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Regional Science Parks: A step forward to innovation ecosystem in Thailand

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Executive Summary

Differences between central and regional economy are massive issues in Thailand, especially gaps of value added between products from industries and agriculture are considerable. Regional science parks (RSPs), which are directly supported by Science Park Promotion Agency (SPA) under Ministry of Science and Technology (MOST), are key mechanisms to bridge those voids and lead Thailand with science technology and innovation (STI) base. Three RSPs are located in northern, northeastern and southern region with distinct flagship projects such as rice, livestock and rubber technology. 5 platform action plans including RSP services, STI business incubation, technical consultancy, collaborative research and infrastructure development are operated to create more STI based business in the regions. Started in 2013, SPA and RSPs have so far generated $16m regional economic impact and gradually create innovation ecosystem in Thailand with central facilities of three RSPs are scheduled to be opened by 2018.

1. Introduction

Located in the center of Southeast Asia, Thailand is well-known for its rich history, natural resources, authentic cuisine and also as a world-class tourist destination. However, in term of global competitiveness, Thailand is still well-behind other leading countries in Asia, especially in the area of science, technology and innovation (STI). In 2015, Thailand is ranked 31st from 144 countries by the World Economic Forum in term of the overall competitiveness, with the ranking of 67th and 65th in the areas of innovation and technological readiness respectively[1]. Similarly, IMD (International Institute for Management Development) put Thailand's S&T readiness at 46th in science infrastructure and at 41st in technology infrastructure out of 60 countries. Moreover, uneven income and development distribution is also a challenge for Thailand[2]. The difference in GPP (Gross Provincial Product) per capita between people living in the industrial zones and the majority of the population, which live in agricultural and rural areas, is very significant[3]. For instance, the average income in Rayong province, where industrial estate zones and international ports are located, is $30,230 per year, while the average incomes in Bangkok and Chonburi provinces are just $13,340 and $13,080 respectively. The gap is even greater for provinces that have agricultural-based economies. For example, agricultural provinces such as Nong Bua Lam Phu, Kalasin and Yasothon have GPP per capita at just $1,335, $1,660 and $1,670 respectively.

To assist private sectors in building up innovation-based and sustainable business, especially in the regional areas, Thai government have implemented various supporting programs: National Village and Urban community fund[4], activities from The Office of SMEs Promotion (OSMEP)[5], the incentives granted by Thailand Board of Investment (BOI)[6] and the New Entrepreneurs Creation Program (NEC)[7]. However, the keys to sustainable development of SMEs, private sectors, startups and entrepreneurs are not just access to financial capitals, but also the application of science, technology and innovation (STI). Thus, Science Park Promotion Agency (SPA) was established under the Ministry of Science and Technology (MOST) in 2012 with the missions to develop science parks in regional Thailand and to design supporting programs for stimulating SMEs and private sectors by combining STI and regional know-how. The missions of SPA are also in alignment with the National Science Technology and Innovation policy (2012-2021)[8], which plan to drive Thai economy with STI and also to encourage research institutions to shift their research and development, from previous focus on fundamental issues, to more practical research.

2. Thailand's regional economy needs

Thailand's economy is mainly relied on contributions from Bangkok and central region. It was shown in 2013 that 71.7% of the country's GDP was from those two areas with industrial sector played an important role[9]. While rest of the country's business including northern northeastern and southern regions were dominated by service (more than 50% of their GDP) and agricultural sectors (around 30%). Contribution from industrial sector only occupied less than 20% of those three regions' GDP whereas the central region had more than 50%. Moreover, labor in agricultural sector did not create value added to Thailand's economy as much as those in industrial sector. It was presented in 2014 that value added to the country's business are from service sector (49.8%), industrial sector (37.9%) and agricultural sector (12.3%) while labor forces consist of 49.4, 34.9 and 15.6% in service,

[1] World Economic Forum, The Global Competitiveness Report 2014 – 2015, 2014
[2] International Institute for Management Development, IMD World Competitiveness Yearbook 2014, 2014
[3] National Economic and Social Development Board of Thailand (NESDB), GPP CVMs Time Series Data 1995-2013 (http://www.nesdb.go.th/Default.aspx?tabid=96), accessed on 18 April 2016
[4] National Village and Urban Community fund office, http://www.villagefund.or.th/index.aspx, accessed on 18 April 2016
[5] The Office of SMEs Promotion (OSMEP), http://www.sme.go.th/eng/, accessed on 18 April 2016
[6] Board of Investment Thailand (BOI), http://www.boi.go.th/index.php?page=incentive, accessed on 18 April 2016
[7] Department of Industrial Promotion, http://nec.dip.go.th/, accessed on 18 April 2016
[8] National Science Technology and Innovation policy Office, National Science Technology and Innovation policy (2012-2021), 2011
[9] Future of Northeastern Thailand Economy under the World Economy and Thai Government Policy, Suriya Chankrajang NESDB, 2015

agricultural and industrial sector respectively[10]. This is because technologies applied in industries help to increase labor's efficiency and provide more impact on the country's economy.

There are some examples which reflect problems of Thailand's regional economy and needed to be tackled quickly. First of all, regional business have low growth rate during 2004-2012 compare to that of eastern region where big industrial zones are located[11]. Second, prices of main agricultural products such as rice, rubber and oil palm drop due to more supply in the world market from other agricultural based countries i.e. China, and Vietnam[12]. Third, people have low purchasing power due to low income affected by the agricultural product price dropped. Finally, Thailand is heading to aging society by 2025 earlier than other developing countries such as China (2030), Vietnam (2040) and Indonesia (2050)[13]. However, tourism industry is a very competitive business for Thailand's regional economy. With various types of attractions including historical and natural, Thailand is a main destination for tourists from all around the world especially China. This reflects by an increase of airport passengers by 35.4% in 2015[14,15].

It was mentioned previously that pushing labor to industrial sector is a key for successful economy growth. Moreover, a study on a ratio between (imports of capital good/labor working hours) and (research and development investment/GDP manufacture) also proves that labor intensive industries have less R&D investment than those from high technology industries[16] which will impact Thailand's competitiveness in the future. The industries concentrating on doing R&D are petroleum and chemicals.

Some Thai industries and SMEs have been applying STI as their process solutions previously but they are still facing some following problems. Firstly, they cannot confront with high-technology demand from the world market although their manufacturing capacity have been improved. As a result, they lost chances to sell high value added products due to lack of high technology investment[17]. The best example is shown in the growth of the hard disk drive (HDD) manufacture, which dominates Thailand's electronics export market during the past few years, have dropped recently. This is because an introduction of a new, more stable and reliable product called "solid state drive (SSD)" which provides users more convenient and faster access to their data. Although SSD is more expensive than HDD, it is on a high demand from customers and will soon replace HDD. Thailand have failed to cope with this new technology and still struggle to produce SSD. Secondly, most technologies applied are in their primary stages. Thailand is the country relied on agricultural products so most SMEs still concentrate on developing food processing products using primary stage technologies which do not create much value added. A lack of productive research and development, which results in short of new emerging products, is another point of concern.
All the problems mentioned have been taken seriously by Thai government and involving organizations. It was suggested that Thailand must start building strength from within by applying science technology and innovation to all sectors including industrial, service and agriculture. For example, a new initiative called "modern farming" has been created in order to increase value added throughout value chains of Thai food industries i.e. rice, sugar cane and oil palm by using STI. It consists of different methods i.e. various processes producing products and by-products, zero-waste manufacturing and smart farming[18]. Thai government initiated "special economic zone (SEZ)" to galvanize economy in regions along Thai border line and attract purchasing power and investment from countries nearby. Other important policies were also introduced to upgrade regional economy

[10] Vision and Short-term plan on Thai Economy, Thailand Development Research Institute, 2015
[11] Southern Thailand New Economy Trend, Aree Vibulpong, 2015
[12] Southern Thailand Economy in 2015 and its Trend in 2016, Bank of Thailand, 2016
[13] Thailand's Economy – Where Do We Go From Here?, Thailand Development Research Institute, 2015
[14] Northern Thailand Economy Trend in Q4 2015, Bank of Thailand, 2015
[15] Northern Thailand Economy Trend, Sureerat Luckkananit, 2015
[16] What Stalled Thailand's Structural Transformation and Way Forward? : A Labour Market Perspective, Bank of Thailand, 2015
[17] 2014 Thai Economy Annual Report, Bank of Thailand, 2015
[18] How do Northeastern Thailand Economy Adapt under the World Economy and Thai Government Policy, Somkiat Anurat, 2015

such as railways and roads improvement, closing inequality gap, enhancing competitiveness, startups business support and incentive[19].

In conclusion, Thailand's regional economy is in developing phase but regional products have potential to break into international market due to rich resources and uniqueness. It was presented that applying STI to regional SMEs is one of a success factor to achieve high value added in their business while increasing R&D investment leads to a long-term and sustainable economy. Thai government provide various strong support for regional economy and the regional science parks are leading mechanism to solve regional economy problems with STI.

3. Science Park Promotion Agency (SPA)

As a government agency, SPA is responsible for planning and developing Regional Science Parks (RSPs) which are specialized with technologies, resources and collaborations in their areas. It is expected that RSPs will be important mechanism to promote R&D investment from international and domestic private sectors, increase utilization of public resources such as scientific equipment and laboratory, develop regional economy with STI and collaborate with local private sectors.

3.1 Roles

In 2011, Thai government announced the Regulations of the office of the Prime Minister on Science Park Promotion focusing on science park development for country's competitiveness and innovative economy[20]. Science park is also an important mechanism to drive research output from lab scale to commercial scale and incubate new technology entrepreneurs and startups. Chaired by the minister of science and technology, the board of science park promotion was appointed under the regulations and responsible for planning and developing science park in Thailand, issuing criteria and guidelines for science park promotion to encourage both public and private organization to operate science parks, monitoring and evaluating regional science park performances and presenting annual report to the cabinet. SPA was appointed as secretariat unit of the board.

SPA was established under Ministry of science and technology to support the board of science park promotion. Their missions are classified into 2 main categories as follow

- Policy and plan on science park development
  - Generate policies on science park promotion
  - Capacity building
  - Raise awareness, create a cooperation network and knowledge dissemination of science park
  - Science and technology infrastructure databank (STDB)
  - Integrate and cooperate with local agencies
  - Secretariat of the board of science park promotion
  - Monitoring and evaluating science parks that SPA support

- Science park promotion
  - Infrastructure development
  - Science technology and innovation business incubation
  - Collaborative research
  - Intellectual property services for industries
  - Innovation design center
  - Laboratory services
  - Industrial research and technology capacity development program (IRTC)
  - Office of industrial liaison (OIL)

3.2 National science park development strategy (2013-2017)

[19] Future of Northeastern Thailand Economy under the World Economy and Thai Government Policy, Pisit Puapan (Fiscal Policy Office), 2015
[20] The Regulations of the Office of the Prime Minister on Science Park Promotion,2011

National science park development strategy (2013-2017)[21] was generated from collaboration among SPA, National science and technology development agency (NSTDA) and National Science Technology and Innovation Policy Office (STI). It has been used as a framework for science park development in Thailand, especially in regions, in the past few years. This master plan consists of 7 science park development guidelines, 3 incentives and promotional packages and 3 criteria for science park establishment by public sectors as follow.

- Science park development guidelines
  - Encourage private sectors to invest in research and development
  - Promote Thailand as a research and development hub for international and domestic companies
  - Support private organizations to establish and operate science parks
  - Utilize public infrastructures and resources at their full capacity
  - Connect science parks and local organizations (public/private) to stimulate local economy
  - Generate science park network and ecosystem
  - Contribute clear and continuous policy support (from government)

- Incentives and promotional packages
  - Privileges and incentives such as tax reduction, talent mobility, STI infrastructure services and public-private partnership (PPP) on research and development infrastructure
  - Capacity building for science parks and their staffs, for example, develop science park management skill, improve marketing skill, incubate new science park operators, support research and development commercialization for entrepreneurs and promote science park future customers
  - Science park development investment plan
    - Public science parks
      Phase 1 – provide full financial support on infrastructure investment for public organizations that are ready to establish and operate science parks
      Phase 2 – provide full financial support on science park operation cost during its first 5 years then decrease the support when the science park starts to receive income from 6th year
    - Private science parks
      Support private organizations to establish and operate science parks through public-private partnership mechanism

- Criteria for science park establishment by public sectors

  - Science park customers (demand side)
    - Identify tenants who are ready to invest in research and development in science parks
    - Identify private companies who wish to receive supports from science park i.e. research and development, technology transfer, science and technology business incubation and intellectual property services
  - Potentiality and capability (supply side)
    - Experience on collaborative research with private sectors
    - Readiness on STI infrastructure for industry i.e. laboratory services and rental spaces

[21] National Science Park Promotion and Development Strategy (2013-2017), Science Park Promotion Agency, 2012

- Well-structured organization which can provide full support and effective management on science park operation with experienced and quality human resources
- Area for science park infrastructure

- Policy support
  - Policies that support science park and related activities such as PPP program, intellectual property policy and human resource management
  - Networking with local agencies (public/private) which supports science park operation

3.3 Networks

RSPs, which are currently three of them in northern, northeastern and southern Thailand, are operated by collaborations between SPA and regional universities.

First of all, Northern Science Park (NSP) has a head quarter in Chiang Mai (Figure 1) where the main responsible member, Chiang Mai University, is located. Cooperate with 6 other regional universities (Maejo University, Mae Fah Luang University, Naresuan University, University of Phayao, Uttaradit Rajabhat University and Pibulsongkram Rajabhat University), NSP focus on developing innovative products from local resources such as rice technology, cosmetics and foods. They also specialize on IT, software, digital content, material science, biotechnology and sustainable energy which fulfil requirements of private companies in northern Thailand. With an advantage location in the north of the country, NSP is a gateway to do business with nearby countries such as Myanmar, Laos and also China.

The Northeastern Science Park (NESP) is managed by 4 members which are Khon Kaen University (head quarter), Suranaree University of Technology, Mahasarakham University and Ubon Ratchathani University. With livestock technology as a flagship technology, NESP also concentrate on agricultural technology, food processing, IT, health science and bio-materials. Not only has the largest area of the country, holding 33.5% population which is an extensive market, but Northeastern region also provide an excellent connection to Laos and Cambodia via several bridges.

Prince of Songkla University (head quarter) and Walailak University are two members operating Southern Science Park (STSP) with rubber technology as their flagship. Other technologies on oil palm, medical equipment, seafood and halal food are important for this region too. With only 75 minutes driving from Songkla to Kedah, the south of Thailand is a perfect entrance to Malaysia where the market can be extended.

Networking system has been applied to operate RSPs. Various forms of supports from SPA including funds, third party (domestic and international) collaboration, exclusive events from MOST and capacity building programs are directly distributed to the head quarter of each region annually. Then the head quarter universities will manage resources with their networking units depend on customers' demands, capabilities, technology owned, efficiency and performances. In term of deliverables, key performance indicators (KPIs) were agreed between SPA and all members in the network which head quarter universities fully commit to the targets, manage and assign KPIs to their members. Planning of projects, events and activities under RSPs have to be relied on Thai government fiscal year (October-September).

Figure 1: Regional Science Parks (RSPs)

4. 5 Platforms action plans

Activities of RSPs have been designed into 5 platforms including Services, STI business incubation, Industrial Research and Technology Capacity development (IRTC), Collaborative research and Infrastructure development (Figure 2).

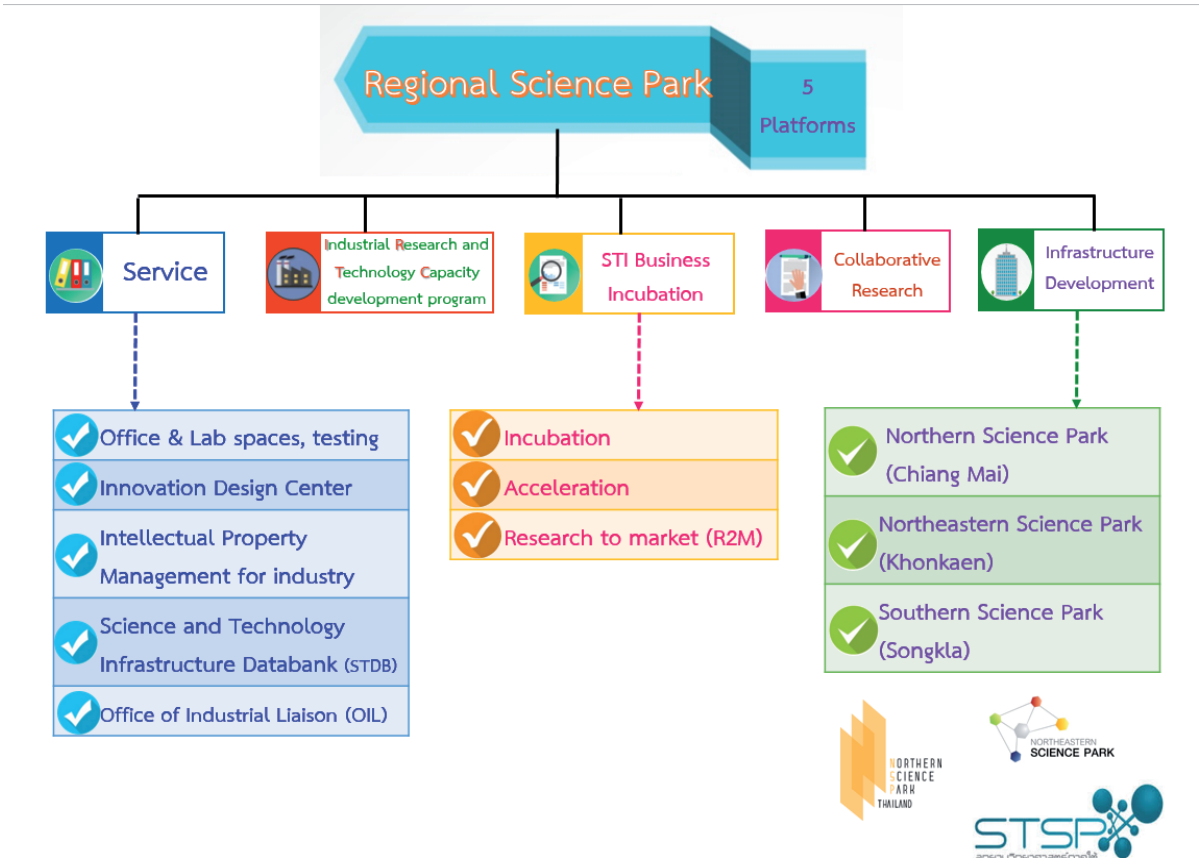

Figure 2: Structure of 5 platform action plans

4.1 Service Platform

The Service platform consists of 5 assistances for STI-based companies i.e. office and lab spaces including testing laboratory (currently using facilities of regional universities), innovation design center, intellectual property consultancy, Science and Technology infrastructure DataBank (STDB - supporting database providing useful information for STI business such as service laboratories, scientific equipment, researchers and academic papers) and Office of Industrial Liaison (OIL - technical assistant for RSPs customers). All the services were designed by considering requirement from private sectors and SMEs in regional areas which will support them towards STI based business.

4.1.1 Strengthen Laboratory for Industry

Difficulties to get access to scientific equipment with reasonable fee is one of the main factor to inhibit R&D growth and STI adoption in SMEs who do not wish to invest that much on those tools. A popular solution is to use equipment in public universities and research institutes. However, they are mainly committed to the organizations' objective such as academic use, carry out impact research and publications. Therefore, access for industrial and commercial usages are limited. Availability of scientific tools with acceptable fee in RSPs will play an important role to solve industrial needs. The aim of this activity is to support and locate "some high-demand equipment" in RSPs for exclusively serving industries and science park customers, not academic purpose. RSPs must contribute an effective management to provide access to private sectors and SMEs such as user friendly atmosphere, outside office hour service and self-service equipment for qualified users. It can be seen that this activity targets to fulfill a gap in industrial laboratory services, not building a new lab. Due to an ongoing constructions of all RSPs buildings, all equipment are currently operated in the networking universities and will be transferred to the RSPs buildings once they are ready.

Figure 3: Laboratories strengthened by RSPs

4.1.2 Innovation Design Center

Product appearance is one of a key factor when customers decide whether to purchase it whereas an attractive design and branding also creates more value added to a product. Regional SMEs are also acknowledged and ambitious to make their product interesting and more valuable with functions and creative designs. The innovation design centers are functioned in all RSPs units to support different needs involving designs i.e. product design, packaging design, trademark/logo/brand design, social media design, advertisement design while engineering design is only available in universities with engineering school. RSPs operate this service with different types of designers such as full time, part time and outsource. Each job is targeted to be finished within one month and customer satisfaction poll will be carried out to keep improving the service.

Figure 4: Logo and packaging designs by RSP Innovation Design Center

4.1.3 Intellectual Property for Industry

Awareness to protect knowledge and know-how is still powerless in Thai society. This might come from different reasons such as Thailand is not an innovative country so no protection required, it is cheaper to buy something that is protected by someone than initiates something and protect it, some researchers prefer to keep their knowledge as secrets with no commercialization or a control and use of IP laws is not strict enough. Therefore, it is a huge task for RSPs to guide their customers, who are mainly STI based, to aware of an IP protection. A typical model of IP ownership of RSPs' customers is a joint-owned between university researchers and private company. Although acts as a funding agency, SPA have stated themselves not to involve in any IP ownership and allow RSPs to manage independently. IP services are available in all RSPs members with different approaches. Some RSPs use IP service as a supporting tool for customers' who engaged with other activities such as STI business incubation, IRTC and collaborative research. On the other hand, IP service is applied as a secure mechanism to advice researchers with commercialize-able knowledge to transform themselves to STI entrepreneurs/startups.

4.1.4 Science and Technology Infrastructure DataBank (STDB)

Thai government have significantly invested in scientific infrastructure such as laboratory, equipment (in public universities, research institutes and excellent centers) and human resources. However, it is still difficult for private sectors/SMEs/public to access those resources due to lack of information provided. Science and Technology Infrastructure DataBank is an online gateway (www.stdb.most.go.th) which is created and aimed to give useful information on government invested scientific infrastructure including laboratory, equipment, researchers and publications. STDB also has an optional function to allow user to reserve equipment online which will maximize the tools' usage to their full capacity. STDB currently contains data from RSPs network and is an important tool for RSP staffs to look for supporting information to serve their customers. SPA acts as a central operation unit of STDB whereas the RSP staffs help to keep all data up to date.

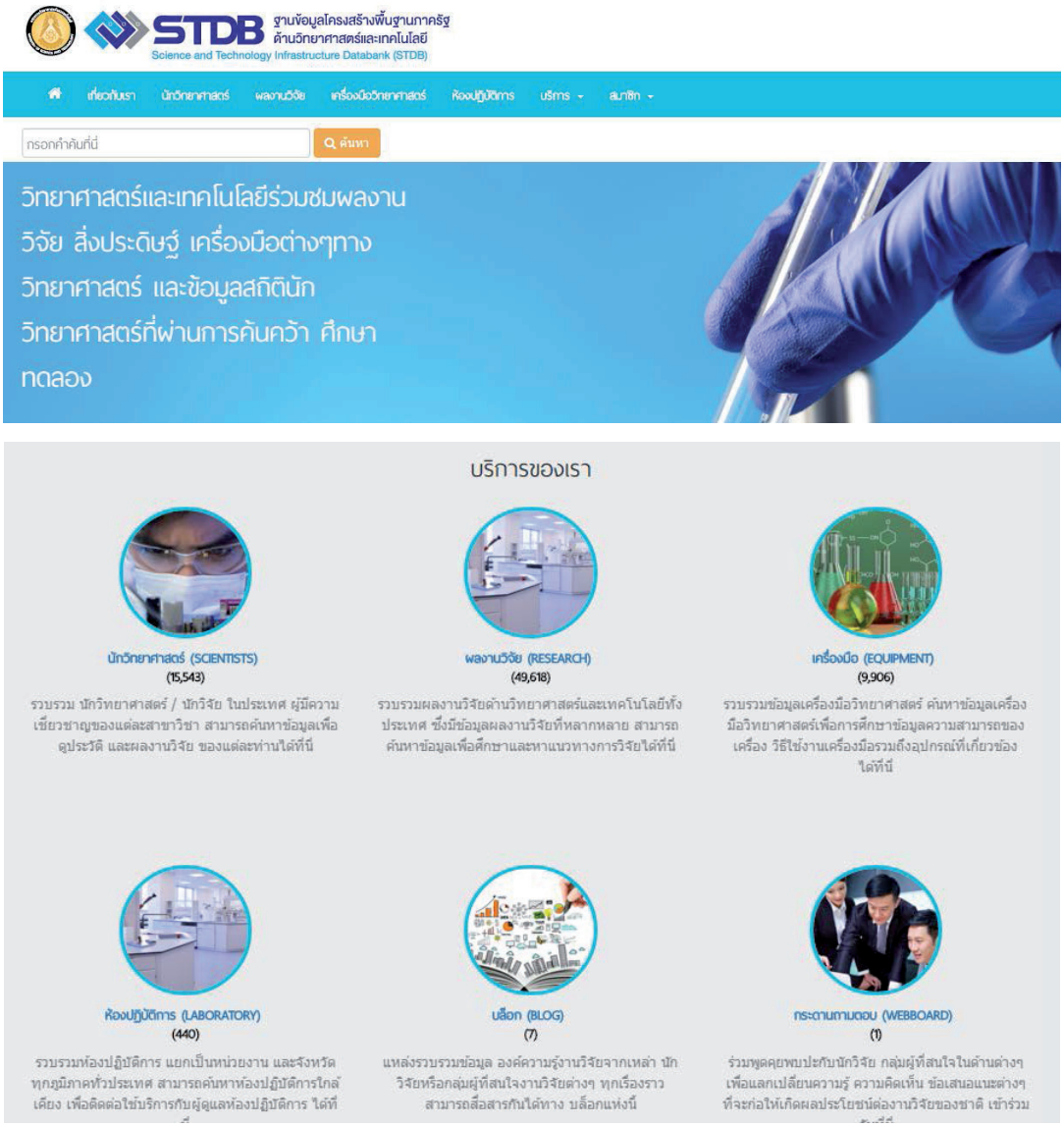

Figure 5: Science and Technology Infrastructure DataBank (STDB)
www.stdb.most.go.th

4.1.5 Office of Industrial Liaison (OIL)

OIL is designed to be a customer relation unit and a mechanism to build awareness on regional science parks. Operated in all RSPs, OIL will also act as a classified unit to help RSPs customers to apply and receive appropriate services. Staffs of this activity are required to have in-depth knowledge about RSPs, ability to communicate and persuade private sector/SMEs to utilize RSP services and activities, skill to match customers to right experts and strength to actively provide RSPs information to public. OIL is responsible for organizing “Regional Science Park Innovation Fair”, an annual event hosted by RSPs in 3 regions. The event is arranged to focus on flagship project, customer demands, resources, interesting technology of each region and also building RSPs awareness.

Figure 6: Regional Science Park Innovation Fairs in 2015

4.2 STI Business Incubation

STI business incubation platform contains 3 activities which are incubation, acceleration (joint program with other government agencies) and Research to Market (R2M). This platform strongly supports the national target to create more STI based companies in this country.

4.2.1 STI Business Incubation

It has been widely known that two distinct valleys of death are barriers preventing STI based entrepreneurs/startups from success (Figure 7). The first is called “Technological valley of death” which is located between R&D and prototype/proof of concept phase. It reflects a difficulty of transforming an output from lab scale to become a commercial proof-of-concept then a reasonable prototype which is ready for scaling up. At this phase, a further capital to undergo a process of developing, testing, and refining technology is required in order to prove to private funder that the technology will be viable in market beyond initial success in the laboratory. However, investors are typically reluctant to fund such early-stage research due to its risk. As a result, many start-up firms are unable to accumulate the necessary capital to see their innovative research concepts transformed into commercial products. “Commercialization valley of death” is the second, which is in between pilot/demonstration and commercialization/maturation phase. It affects technologies that have already shown proof of concept but still need large capital infusions to prove that their design and manufacturing processes can be brought to full commercial scale (e.g., a first-of-a-kind full-scale power plant or manufacturing facility). The challenge is to accumulate enough capital for the commercialization, production, and manufacturing processes associated with demonstration and market launch[22].

STI business incubation program is aimed to support STI based entrepreneurs/startups to survive through the valleys of death during early stages of their business. Each STI based entrepreneur is allow to stay in the program for three years maximum. RSP staffs will provide supports to both technology and business incubation and help seeking advices from university and private experts. The program will also help new startups to break into the market with MOST-RSP and their collaborative network. Moreover, incubatees are given some special discount for other services in

[22] Bridging the Clean Energy Valleys of Death, Jesse Jenkins and Sara Mansur, 2011

RSPs including office spaces which are currently university facilities. The entrepreneurs who join this program will not be funded directly but will be supported in service forms and connected to private venture capital instead. They can also join other programs such as IRTC and collaborative research if necessary but have to be approved by RSP staffs. RSPs currently produce 50 more STI based entrepreneurs annually.

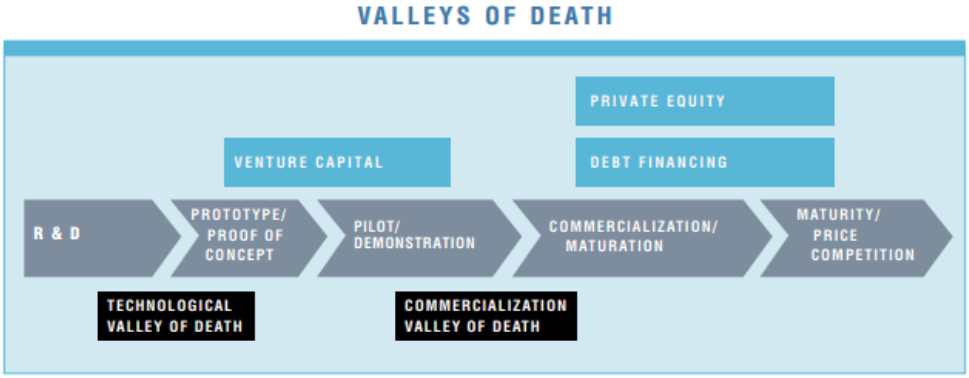

Figure 7: Valleys of death[22]

4.2.2 Acceleration

Acceleration is similar to the incubation program but it is conducted intensively in a shorter period with high potential and high capability entrepreneurs. The program requires a huge supporting fund for a short period of time (normally 3-6 months) so, in some countries, money is mainly came from private sectors who notice a chance of success in the product[23]. Due to Thai laws and regulations, SPA is unable to support acceleration program to its customers but does create a collaboration with the National Innovation Agency (NIA), another government agency with ability to inject a seed fund-liked to private companies. This cooperation allows high potential RSP incubatees to get early chances to access a screening process of a funding called “Innovation coupon” which is a positive oppotunities for STI based entrepreneurs to receive extensive support for upscaling their business after the incubation program.

4.2.3 Research to Market (R2M)

This activity aims to create entrepreneurial skill in university students by simulating business pitching contest in national and regional levels. Competitors will enter the contest as a group of 2-5 persons and have to choose one of R&D proved technology and produce a business plan for it. All participants will enter a boot camp to learn some business basics and presentation skills for three days. Then they have to present their business plan to judges who are from various background. There are three rounds of the competition, first, university level which all 13 RSP universities have to arrange their own contest to qualify participants for the next round, second, regional level which consists of three events from north, northeastern and southern region. Finally, national level which qualifiers from regional level will compete for the highest price. Students who enter the competition and want to do business are provided opportunities to join the STI business incubation program.

Figure 8: Research to Market (R2M)

[23] Accelerators – competition, tools or growth engines for STP and AI?, Hardy R. Schmitz and Sascha Brinkhoff, 2015

4.3 Industrial Research and Technology Capacity development program (IRTC)

The IRTC platform acts as a bridging package between private sectors and researchers from RSPs who provide technical supports and capacity buildings. It was presented that Thai companies and SMEs do not concern about adapting STI as a tool for adding more value to their products. Therefore, IRTC program was constructed to provide STI based guidance and develop STI based capacity for participants. It is also aimed that this activity will persuade SMEs to invest more on R&D and become RSPs' customers in the future. IRTC Projects are not intensive research and development but mainly focus on solving industrial problems such as process improvement, process management, product development, zero-waste management and STI capacity building. Most projects are operated for around 6-12 months. This platform has the same rule as the STI business incubation platform that the participants do not directly receive funding but have to pay expenses in advance and claim it back after the project has finished. Each company is allowed to join one project a year for 3 consecutive years at maximum. Each project is capped at $10,000.

4.4 Collaborative Research

Private company and RSPs could also generate a joint-industrial research under the collaborative research platform with expected investment between private sectors and RSPs at 70:30. The program aims to engage big company as an anchor tenant to a regional science park. However, a research content has to be near market issue and mainly came from industrial requirement. As mentioned in IP service section, SPA will not hold any IP ownership resulting from research but RSPs have to sort out agreements with private sectors. There is no capped budget for projects under this platform but a qualification process will be conducted by a committee that is appointed by MOST. This process is different from STI business incubation and IRTC platforms where SPA assign KPIs and permit RSPs to manage qualification processes. Although targeting anchor tenants and big impact from this platform, it has been clearly stated that SPA will focus on strengthen RSPs ability to provide services to all customers. Therefore, around only 10% of SPA budget goes into this collaborative research platform annually.

4.5 Infrastructure Development Platform

Finally, the infrastructure development platform aims to build central facilities for RSPs by 2018. The main infrastructures include Northern Science Park (NSP) building (Figure 9), Northeastern Science Park (NESP) building (Figure 10) and Southern Science Park (STSP) building (Figure 11). The first is located in Chiang Mai University, Chiang Mai province, with 4 sub-buildings and one rice grain lookalike –landmark auditorium. This building is planned to be a central hub of STI solution for technopreneurs in northern region and high-demand STI service provider. NSP building has total space of 22,000 m^2 including 2,087 m^2 office rental space, 1,431 m^2 for dry lab, 1,941 m^2 for wet lab, auditorium for 400 attendances and 31 meeting rooms. The second is in Khon Kaen University, Khon Kaen province, with only 10 minute drive from Khon Kaen airport and very close to the center of the northeastern economic zone. The building was designed under convenient use and flexible maintenance concept. It has total space of 17,400 m^2 including 850 m^2 office rental space, 835 m^2 for dry lab, 825 m^2 for wet lab, auditorium for 250 attendances and 4 meeting rooms. The third is placed in Prince of Songkla University, Songkla province, with environmental friendly atmosphere for high quality of life of people who live in the park. STSP aim to utilize this building as a driving force for southern economy which can be expanded to Malaysia and Singapore. The building has total space of 19,121 m^2 including 1,500 m^2 office rental space, 1,162 m^2 for dry lab, 4,410 m^2 for wet lab, auditorium for 150 attendances and 9 meeting rooms. Moreover, SPA also support pilot plants on focus technology which there are currently two of them (Radio Frequency Technology Pilot Plant (for rice and grains) and Steamed Technology Pilot Plant (for fruit export)). All buildings are owned by SPA and MOST on the lands which are supported by those three universities. Each infrastructure will be managed by a joint committee between SPA and involving RSP.

The 5 platform action plans have been arranged as frameworks for RSPs who still have freedom to adapt them to suit their regional environment, requirements, backgrounds and resources. The three RSPs will submit proposals to SPA annually and the budget allocation will be analyzed by MOST. RSPs normally receive funding support from SPA during the 1st quarter of Thai government fiscal year (October-December). They also have to report the progress regularly through an online platform and will be evaluated by SPA at the end of fiscal year.

Figure 9: Northern Science Park

Figure 10: Northeastern Science Park

Figure 11: Southern Science Park

Figure 12: Pilot plants: Radio Frequency Technology Pilot Plant (top row) and Steamed Technology Pilot Plant (bottom row)

5. Regional Science Parks

The RSPs have been working with SPA since 2013 under the 5 platform action plans. The works gradually implant STI based knowledge to regional private sectors and SMEs although the infrastructures are not ready to serve. Success achieved so far are presented as follow.

5.1 Northern Science Park (NSP)

NSP has a head quarter in Chiang Mai where the main responsible member, Chiang Mai University, is located. Cooperate with 6 other regional universities (Maejo University, Mae Fah Luang University, Naresuan University, University of Phayao, Uttaradit Rajabhat University and Pibulsongkram Rajabhat University), NSP focus on developing innovative products from local resources such as rice technology, cosmetics and foods. They continuously construct STI ecosystem in the northern region through 5 platforms. Total R&D investment from private sectors was $3.2m. Almost 80 STI based entrepreneurs with average of $170,000 gained per year were incubated during this first period. With support from NSP laboratory services, value of tested products were totally increased around $5.8m. The innovation design center also helped to create around $550,000 value added to

products in total. 31 private companies invested more in R&D capability and human resources after finished projects under IRTC platform whereas 124 SMEs were successfully solved their problems with helps from RSP experts. The NSP privilege card was introduced to provide more incentives and convenience for holders when using NSP services throughout their network.

5.2 Northeastern Science Park (NESP)

NESP is managed by 4 members which are Khon Kaen University (head quarter), Suranaree University of Technology, Mahasarakham University and Ubon Ratchathani University. With livestock technology as a flagship technology, NESP also concentrate on agricultural technology, food processing, IT, health science and bio-materials. STI ecosystem in northeastern Thailand has been progressively built by efforts from the 4 units of NESP. 60 STI based entrepreneurs were created under the STI business incubation platform. 24 labs were strengthened and provide full support to industrial sectors. More than 500 pieces of design were produced and assist NESP customers to increase more value on their products. 24 technologies under RSP's IP management program were commercialized. Almost 80 projects under IRTC platforms were operated which help SMEs to solve their industrial-scientific problems. 12 private companies adapted results from collaborative research projects with RSPs to their industrial use. Efforts from NESP during this first period (2013-2016) affect regional economic impact around $7m with mostly from livestock industry.

5.3 Southern Science Park (STSP)

Prince of Songkla University (head quarter) and Walailak University are two members operating STSP with rubber technology as their flagship. Other technologies on oil palm, medical equipment, seafood and halal food are important for this region too. STSP increasingly create STI ecosystem in southern Thailand through 5 platform activities especially IP management which is used as a tool to generate technopreneurs. More than 30 entrepreneurs are outcome of the STI business incubation activity whereas 5 companies joined acceleration program. More than 130 customers were benefit from 6 strengthened labs. Almost 400 cases were served by the innovation design center. Around 30 technologies under the IP management program were commercialized. STSP are also working hard on IRTC and collaborative research platform to create STI awareness in industrial sectors and producing customer base for STSP building in the future.

Figure 13: RSP Products and Technologies

6. Conclusion

SPA and RSPs have been closely working together since 2013 to enhance Thailand's regional economy by building STI ecosystem. The 5 platform action plans are aimed to fill the gap and promote Thailand from agricultural based, which labor contribute lower value added compare to those in industries, to STI-industrial based. With a clear vision and strong support from MOST, SPA have been intensively supporting RSPs to reach the target which is planned to strengthen Thai regional economy from within. Services from RSPs provide all-round support for STI based companies/SMEs/startups whereas the activities under the STI business incubation platform give in-depth assistances on constructing new STI based entrepreneurs. Moreover, SPA also arrange various technical supports to fulfill existing private sector's requirements such as collaborative research and IRTC. SPA and RSPs have been so far supporting STI to more than 150 private companies under the STI business incubation platform, consulting technology supports to more than 200 private sectors through IRTC platform and generating more than 30 joint-industrial research which approximately equal to $16m economic impact. MOST and SPA are still continue supporting RSPs as their leading project with $240m economic impact expectation when all three main central facilities of RSPs are fully operated and become key mechanisms for innovation ecosystem in Thailand.