012 on Strengthening Regional Innovation System. The most recent policy is from the newly installed government with the Five year plan of development 2014-2019, one of them is the mission to develop 100 science and techno parks within five years in presidential seat from 2014-2019. The Ministry of National Development Planning (BAPPENAS) also adopts STP paradigm as innovation system "vehicle" and provides guidance on developing new STPs in Indonesia.

The establishment of National Innovation Committee (KIN) strengthens the national (and regional) innovation perspective and currently, KIN has made road map to achieve the vision of Indonesia as an innovation-based economy in 2025 with the main drivers of technology. KIN is a non-structural and independent organization established by the President to explore the thoughts and views of the parties with an interest in promoting socio-economic development nationwide through national innovation system. The organization is directly under president and ratified in Presidential Decree.



Picture I. National Innovation Committee Roadmap

However, Government perspective and direction on the development of STPs in Indonesia is challenged by the dynamics interaction between already established STPs and issues on reposition of R&D institutions and STPs role and its movement of spatial based responsibilities. The domination of government-led STPs within networks of ministries also characterizes their management and financing mechanism. BAPPENAS, which harmonizes their plan to several government agencies in research and innovation such as LIPI (Indonesia Science Institute), BATAN (National Atomic Energy Agency) and BPPT (Agency for Assessment and Application of Technology) and national and regional research council, is lack of approach to the second and third sector of STP. Private-led and Academia based STPs in their operational of STPs utilizes the support of government through Ministry of Research, Technology & Higher Education (RISTEKDIKTI) for their addition of financial support. This mandate to RISTEKDIKTI, however, has not been able to consistently implement. Main constraint in implementing this law is

the fact that this legal authority has not been coupled with financial authority. RISTEK fund for R&D and Innovation is very small that they have to rely on regional government and local government budget for STP activities in their region.

This factor, policy support and financial support, is important and urgent to the STPs. Academic based STPs such as science parks in university have their own source of fund, but the support from government takes place in the form of education and training of human resources such as SMEs development program in the STPs in university, short course abroad for human resources in specific STPs focus, for example machinery, manufactures and biotechnology.

Interviewees all agreed that there are many inconsistencies in policy implementation. STPs requires business climate that is coherent to policy at the local level. In regional autonomy era, support from local and regional government is needed, through their regional innovation system to strengthen the STPs productivity. STPs participation depends not only on policy design, but also on policy consistency and coherence, effective implementation, and coordination.

According to innovaton expert opinion, ideally, STPs should not be merely a park, but an area which attracts talents in R&D and produces innovative products and services. STPs should be "lively" and support the innovation activity and development and create "innovation ecosystem" in the area and also in the region where the STPs is located. Most of STPs in Indonesia have training centre activities to strengthen the human resources. However, the training activities and pre-incubation activities should continue and leverage the phase to become incubation and attract more industries to the STPs to be their centre of R&D activities. The

condition would set up the ecosystem of technopreneurship in the region and tackle the economic challenge through product competitiveness.

R&D is the core activity of STPs. However, this activity should answer the problems in the society. Product from STPs should become solutions for society problems, including economic problems. Since R&D needs financial support, thus support from policy makers also derives from financial support. Funding of STP is a concern of most STPs in Indonesia. Even though STPs from private parks such Cikarang Teknopark have their own financial support, the need of government funding is essential to develop the program of incubation activities and STP services to their tenants.

National strategy to strengthen the competitiveness of Indonesian products with innovative products and services meets the challenge to harmonize the national policy with local policies. Decentralization and autonomy in local level (regencies and cities) have made cities and regencies focus on their own policy to improve the economy. Innovation in certain sector as central government plan through various agencies is challenged by local government agencies which have their own R&D agenda in specific sector. Or else, reluctance of R&D in specific sector because of local government plan agenda is different from national government agenda for economic development tool from certain sectors. Therefore, national strategy through national and regional innovation system developed by government agencies and as binding policy for local government should be in line with the STP development as the main vehicle for the economic development in competitive world.

Second factor in macro-environment success factor is global and regional business in technology toward the existence of Small Medium Enterprise (SME) as startup companies in STP. Most of Indonesia STPs and policy makers are influenced by STP development and activities in China and South Korea. Government officials repeatedly visit South Korea to analyse, discuss, and study about their development toward smart city and clusters such as Hong Kong or Daedok. Range of value added products from electronics, digital devices and gadgets to simple housewares is designed and produced in innovative ways. With the support of central and local government to private sectors and academia in STP based R&D and Innovation. Indonesian government learns that the support of government is vital to the development and national and regional economy should be enhanced by developing STPs in several regions to support national competitive advantages. Therefore, cooperation, collaboration and knowledge transfer from abroad, particularly these countries are needed. That is the purpose of Human Resources movement of government officials to countries regarded as advanced in STP development and economic performance. The problem is, according to interviews with academia and innovation experts, many visits with supported financial by government and stakeholders of STP are not effective, because some government officials do not have clear agenda and further step after their visit to "successful STP".

Yet, based on the interviews, learning from abroad is important and urgent. STP in developed country and emerging economies such as in Asia which share important geography and geopolitics has developed its innovation system and has been supported by economic performance of their STP. Learning from nearby country such as Thailand and Malaysia specifically on their agricultural and marine

innovation system should become valuable inputs for evaluation of Indonesia's STP in agriculture and marine innovation. The condition is also the same to learn from South Korea in order to develop STP in Indonesia to be Innopolis. The empirical condition that regional autonomy practices in Indonesia where regions can innovate and budget their innovation is also important factor to support impactful STP to the regional economy. In ASEAN context, the aim of the STP is also to be source of innovative products and can be competitive in the ASEAN Economic Society which is already established in 2016. Human resources and innovative market-demand products are the target to be strengthened to face the AEC and become local brand with international reputation and also fill the position of experts in the field of technology business at regional level.

However, as Cohen & Levinthal (1990) stated that to fully utilize the potential external knowledge provided, the firms need to absorb and integrate the knowledge they acquire with their capability. The empirical condition that regional autonomy practices in Indonesia where regions can innovate and budget their innovation is also important factor to support impactful STP to the regional State economy. In ASEAN context, the aim of the STP also is to be source of innovative products and can be competitive in the ASEAN economy. The domination of government-led STP within networks of ministries also characterizes their management and financing mechanism. BAPPENAS which harmonizes and directs the plan to several government agencies in research and innovation such as LIPI, BATAN and BPPT and national and regional research council is lack of approach to the second and third sector of STP.

Tabel 2. Macro Level Factors

MACRO LEVEL FACTORS

		URGENT FACTOR	
		Very Urgent	Least Urgent
IMPORTANT FACTOR	Very Important	clear STPs strategy, policy support, financial support, learning from abroad, tech transfer, tech exchange	HRD development, global innovation challenges
	Least Important	coherent strategy of STPs to national system of innovation	harmonize and synergize local economic development scenario by utilising STPs facilities to national plan and scenario

Source : interviews, elaborated by author

4.2. Meso-Level and STP Management

In managing the STPs, based on the interview to park managers, the productivity of tenants and their innovation output is urgent and important factors for Indonesian STP. The output of innovative products and services is designed to meet the objectives of the park. The "function follows money" paradigm used in the productivity criteria in various STPs in Indonesia has led to STP product and services created mainly for the purpose of providing products from existing financial coverage available (and approvable by stakeholders).

Commercialization of research is important factor. Most of STPs in Indonesia conduct R&D based on the "proposal" and "projects". Problems with commercialization also relate to the awareness level of Intellectual Property Rights (IPR). IPR constraints in Indonesia usually occur because of two factors. First, lack

of international patent because the innovative product developed has already developed by other parties and IPR has already taken by other innovative foreign companies, through STP or not. Second, tenants and parks do not patent their products. Therefore, according to interviews, all agreed that commercialization as the factors of successful STPs in Indonesia's is difficult to optimise right now, but an urgent and important matter as the key to successful STPs.

Park governance such as the management of tenants, where STPs should not only provide place for gathering tenants to focus on their R&D, but also set up institutional arrangements such as incentives, free facilities, networks and collaborations to other STPs and research centre entities. STPs also has vision, mission and objectives to carry out the STPs activities. Expected output is the increased innovation-based industrial products, new entrepreneurs spinoff, patent, work-ready graduates, financial marketing technology consulting services and seed capital. In addition, the number and value of investments in science and technology-based industries increase, so that the added value of domestic production goes up. Automated public welfare is reached.

Stakeholders in STPs are usually a collaboration of government, including central and regional government, private sectors and academic institutions. For example, according to Cikarang Teknopark manager, which is also former Solo Techno Park manager (which is consider as one of very few "successful park" in the era where Mr Joko Widodo, current Indonesia's president served as major of Solo city before His leapfrog to the presidential seat), Central government has supported the development of human resource capacity (capacity building) including sending

some STPs operators and tenants to partners abroad to learn new skills in their STP focus, such as ICT, manufactures and ship building technology. STPs also builds extra spaces for tenants, including the procurement of multiple machines supporting the operation of ideal scale manufacturing. Engagement of these stakeholders is important success factors for STPs development in Indonesia. In research and development collaboration, role of actors in STP management, therefore, is critical to be addressed in order to align the STP activities to be productive and innovative.

Collaboration and networking is perceived by interviewee as important success factors for STPs development in Indonesia. From the networks, knowledge flows. In many STPs evaluations, the natural flow and technology transfer from academic and research institutions to the business world are identified as key factors. (Comins & Rowe, 2008). The literature on knowledge flow suggests two categories, knowledge transfer where it exchanges intentionally with people and organizations, and knowledge spillover where knowledge is gained/exchanges unwillingly outside the intended boundary (Chan, et.al, 2008). Similarly, Christopherson et al. (2008) differentiated to knowledge transfer and knowledge exchange. The former represents a rather linear and unidirectional knowledge flow (mainly from university to industry) while the latter manifests a more complex non-linear relationship such as forums and cooperation. Through knowledge transfer/exchange, STPs will gain markets, enhance skills of human resources through collaboration to innovate products. It is necessary to enhance the development of STPs.

Networks of STPs in Indonesia could be enhanced by two scenarios. First, by annual or tri-monthly forums facilitated by the government to provide STP update development and motivate other STPs to become successful. The forum also can increase the successful of STPs in Indonesia if the forum also provides awards and incentives for several STPs that have reached satisfying level. Second, through networking to other global innovation actors beyond the local STPs network and collaboration. The innovation actors are ranged widely from individuals to research entities and training and development organizations across the global world. In the specific sector of STPs focus, many research centres and development organization could be collaborators in training of human resources, collaborative research, joint consortium of research and technology. It also ranges from national, regional of ASEAN, inter-regional and international forum and collaborations.

However, while incentives become important factor, some STPs hardly get tenants to join. Incentives given to the tenants on STPs and incentives for STPs are usually only in interpretation of financial support. STPs needs more than financial support, but also institutional arrangements and policy such as tax free, laboratory development, human resources training and networking to enhance their skills and ability and collaboration for research such as consortia, and promotional and marketing activities to their innovative products. However, Experts from academia noted that many of spin-offs and start-up companies from STPs incubation activities could not survive after six month from their “graduation” from STPs incubation. The condition is forced by lack of income projection after they start their initial company, while in STPs such support derives from government fund for R&D. Some of ICT based tenants which produce innovative multimedia

applications usually rely on initial fund for government or STP management financial support, not from targeted customers since they face the challenge of piracy of multimedia products in Indonesia.

Intellectual Property Right (IPR) is also significant factor for evaluating the successful of STP. The problem with IPR is not many patents registered. Without patent, most STPs operating in Indonesia depend on their “project proposal” and conduct daily activities of research and development in accordance to their accepted proposal. Indonesian STPs do not concern about IPR and it is not a factor that becomes important performance indicator. An international network of inter-university and inter-STP research and innovation should also overcome the condition. Hence, the idea of "international co-authorship" and "international co-patenting" could help to solve the challenges of global innovation.

Human resources are also important factor in management of STPs. In Indonesia, especially STPs which is a “government STP”, the personnels of STPs are “public servants”. The cultures attached on those public servants are “working at STP”, not “researching”. Therefore, even though the status of the public servant in STP is researcher, their daily activities are on a regular working basis. Innovation in this condition is where there is an initial program to conduct research on specific or general products and sectors, and there is no immediate output which should be done, for ultimately, new innovative products, but only to report their R&D activities to their supervisor. The quantity and quality of human resources that contribute to the innovation of R&D is one of the key determinants of the STP successfullness. The education budget by 20 per cent of the national budget should

be able to form the intellectual culture. Increased number of intellectuals should impact on more research, systematically and massively in order to form the culture of "achievers".

Tabel 3. Meso Level Factors

MESO LEVEL FACTORS

		URGENT FACTOR	
		Very Urgent	Least Urgent
IMPORTANT FACTOR	Very Important	productivity, patents, new products, linkages univ-industry-gov	role of stakeholders, role of actors, networking, forum for actors, B2B
	Least Important	marketing, promotion activities, incentives	authority to market & promote, government help through regulation, law, formal channeling G2G

Source : interviews, elaborated by author

4.3. Micro level and STP Infrastructures

According to interview result, Infrastructure is important and urgent for initial development of STP and ensuring the STP activities. However, infrastructure gaps, such as Internet, between the Eastern and Western part of Indonesia have been obstacle for collaboration of R&D and Innovation. In fact, the implementation of e-government is highly dependent on local leadership hindered the development of STP in Indonesia. Innovation centre projects small and medium enterprises (SMEs) as start-up companies also need more attention of the government and the business world. In addition, triple-helix formation units of R & D in universities should be encouraged to be churning that produces new start-up companies.

STP facilities such as incentive for tenants in STP such as tax free, intensive groups of specific focus of R&D with other tenants, availability of supportive funds, complexity of labs available, access to resources (database, journals, prototypes, international collaborations), also amusement centre and book collections are important support for tenants in STP. These facilities should be provided at their convenience, to meet their expectations of R&D environment in STP.

Incubation activities in STPs should also become important feature. However, incubation activities in Indonesia are predominantly by proposal selections in which STP tenants competitively propose their "research project" to government with university students, research centres and individuals/teams, consortium of research, that geographically not inside the STP (off-STP projects). The consequence of such mechanism is that tenants have habits to rely on the networking factor of STP and the government. If the STP is government-led or has close connection with government official, particularly those in coordinative ministries, the incubation and R&D activities will be running well, if not, the STPs should compete to another grants and using their indigenous source of funding from various sources.

If the role of STP is as centre of incubation, STPs have to be supported by incubation management by STP itself. However, the need to have incubation should be incorporated to any STP in Indonesia. Because, some STPs still provide place for training and skill development, as human resources that industry would ask, not systematically develop new entrepreneurs and new firms. Solo Techno Park has their incubation facilities after their other main activities such as training and courses on skill development of manufactures, Bandung technopark in their

Multimedia training scheme and also for private such as Cikarang Teknopark which has training and recruitment as their main business in STP. The same issue on the human resources, in the Private STP such as Cikarang Teknopark, has their own management by providing skill training on manufacture and cooperation to their industrial partners to industrial placement of their talented human resources. While tenants in the park are diverse not only for R&D but also for recruitment firms and other general trade and business firms.

The number of start-up companies sprung out from STP is also considered as success factors for the performance of STP. Larger start-up means that STP incubation is successful and the next step is to maintain these start-ups and provide facilities to increase their productivity and also expansion for a broader market. For example, the instalment of modern tools and computerized mechanism which is important for the production process can be more effective and efficient. Problem in technology equipment of STP is that it needs additional maintenance activities. It is suggested that these kind of infrastructure could be managed by STP and local government.

Infrastructure development has been collaborated from various stakeholders. Central government, local government, private sectors through investment and innovation demand. The case of Indonesian STP scenario largely comes from government STP initiatives and investment on infrastructure development. Recent establishment of several STPs in Java and Borneo indicates that the mission to build 100 STPs in Indonesia within 5 years is intensively on going. However, establishment of 100 STPs is quite a jargon and program pursuer. The role of STP

is not only number of STP established, but also in STP quality of services that STP provides to business partners, their tenants on-site, as well as the implementation of vision, mission, objectives and programs of STP.

Tabel 4. Micro Level Factors

MICRO LEVEL FACTORS

		URGENT FACTOR	
		Very Urgent	Least Urgent
IMPORTANT FACTOR	Very Important	Infrastructure, attractive Incentives, intensive incubation	priviledges of tenants in STPs, STPs services, number of startups
	Least Important	Access to various government resources and current R&D	ICT related facilities, amusement & leisure support, location of STPs, Paradigm shift

Source : interviews, elaborated by author

5. CONCLUSIONS

Macro level factors: Factors that influence the successful of the STPs in Indonesia in macro level and environment of STPs are policy support and learning from abroad. These factors are important as strategic planning for STPs to operate in an effective and efficiency way. The Asian Economic Community (AEC) challenges the productivity of STP to contribute to the economy by winning the competitive market of innovative products. STP development in Indonesia should consider the objectives in the very beginning of planning, including strategic value in developing STP in the region. Important and urgent that STPs should have a clear strategy. The strategy is also have to coherent with National Innovation strategy and guidance to make it works and STPs able to move the regional and national economy acceleration through their performance. Therefore, harmonize the STPs development scenario and their local stakeholders strategies with national actors to make impact for the greater economic performance. Learning from abroad should add intellectual strength to the productivity of STPs. Technology transfer, technology exchange and technology spillover from various opportunity to engage in global collaboration is important and urgent as factors that can make a successful STPs.

Meso level factors: For meso level and how the STP management is implemented, the role of stakeholders, productivity of tenants and productivity of STPs as organization is important and urgent. Productivity is on the quadrant of very important and very urgent. However, the productivity should be evaluated in a standardized aspect. The productivity includes tenants' output of new innovative

products, Patents. Including to the STPs managerial and technical to handle the activity such as daily administrative and marketing activities. STPs should do more to market the innovative products. Therefore, the need of networks to business entities, markets, and global reach is necessary to value the productivity. Networking through establishment of Forum or symposium of STPs in Indonesia is one of desirable Government support besides financial support. Global networking forum is also a feature that should be established by the stakeholders, especially government because of their Government to Government (G2G) relationship. While Business to Business (B2B) also strengthens accordingly, G2G would be effective to facilitate international forum and networking among other emerging countries with the focus of technology development and STP-based productivities. The proportion of authorities of managing the STPs should be given freely to accommodate marketing and promotion of STPs. Government helps STP by providing law and regulation to support R&D process by incentive, monetary and finance support, also policy on innovation and creating favourable business climate of STP in commercializing their products. Therefore, STP Governance, productive engagement with stakeholders (academic, business, and government) is urgent and important.

Micro level factors: Micro level has ultimate factor, namely STP infrastructure. The infrastructure also ranges from providing ICT to the STPs, for example to access sources of research data such as databases and internet connection, and also for building infrastructures such laboratory, meeting classes, equipment, and supportive environment such as boarding room, amusement centre, and book collections in the library as STP services to their tenants and researchers. There

should be also a paradigm shift in STP planning, development, and management. STP function is not only to be research and development centre, but to produce three basic performances. First is to be incubator for new business start-ups. Collaboration should be necessary to be able to provide incubation system in STP that works effectively and efficiently to produce new entrepreneurs and firms. Second, in order to have impact to the regional economy, it also should be able to attract tenants into the STP. Incentives and promotion of STP are therefore necessary. Third, the continuous research and development should be conducted by STP. R&D contribution in STP should be intensive and focus in specific sectors to the potential STP in the region the STP is established. Nevertheless, STPs human resources are not "Doer" but tenants are. Therefore, STPs productivity in R&D depends largely on how incubated activities result in new start-ups, new innovative products and continuous R&D activities within the park.

Model of STP Success Factors: All the stakeholders of STPs in Indonesia should be aware that there are three specific level and boundaries, from STPs internal support of infrastructure and services, STPs management practices, and STPs political cultural environment at macro, meso and micro that challenge STPs in Indonesia. Understanding the success factors of each level and boundaries would be valuable and responsible for the future form and performance of STPs in Indonesia. Model developed for analysing STPs success factors in Indonesia (table 2) has been refined and enforced with the macro, meso, and micro factors that influence the future performance of STP in Indonesia.

From analysis and discussion about Success Factors of Science and Technology Parks development in Indonesia, there are several recommendations:

1. Government
    a. Macro: Government is main actor in STPs in Indonesia. Therefore it should provide regulations and guidance for STP development and also for STP management because not only to regulate their "civil servants" of STP to have "research culture" but also to provide framework for STPs to enhance their performance and impactful for economic development. Government should also evaluate the performance of STPs in regular basis, and develop STPs in accordance to the potential region where STP is established. The palm oil and natural resources cluster in Sumatra for example, should be suitable for agriculture STP, while in West Java with high penetration of ICT should be more effective and efficient to build creative economy based STPs.
    b. Meso: Government should optimize the development and management of STP by creating national forum of STPs, national and regional festivals, forums, and public engagement activities to support the marketing activities of tenants in STPs.
    c. Micro: Government involvement in STPs activities should be limited in active control on micro activities. However, infrastructures of STPs usually come from government fund therefore STPs should also actively manage their source of fund

from investors and their own budget for R&D. Government role in STP should be from macro perspectives (policy, support).

2. STPs

   a. Macro : STP should not rely on the government financial support only, but also for other support from government such as infrastructure development, human resources training and development, networking forums and facilities also seek for assistance in planning and development of STPs.

   b. Meso : STP should manage themselves to be professional. The wider degree of independence should be given to STPs to manage, promote and produce innovative solution of products and services in specific sector.

   c. Micro : STPs should maintain three basic performance, incubation activities, tenant promotion and management, and continuous R&D.

3. Stakeholders of STPs in Indonesia:

   Success factors that has been identified is ranged from micro factors, meso factors and macro factors. Stakeholders of STPs should aware that these factors are critical to further successful development of STP in Indonesia.

Table 5 STP Success Factors in Indonesia (empirical analysis)

Macro Factors STP **E**nvironment :	Policy Support, Global and Regional Environment (technological spillover, technology/knowledge transfer), STP should coherent their strategy with national innovation policy and continuous R&D activities
Meso Factors STP Management :	Role of actors in STP (networking, research collaboration university-industry in STP, productivity and commercialisation), STP Governance from stakeholders
Micro Factors STP Facilities :	STP facilities. STP should have well functioned incubator, value added that attract tenants, good infrastructures for continuous R&D

Source : author

References

Annerstedt, J. 2006. “Science parks and high-tech clustering.” In: Bianchi, P. and Labory, S. (Eds.*), International Handbook of Industrial Policy*. Cheltenham: Edward Elgar, 279-297.

Cao, C. 2004. *Zhongguancun and China's High-Tech Parks in Transition: ““Growing Pains”” or ““Premature Senility””*? Asian Survey, Vol. 44 No. 5, September/October 2004; (pp. 647-668) DOI: 10.1525/as.2004.44.5.647

Campbell. J. 2013. *Becoming a Techno-Industrial Power: Chinese Science and Technology Policy.* Issues in Technology Policy. Number 23, April 2013. Brookings.

Chan, K., Oerlemans, L., & Pretorius, M. 2008. *A Conceptual Model of the Impacts of Networking on Innovative Performance of New Technology-Based Firms*. Portland International Conference on Management of Engineering and Technology, 443-453.

Chan, K., Oerlemans, L., & Pretorius, M. 2010. *Knowledge exchange behaviours of science park firms: the innovative hub case*. Technology Analysis & Strategic Management, 22 (2), 207-228.

Christopherson, S., Kitson, M., & Michie, J. 2008. *Innovation, networks and knowledge exchange.* Cambridge Journal of Regions, Economy and Society, 1, 165-173.

Comins, N. and Rowe, D. 2008. *Success Factors for Science Parks in the Developed World and Emerging Economies.* Available at http://www.warwicksciencepark.co.uk/wp-content/uploads/2011/03/SuccessFactorsforScienceParks.pdf

Cohen, W. M. & Levinthal. 1990. *Absorptive Capacity: A New Perspective on Learning and Innovation.* Administrative Science Quarterly. 35(1), 128-152

Covey, S. 1989. *7th Habit of Highly Effective People*. Free Press: UK.

Dabrowska, J. 2011. *Measuring the success of science parks: performance monitoring and evaluation.* Full Paper for the XXVIII IASP World Conference on Science and Technology Parks. Available at http://www.pmf.sc.gov.br/arquivos/arquivos/pdf/08_07_2011_16.28.06.346a693b4baaca30ad620164d8186c1d.pdf

European Union. 2014. *Setting Up, Managing, and Evaluating EU Science & Technology Park. EU.* European Commission, Directorate-General for Regional and Urban Policy. REGIO. http://ec.europa.eu/regional_policy/sources/docgener/studies/pdf/stp_report_en.pdf

Hassink, R and X. Hu. 2012. *from Specialisation to Diversification in Science and Technology Parks.* World Technology Review. Available at http://www.wtanet.org/ds_imgs/sub04/wtr1/WTR01010101AT.PDF

Jung, M. Lee, Y-b. & Lee, H. 2014. *Classifying and prioritizing the success and failure factors of technology commercialization of public R&D in South Korea: using classification tree analysis*. Journal of Technology Transfer. DOI 10.1007/s10961-014-9376-5

Ketels, C. H. M. and O. Memedovic. 2008. *from clusters to cluster-based economic development*. International Journal of Technological Learning, Innovation and Development. Vol. 1, No. 3

Lakitan, B. 2011. *National Innovation System in Indonesia. Present Status and Challenges.* Paper presented at the Annual Meeting of Science and Technology Studies, Tokyo Institute of Technology, 10-12 June 2011.

Lakitan, B. Hidayat, D. & S. Herlinda. 2012. *Scientific productivity and the collaboration intensity of Indonesian universities and public R&D institutions: Are there dependencies on collaborative R&D with foreign institutions?* Technology in Society 34 (2012) 227–238

Link, A.N & Scott. JT. 2007. *The economics of university's research parks*. Oxford Review of Economic Policy, Volume 23, Number 4, 2007, pp.661 – 674

Luger, M. I., and H. A. Goldstein. 1991. *Technology in the Garden*. Chapel Hill, NC: University of North Carolina Press.

Luger, M.I and H. A. Goldstein. 2006. *Research Parks Redux: The Changing Landscape of the Garden.* Washington, DC: U.S. Economic Development Administration.

Mian, SA, J. Doutriaux and L. Corona. 2007. *Building Mechanism from Nurturing Innovative SMEs – Lessons from North American Science Parks and Incubators.*

Ministry of National Development Planning Republic of Indonesia. BAPPENAS. 2014. *Guidance of Science Park and Techno Park Development 2015-2019*.

Nelson R. & Kim L.(ed). 2000. *Technology, Learning and Innovation: Experiences fo Newly industrialising economies.* University of Cambridge Press.

Oh, D-S, & Phillips, F. 2014. *Technopolis: Best Practices for Science and Technology Cities*. Springer.

Phan, P. H., Siegel, D. S., & Wright M. 2005. *Science parks and incubators: observations, synthesis and future research*. Journal of Business Venturing 20, pp. 165;182

Phan, P.H. 2007. *Asian Perspectives on Research/Science Parks: An Example of Singapore.* Workshop Research and Metrics on U.S. Science Parks, December 3, 2007. National Science Foundation, NSF. 2007. Available at http://www.nsf.gov/statistics/workshop/sciencepark07/phan.pdf

Philips, F.W. 2014. *Technopolis Benchmarking: A Maturity model and database.* Conference paper, UNESCO-WTA International Training Workshop. Valorization : Tangible Benefit from S&T Parks. 14-17 Nov 2012.

Poon, J.P.H., Hsu, J-Y & Jeongwook, S. 2006. *The geography of learning and knowledge acquisition among Asian latecomers.* Oxford Unversity Press.

Soenarso, D. Nugraha, D. & Listyaningrum, E. 2013. *Development of Science and Technology Park (STP) in Indonesia to Support Innovation-Based Regional Economy: Concept and Early Stage Development.* World Technopolis Association. WTR 2013:2:32-42

Sun, H., Ni, W. Leung, J. 2007. *Critical Success Factors for Technological Incubation: Case Study of Hong Kong Science and Technology Parks*. International Journal of Management, Vol. 24, No. 2, June 2007, pp. 346; 363

Tsai, C-L & Chang, HC. 2016. *Evaluation of critical factors for the regional innovation system within the Hsin Chu Science-Based Park.* Kybernetes, Vol. 45 Iss 4 pp. -Permanent link to this document: http://dx.doi.org/10.1108/K-02-2015-0059

UNIDO. 2012. *Europe and Central Asia Regional Conference on Industrial Parks as a tool to foster local industrial development.* Conference Report. Baku, Azerbaidjan. 17-18 April 2012. Available at https://www.unido.org/fileadmin/user_upload/Europe_and_Central_Asia_Regional_Conference_on_Industrial_Parks_as_a_tool_to_foster_local_industrial_development.pdf

Wasim, M.U. 2014. *Factors for Science Park Planning. Best Practice of Science/Technology Parks*. World Technopolis Review 2013; 3:97-108

Wessner. C. (ed). 2009. *Understanding Research, Science and Technology Parks: Global Best Practice: Report of a Symposium*. USA. National Academy of Sciences. Available at http://www.nap.edu/catalog.php?record_id=12546

Wonglimpiyarat, J. 2014. *Technology Transfer and Entrepreneurial Development through University Business Incubation Process in Thailand*. World Technopolis Review 2014;3; 78-88

Youssef, A.B, Elaheebocus, H.M., & L. Ragni. 2013. *Are Technoparks High Tech Fantasies? Lessons from the Tunisian Experience*. European Review of Indusreial Economic & Policy. Number 5, 2013

Zhan, L. 2013. *Entrepreneurial Experience and Science Parks and Business Performance in Beijing, China*. Durham theses, Durham University. Available at Durham E-Theses Online:http://etheses.dur.ac.uk/7760/

Zhang, Y. 2004. *Critical factors for science park management: The North American and European experience*. International Journal of Entrepreneurship and Innovation Management (IJEIM), Vol. 4, No. 6, 2004.

Zhang, H and Sonobe, T. 2011. *The Development of Science and Technology Parks in China, 1988-2008.* Economics: The Open-Access, Open-Assessment E-Journal, Vol. 5, 2011-6. doi:10.5018/economicsejournal.

Appendix

Table 2. STP Success Factors and Adjusted Success Factors

STP Success Factor areas	STP Environment	STP Management	STP Facilities
Level & Boundary / Authors	Long-Term, Macro, External-Strategic	Medium-Term, Meso, Internal-External-Inter-Firms	Short-Term, Micro, Internal, Intra-STP
UNIDO (2012)	Inline/Accordance to national development strategy, Location, Cluster	Management capacity, Innovation linkages, Marketing and Promotion of STP	Infratructure and Services provision
EU (2014)	Setup/planning the objectives and strategy, deciding best model for implementation, Ensure the specific spatial/region of STP, its capital and revenue objectives Address the availability of regional and national markets or corporate supply chains, Select and focus on package of service to deliver to tenant companies and business in wider economy, Appropriate STP model in accordance to its future financial sustainability within a reasonable timescale.	Engagement of the knowledge base (multidimensional relationship over stakeholders), Interaction with the public sector at local/regional, national level, Local skill-base (firms and entrepreneurship), Selects strong leadership	Professional business support and innovation services
Comins & Rowe (2008)	The nature of business, the research cultures and experiences can have a profound effect on the rate developments of technology-based firms	the natural flow and technology transfer from academic and research institutions to the business world	

	(TBF's) both individually and as a sector.	investors capable of managing the risks related to emerging knowledge-based companies	
UK Science Park Association (UKSPA, 1998)		Accuracy and strict control over activities of park tenants, Professional and effective management, Participation of a university with a solid research base, Availability of supporting and financial services	Availability of incubation spaces
Mian, Doutriaux & Corona (2007)	established in region that has a large, metropolitan, diverse and well established economy,	has strong research base, culture of entrepreneurship, stakeholders including university or research centre that actively engaged in providing resources to establish STP, and proactive and entrepreneurial management the provision of a non-monetary value proposition related to R&D (proximity to a university or large research laboratories, presence of large anchor organizations or other local concentration of R&D activities)	to the availability of business services that enhance the development prospects of client companies
Luger & Goldstein (2006)	Meeting the goals of legislation. Return on public investments.	Enhanced firm performance. Enhanced university performance Value of the park to tenants	
Wessner (2009)	The availability of finance.	A strong science and industry base. The presence of entrepreneurs.	

		The presence of trust networks at an individual level. The opportunity for collaboration among universities, businesses, and other organizations.	
Wasim (2014)	Future Trends and External Factors such as monetary environment, business environment, policy instruments, global economy, science & technology, innovation model	Governance, such as Management, Stakeholders, Target Group, Capital, Technology Focus, Eco-Settings. Growth such as incentives, proximity, business support, infrastructure, networking, culture, Sustainability such as linkages, objectives, tenants, marketing, analytics	
Adjusted Key Success Factors (author analysis)	STP Clear and In-line Strategy with National Innovation Policy and Development Strategy	STP Governance, productive engagement with stakeholders (academic, business, government)	STP Professional and Supportive Facilities for Innovation
STP Minimum Functions	R&D Activities	Marketing Activities	Incubation Activities

Interview Protocol

Interviewee Profile

Name :

Organisation :

Position :

MACRO LEVEL / STP ENVIRONMENT

1. Why STP?
2. What Are Goals of STP
3. What Are Stakeholders of (your) STP
4. Given These factors, what is your opinion about
    a. STP R&D Activities
    b. STP Development Strategies
    c. STP Strategic Planning
    d. STP and Innovation Policy
    e. Other macro factors?
5. Given the matrix, which are important/Urgent?

	VERY URGENT	LEAST URGENT
VERY IMPORTANT	Very Important and Urgent Factors:	Important Factors but Least Urgent :
LEAST IMPORTANT	Less Important, but Very Urgent factors :	Less important, less urgent factors :

(On separate sheet)

MESO LEVEL / STP MANAGEMENT

1. What are managerial issues in STP?
2. Given these factors, what is your opinion about :
    a. STP Governance
    b. STP Engagement/Collaboration/Networking
    c. STP Stakeholders role
    d. STP Productivity, Promotion, Commercialisation
    e. Other meso level, STP management inter-STP factors?

3. Given the matrix, which are important/urgent?

	VERY URGENT	LEAST URGENT
VERY IMPORTANT	Very Important and Urgent Factors:	Important Factors but Least Urgent :
LEAST IMPORTANT	Less Important, but Very Urgent factors :	Less important, less urgent factors :

(On separate sheet)

MICRO LEVEL / STP INFRASTRUCTURE & SERVICES

1. What are STP infrastructures and services that should become significant features of an STP?

2. What are issues in STP Infrastructures and Services that you mentioned before?

3. Given the matrix, which are important/urgent?

	VERY URGENT	LEAST URGENT
VERY IMPORTANT	Very Important and Urgent Factors:	Important Factors but Least Urgent :
LEAST IMPORTANT	Less Important, but Very Urgent factors :	Less important, less urgent factors :

(On separate sheet)

List of Interviewee

No	Name	Organisation	Cluster	Date of Interview
1	Eng. Irsan Pawennei, M.Sc.	Centre for Innovation Policy & Governance	Academia /Experts	Jakarta, 27th June 2016
2	Prof. Dr. Tualar Simarmata	Padjadajaran University, Innovation Director	Academia /Experts	Bandung, 7th December 2015, 15th June 2016
3	BB Triatmoko, SJ	Cikarang Teknopark	Park Manager	Cikarang, 28th October 2014, July 2016
4	Dr. Mika Syahbana	IPB Science Park	Park Manager	Bogor, 25th July 2016
5	Dr. Wisnu Sardjono	RISTEKDIKTI	Government	Jakarta, 13th October 2014, July 2016