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Foresight for science and technology parks in a smart specialisation context

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Abstract: The purpose of this paper is to propose and discuss an alternative approach to the identification and selection of 'transformative activities' of smart specializing strategy by integrating the use of foresight, the concept of regional innovation system and science and technology parks. We used desk study, interview and Delphi method to collect data, develop in-depth analyses and set policy priorities from experts in Songkhla province, Thailand. The practical outcomes imply the direction of promising technology development, possible global megatrend, policy instruments at regional and science park level. The contribution of the paper is an integrated analysis of the regional innovation system and science and technology park framework in an innovation system foresight process to initiate a smart specialisation strategy.

Keywords: Foresight; Smart Specialisation; Science and Technology parks; Regional context; Peripheral regions

1 Introduction

This paper addresses the challenge of developing innovation ecosystems in order to contribute to the Thailand 4.0 Economic Development Model.

The study behind the paper departs from the empirical problem that Thailand's innovation performance has a low ranking compared to other middle income countries in Southeast Asia. In accordance with the contemporary understanding of national innovation systems (NIS) Iamratanakul, (2014) argues that Thailand NIS faces a range of challenges. For example, there is no coherent innovation policy, policy to promote industrial technology has a low priority. Moreover, the links between firms and universities are weak, and the country allocates limited expenditure for research and development (OECD, 2013).

Already in the period 2004 – 2007 early regional science parks were established in Thailand to fill the economic inequality gaps between Bangkok and peripheral areas by combining Science, technology and innovation policy with regional know-how to assist the private sector in building up innovation based and sustainable businesses (Tridech, 2016). The parks were planned in affiliation with three major universities in different part of Thailand (north: Chiangmai University, northeast: Khonkaen University, and south: Prince of Songkla University)

In 2015, the Thai government official released Thailand 4.0, a policy agenda to promote and support innovation, creativity, research and development. In the light of this development, the role of Science and Technology Parks (STPs) - among other policy initiatives - received more attention. However, the policy initiative is inspiring and ambitious, but the practical implementation is still vague and unclear (Jones and Pimdee, 2017).

STPs have been argued to play a key role in policies for regional innovation ecosystems because they can act as a technology and innovation hub for entrepreneurial activity in a region (Nauwelaers et al. 2014). However, as STPs are often weakly linked to pre-existing activities in the region and therefore rarely fulfil their potential. The challenges of such place-based innovation policy for region industrial development is acknowledge also for other regions of the world and approached in the European Commission's Smart Specialization Strategy (S3). The S3 approach has gained increasing attention throughout the world, also in Thailand[1]. S3 aims to shape policies for regions to revitalize their economies. The rationale behind S3 is the importance of regions to focus on certain domains related to pre-existing economic activities, in order to develop distinctive areas of future regional specialization (Foray, 2016). Policy interventions should build on analysis of the strengths and potentials of a regional economies and on participatory processes ensuring wide stakeholder involvement. While S3 strategies address regional innovation policy in general, Nauwelaers et al. (2014) discuss the role of STPs in the context of S3. They argue that STPs potentially can provide an adequate innovation ecosystem for initiating innovation activities in the region. Moreover, Nauwelaers et al (2014) argue that STP can become a key actor as gathering multiple stakeholders in contributing to shaping S3 strategies. Likewise, STPs may also become an extra-regional connector for implementing S3 strategies. However, in practice, the process of developing STPs in order to leverage regional capacities and potentials in accordance with S3 strategizing is complicated.

In this paper, we aim to concretize a practical route for regional S3 strategy processes, where STPs play a central role. As such we propose and apply a novel approach for identification and selection of 'transformative activities' as an alternative suggested by Foray, Keller and Bersier (2018). For that aim we depart from a recently developed conceptual framework that highlights the importance of regional contextual factors and the STPs' performance (Poonjan and Tanner, 2019). This RIS-STP framework draws on experiences across the world and outlines how designs of STPs need to be reshaped and planned to be aligned with regional and extra-regional context and challenges. Furthermore, our contribution combine the RIS-STP framework with the framework of innovation system foresight (Andersen and Andersen, 2014). Innovation system foresight is defined as a *'systemic, systematic, participatory, future-intelligence-gathering and medium-to-long-term vision-building process aimed at present-day decisions and mobilising joint actions to improve innovation system performance with the ultimate goal*

[1] Thailand has registered to EU's S3 policy platform in 2019 (https://s3platform.jrc.ec.europa.eu/)

of improving desirable socio-economic performance' (Andersen and Andersen, 2014). While Andersen and Andersen focus on foresight for national innovation systems, others have focused on foresight for regional innovation systems (Battistella and Pillon 2016; Fikirkoca and Saritas 2012; Harper and Georghiou 2005 and Piirainen, Tanner, and Alkærsig 2017). Despite the growing focus on regional innovation system and innovation policy design through foresight, none of the previous studies have applied a comprehensive perspective as the RIS-STP framework represents, while zooming in on the role of STPs for developing regional innovation ecosystems.

Hence, the theoretical research question that this paper aims to answer is how the integration of the frameworks of innovation systems foresight and RIS-STP can contribute to the implementation of S3. That is the identification and selection of 'transformative activities' as framed by Foray et al. (2018) but in our case with a novel and alternative approach.

The practical contribution of this paper relates the Prince of Songkla science park in the Songkhla province of Thailand. The aim and contribution is here to suggest policies for the science park management and regional authorities. In dialog with representatives of the Prince of Songkla science park and of Songkhla regional authorities the practical research questions are formulated as:

- What are the promising technology development for selected focus sectors in the Songkhla province over the next 10 years?
- What are the important of regional policy and STPs policy instruments to support the development of promising technology over the next 10 years?
- What are the global megatrend that will have an impact to the development of that sector over the next 10 years?

By this, the paper also contributes with a novel conceptual approach to the literature on foresight for science parks and regional innovations systems (Harper and Georghiou, 2005; Fikirkoca and Saritas, 2012; Battistella and Pillon, 2016).

2 Theoretical Framework

Regional contextual factors and STP performance: RIS-STP framework

In this study we use the comprehensive RIS-STP framework develop from the insight on STPs literature. The rationale behind the framework is that regional contextual factors are important for STPs development. The emphasis on regional contextual factors and regional innovation policy tool has been highlighted in numbers of studies especially in the field of evolutionary economic geography (e.g. Todtling and Trippl, 2005; Asheim *et al.*, 2017). Yet, the notion has not been theoretically and practically well developed with STPs studies.

The concept of regional contextual factor matter inspired by literature on regional innovation system (RIS). RIS is viewed as a dynamic system. The system consists of multiple actors (e.g. local firms, universities and research education and public organisation) that have interaction with each other (Asheim, Smith and Oughton, 2011).

However, regions are different as researchers proposed several frameworks to distinguish regional dominant characteristic. For example, Todtling and Trippl (2005) grouped regional type based on their preconditions for innovation into three types; peripheral region, metropolitan region and old industries region. Each type of region has

different innovation barriers. Hence, regional innovation policy approach should be adjusted and aligned with regional existing conditions. The argument is also applied to the development of STPs. The comprehensive RIS-STP framework provides a systemic approach which will help STPs developer and/or policy researchers assess regional innovation preconditions together with STPs development.

The RIS-STP framework comprises with five regional factors shows in figure 1; university and research institutes, industrial structure, institutional settings, financial support and urbanization as well as two extra-regional networks and STPs' internal factor. The understanding of each factor and their dynamic among each other helps improve STP design and hereby their performance. For example, literature found that STPs tend to perform well in regions where there is a strong link between universities and local companies, through skilled human labour flows, actively networking, spinoffs and start-up activities. Moreover, the collaboration between universities and STP tenants is stronger if universities provide cognitively related research activities. In term of industrial structure, STPs tend to perform well in regions where there is a strong high-tech cluster.

In sum, the framework provides a systemic view as a starting point to assess the region. It will help complement the development of STP and the S3 strategy which will be discussed in the next section.

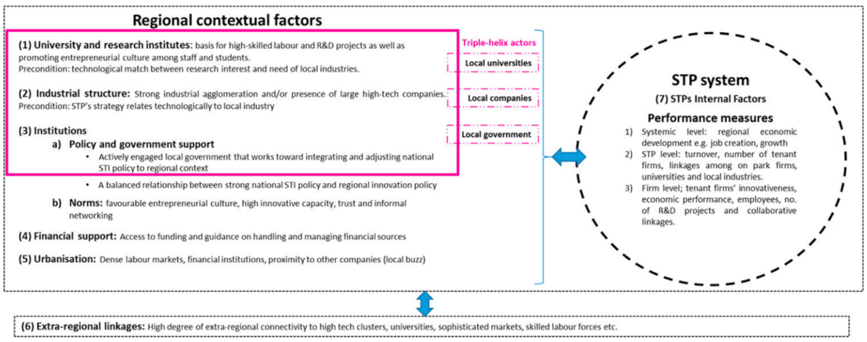

Figure 1 Framework for factors influencing STP performance: regional contextual factors (1–5), extra-regional connectivity (6) and STP's internal factors (Poonjan and Tanner, 2019).

Smart specialisation (S3)

The smart specialisation emerged in 2008 by a group of academic experts as a conceptual policy tool to enhance R&D activities of EU economies. The core process takes innovation as a key driver for regional economic restructuring. The process involves local stakeholders to identify and develop local innovation capacity. The underlining of local stakeholder involving is the key mechanism of the policy so-called entrepreneurial discovery process (EDP). The EDP advocates a bottom-up procedure conducted by relevant regional actors to identify new related activities that have a potential to revitalize local economic activities (Foray, 2016; Asheim, 2018). McCann

and Ortega-Argilés, (2016) summarise the pragmatic approach of S3 as *carefully choosing priorities which are best suited to moving the region from its current development trajectory to a stronger trajectory via the enhancement of the local entrepreneurial climate.*

Transformative activities or a new potential growth often emerge from related activities in sector or technologies that are close to region's existing specialisations. The notion lines with the evidence from empirical studies suggest that regional growth is faster and more sustainable in cases where regions diversify and branch into new technologies activities and skills-set by building upon their existing capabilities. S3 works by prioritising regional development spending on each region's distinct competitive advantages, thus enabling regions to transition into more dynamic and higher value-added sectors. The transition process expects to occur through regional industry upgrading, diversification or emergence (Barzotto *et al.*, 2019).

In practical, S3 implementation is challenging, especially in lagging regions. For example, it is difficult to identify local technological domains and develop collective learning in the region, where local precondition for innovation is weak (e.g. lack of connectedness, entrepreneurial spirit, size in terms of market potential, industrial diversity, quality of local governance). Besides, identifying new related activities is challenging in lock-in regions where the presence of local industrial structure is dominated by traditional industries (e.g. agriculture, textile) (Capello and Kroll, 2016).

We argue that the challenges of S3 implementation can be minimised by STP functions and foresight practice. We perceive S3 as a policy approach process while STP is a complementary instrument to initiate the process. Inspired by Nauwelaers, Kleibrink, & Stancova (2014) and (Barzotto *et al.*, 2019), we find that STPs can complement to S3 challenges in two aspects. First, in the sense of regions that lack of local precondition for innovation, STPs can provide adequate innovation ecosystem activities as well as forming relevant local stakeholders for entrepreneurial discovery process. Second, in lock-in regions and/or the regions that have limited absorptive capacities of local SMEs firms, STPs can compensate by providing extra-regional outlook.

Innovation system foresight for S3 and STP development

Foresight is a tool to support decision making and policy. Foresight allows policymakers to identify how trends can influence the system which helps policymakers to prepare the strategies to cope with the future (Battistella and Pillon, 2016). Foresight has been carried out in different scales; national, regional and corporate foresight. Observation from extant literature present that national and corporate foresight highly concerns to technological emerging issues while regional foresight takes more institutional of the region into account (Kindras *et al.*, 2014). The concept of regional foresight has just developed recently. Regional Foresight aims to provide valuable inputs into strategy and policy planning in regions, while also mobilising collective strategic actions (European Commission Research Director General, 2001). A number of studies have linked regional foresight with the concept of RIS (e.g. Fabbri 2016; Uotila and Ahlqvist 2008; Vecchiato and Roveda 2014). The emerging of S3 has pushed foresight at the regional scale to greater attention.

In the study, we use the innovation system foresight (ISF). The ISF framework developed from the rational that foresight can accommodate to innovation system by associating the problems and the research challenges related to context and demand for

knowledge (Andersen and Andersen, 2014). ISF can complement to S3 in three folds. First, ISF operates in a systemic context dependency. ISF does not just take only emerging of technology foresight into account but also the socio-economy relevant of a specific context. Moreover, ISF views innovation in evolutionary sense that means, there are many actors involve in the system and the system is dynamic. The process of ISF context mapping provides regional reflection on their strength and weakness. The argument aligns with the core concept of RIS-STP and S3 framework, which highlight the heterogeneity of the regions and innovation policy need to be adjusted with the specific context.

Second, S3 aims to identify the promising economic diversification of industrial paths development that create regional structural change. In this sense, ISF complements S3 by providing an evidence-based on how to identify new related activities and diversify technological domain around local specialised industries as well as how to prioritise policy activities. The new related variety needs to be designed to fit new market opportunities by implication and variation of "innovative ideas in a specialised area"(Gheorghiu, Andreescu and Curaj, 2016).

Third, foresight activities accelerate the process of regional innovation networks by directly involving relevant local stakeholders in the process. Involving relevant stakeholder is a key of entrepreneurial discovery process of S3. The process helps to acquire regional asset and a casual promise contract to push the new direction together (Uotila and Ahlqvist, 2008; Fabbri, 2016).

We believe that the integration of STPs, regional innovation system and foresight concept can be a promising tool to identify the new transformative activities of S3.

3 Method

Methodologically, the study was based on a generic innovation system foresight approach (Andersen and Andersen, 2014; Andersen, Andersen and Jensen, 2014). The context is a PhD study funded by the Royal Thai Scholarship and carried out at the Technical University of Denmark. The geographical distance to the Songkhla province determined to some extent the selection of detailed foresight methods. The primary target groups of the foresight exercise were the management of the Prince of Songkla University Science park and the policymakers of the Songkhla province. As mentioned in the introduction the practical aims of the foresight exercise were formulated in dialogue with representatives of the Prince of Songkla University Science park and of Songkhla regional authorities. The Prince of Songkla University Science park has earlier selected four focus areas of industry sectors and technology: rubber, seafood, palm oil and biomedical. Therefore, the foresight also focussed on these four areas. The time horizon was chosen to be 10 years. The analytical level of the study was multi-scalar and focused on both policy instruments at the regional/province level and the policy instruments at the science park level.

Empirically, the study draws on three sources: 1) desk studies of relevant reports, web-pages and similar, 2) interviews and 3) a two rounds iterative Delphi method. The structured interviews were carried out either as phone interview or during visits in the Songkhla province. The interview questions were designed base on regional factors from RIS-STP framework. As an alternative to workshops, a Delphi method was selected for two reasons. First, because of the context as a PhD project carried out in Denmark that

limited the resources and ability to invite the relevant stakeholders to a workshop. Second, because the process is an efficient decision-making approach in limited time and cost situation. Delphi provides consensus information from expert panels without bringing them together physically (Linstone and Turoff, 2002; Rowe and Wright, 2011).

In an iterative process, we developed both key issues as statements within each of the four areas of technology and business, and key questions regarding regional innovation policy and science park management. See figure 1. A first step was a comprehensive desk study to gain knowledge about each sector and identify relevant actors. In the next step, we interviewed 18 relevant local actors to understand the current situation and trends for each specific sector in the province. We use the insight from desk study and expert interviews to formulate first round Delphi survey that aimed to establish an overview and prioritize among four themes, 1) most important technologies and business areas of the four focused sectors, 2) external megatrends affecting the four sectors in Songkhla, 3) possible regional innovation policy instruments and 4) possible science park management instruments to promote industrial development in the four sectors. In a second round of the Delphi, we combined the selected statements with the selected questions on megatrends, management instruments and regional policy instruments. As far as possible we included the same respondents in both the interview and the two rounds of Delphi. See table 1.

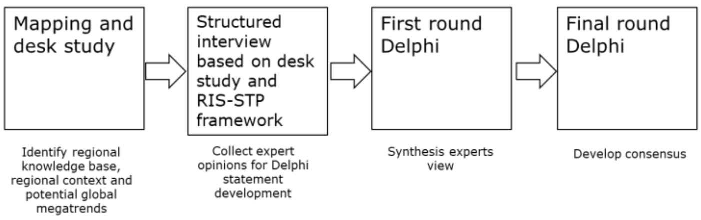

Figure 1: The foresight process in Songkhla province

Table 1. Number of informants from interview and first round Delphi

Sectors	Number of interviewees	Completed responses in first round Delphi
Biomedical	5	9
Palm oil	3	1
Rubber	5	7
Seafood	5	4

4 Findings

The findings derived from three phases of the study; desk study, interview and Delphi survey. We present the findings in three stages. First, the overview context of Songkhla and their industrial structure. Second, a list of Delphi statements and third the result from the Delphi survey.

Songkhla is the province in the Southern region of Thailand which has a border to Malaysia. The province gross provincial product (GPP) per capita is 35% lower than the national average. Population in Songkhla is 1.43 million. The province has an international airport and an inter-provincial train station as well as a deep seaport. A

major university in the southern region is located in Songkhla – Prince of Songkla University which is a host of the science park. As locate in border region, Songkhla is a part of special economic zone (SEZ). SEZ is a government plan in order to develop industrial real estate at the border regions, the government offers both tax and non-tax incentives for investors. The SEZ project planned expects to complete in 2021.

Most economic activities in Songkhla is run by small and medium enterprises (SMEs). The majority of economic activities share among three sectors; agricultural and fishing, mining and manufacturing. The manufacturing sectors concentrate in rubber, seafood and wood production. The labour force in the agricultural sector is at 33.3% from overall the labour force in the province while the GPP from the agricultural sector is just 14.3% of the overall GPP. Besides, a higher level of education accounts for only 23% of all employments. (Songkhla Industry Organisation, 2019). The information from the Prince of Songkla science park shows that rubber, palm oil, seafood, health and medicine are the top sector for intellectual property registration (Prince of Songkla Science Park, 2019).

Rubber and seafood sectors are the major sectors in Songkhla. These two sectors have completed value chain system in the province and have a number of presence big firms. In 2016, the government has established Rubber city in Songkhla as a plan to develop rubber cluster from midstream to downstream industries using innovation-based. However, it has been criticized by the press as unpopular and lack of interested from investors. The development of cluster concept is still weak in the province(Bangkok Post, 2018; Poonjan, 2020).

In contrast to palm oil and biomedical sectors, the value chain system is incomplete and there is no presence of big firms. Innovative actors from the biomedical sector are university researchers, entrepreneurs, biomedical instrument representatives and office users in the hospitals while the university researchers are the only main actors and the province. Science park staff told that most of palm oil industry is concentrated elsewhere outside Songkhla but Prince of Songkhla University has knowledge resources related to the field. Combining the analysis from interview and desk study, we formulated a set of Delphi statements consisting of promising technology in selected sectors, global megatrend, regional policy instruments and science park management instruments as present in table 2, 3, 4 and 5, respectively.

Table 2. Delphi statement of promising technology in four selected sectors

Sector	Promising technology over the next 10 years
Biomedical	Biosensors for external medical examination equipment and point of care application
	Biodegradable nanoparticles for drug delivery system
	Biomedical management software (e.g. cloud database for one-stop solution diagnose, web-based software for biomedical equipment inspection and management)
	Smart devices for aging population (e.g. voice or wearable technology for monitoring blood pressure to glucose levels)
	Medical data diagnose using image processing technology (x-ray, MRI and microscope)
	Medical data analysis using DNA database diagnose for personalised and precision medicine
	Medical robotic for surgery and rehabilitation
	Bionic hand and leg using EMG signal controls

	Telemedicine using application on smart device (direct to consumer visit)
	Senior home service
	Obtain biomedical product certification from international organization such as FDA
Palm oil	Develop new high-yielding and drought resistant oil palm type
	Smart farming using automation technology for fertilisation
	Reduce oil loss in non-streaming extraction process
	Oleochemicals technology (e.g. fatty acid, fatty alcohol, methyl esters, and glycerin), and palm-based constituents (e.g. tocotrienols and carotene) for new value-added product e.g. vitamin E supplementary and palm oil cosmetic
	Carotinoid and/or tocotrienols extraction from crude palm oil processing
	Enhance biodiesel standard using H-fame technology
	Obtain sustainable palm oil production certification (RSPO)
	Agricultural machinery rental businesses
Rubber	Mechanisation and automation in rubber tapping
	Precision farming (e.g. using sensor data to observe, measure, and analyze the needs of rubber)
	Process innovation to reduce cost in rubber processing (e.g. new chemical process)
	Economical feasible technologies to reduce/remove protein from natural rubber
	Using bioprocessing technology to produce natural rubber serum products with commercial applications (e.g. Quebrachitol, Serum Protein)
	Protein free rubber-based products (e.g. gloves) for allergic consumers
	Technology for rubberised road: cup lump modified asphalt for road construction
	Rubber in automotive (e.g. green tyre, rolling resistance tyre compound)
	Rubber technology for railways system (e.g. railway rubber pad)
	Integrated rubber and material technology (e.g. dielectric material, flexible sensor)
	The use of rubber for soft robot medical surgery
	Rubber wood: natural bio-based products for wood coating and protection against degradation
	Rubber wood: develop unique product design (e.g. toy, furniture)
	Obtain sustainability standards and certification on products, processes or management related to rubber
Seafood	Using biotechnology in seafood farming (e.g. using Gonadotropin releasing hormone (GnRH) for fish breeding, fish feed biotechnology, and bio-remediation)
	Precision fish farming using automated feeding strategies and control
	Freezing technology (e.g. Liquid nitrogen freezer, air blast freezer)
	Traceability and IT-enabling food logistics
	Substitute raw materials from seafood by other bio-based raw materials (e.g. seasonal vegetable and fruits) that are compatible with existing production system
	Extraction of bioactive compounds from seafood waste using ultrasound technology to create new value-added product
	High pressure processing, pulsed electric field and cold plasma technology for food preservation to minimise nutrition lost
	Development of new products that are easy to cook and rich in taste by involving culinary and nutritional expertise
	Develop new packages using biodegradable packaging, smart packaging and new packaging design
	Develop new value-added products for senior people (e.g. bio-calcium added tuna)
	Develop new value-added products for health and beauty market (e.g. high protein low carbohydrate snack)
	Obtain sustainability standards and certification on products, processes or management related to seafood
	Obtain standards and certifications for food-safety and health concerns from international organisations

Table 3. List of global megatrend

Global megatrends	Global warming and Climate change
	Environmental Sustainability
	Expansion of China's global influence
	Emerging competition from the Southeast Asia (e.g. Laos, Cambodia and Myanmar)
	Increased Urbanisation
	Ageing society
	Automation and Artificial intelligence
	Increased interest in Healthy, Wellness and Well Being lifestyle

	Increased Digitalization
	Sharing economy
	Blockchain technology
	Rising demand on Customization and Personalization of goods

Table 4. List of regional policy instruments

Regional policy instruments	Improve transportation and communication infrastructure in Songkhla province
	Increase research in biomedical and related knowledge fields at universities in Songkhla province
	Educate high-skilled graduates with competences and skills relevant for the industry
	Promote a culture for entrepreneurship and innovation in Songkhla province
	Develop competences and skills in biomedical and related industry in Songkhla province
	Promote collaboration among companies in Songkhla province, for example between suppliers, customers, users, technology developers and providers
	Promote collaboration between private companies and researchers from the Prince of Songkla University
	Promote collaboration with actors outside the Songkhla province, for example between suppliers, customers, users, technology developers, providers and university researchers
	Availability of funding for developing new products or implementing new process technologies
	Public procurement to stimulate regional demand and market opportunities in the biomedical industry
	Local government initiative on integrating and adjusting national STI policy to Songkhla province
	National government initiative on translating and adjusting national science, technology and innovation policy to Songkhla province

Table 5. List of science park management instruments

Science park management instruments	Support university-industry relationships
	Support and develop science park facilities (e.g. laboratory and co-working space)
	Facilitate the creation of new businesses through incubation programmes
	Support networking and collaboration with actors outside Songkhla province (both nationally and internationally)
	Specialize and prioritize specific technologies and knowledge fields related to local industries
	Promote and improve the quality of university research
	Provide intellectual property rights services (e.g. patent lawyer)
	Stimulate innovative behavior among local companies
	Assist and guide on how to apply for and access funding

The result from first-round Delphi is analysed using a simple statistic method (i.e. mean and standard deviation to provide overview result of central tendency). The limitation of using statistical analysis is because of the small number of sample size (see table 1). From all of the four focused sectors, we found that the palm oil industry is the least strong sector compared to the other three sectors. There is a small number of farmers and researchers in the province. The researchers and science park staff revealed that most of their collaborations are outside the province. Only one out of four respondents completed the survey. Thus, we excluded the palm oil sector from the analysis of our findings and final round Delphi.

The key findings from first-round Delphi are four folds;

- Most of the respondents agree that the promising technologies related to the given statements have a high level of importance but the promising technologies related to the given statements have a low level of competences and skills related to the technology in Songkhla province both at firms and universities.

Seafood is the sector that has a competitive level of competences and skills related.

- The global megatrends that will have an impact on the development of the three sectors in Songkhla are varied from sector to sector. We summarised the result in table 6.

Sector	Most important global megatrend
Biomedical	Aging society, automation and artificial intelligence
Rubber	Expansion of china's global influence, automation and artificial intelligence and increased interested in healthy, wellness and well-being life style.
Seafood	Increased urbanisation and increased interested in healthy, wellness and well-being life style

- Most of the respondents agree that regional policy instruments are important for the development, especially in terms of increasing research in a specific field and related knowledge fields at universities in Songkhla, promoting collaboration among local actors both inside and outside the province and develop competences and skills in related industries.
- Similar to regional policy instruments, all of STP instruments are thought as important, especially in term of supporting university-industry relationships and supporting and developing science park facilities (e.g. laboratory and co-working space).

5 Conclusions

The preliminary results confirm that the use of foresight complements the RIS-STP framework in order to initiate regional S3 strategy. The integration of foresight and RIS-STP framework helps local stakeholders to anticipate the promising technological areas that build on regional strengths and weaknesses. The preliminary lesson learned is threefold.

First, foresight adds a conceptual discussion to the development of STPs and the recently developed concept of S3. As STPs have been criticised of lacking local integration which results in their poor contribution. The integration of foresight and RIS-STP framework provides a systemic assessment of regional innovation ecosystem and their technological capabilities through foresight activities. The systemic assessment is arguably important especially in lagging regions where the resources and policy capacity to achieve innovation performance are limited. Hence, it is important to understand both the obstacles that can hinder S3 in lagging regions and the policy interventions that can support S3 in lagging regions (Barzotto *et al.*, 2019).

Second, practical implication showed that foresight initiatives help identify promising technologies and prioritise policy instruments based on future challenges and the regional context. However, the practical approach of the study is limited by modest participation and representation of innovative local actors which is due to the general weakness of the regional innovation ecosystem. Besides, to implement a successful S3, the commitment from local is important. The practical approach as Delphi should be better with workshops or other activities that enhance the dynamic of local engagement which turn in to a more committed to the project.

Commented [AP1]: Even though, S3 highlight the important of bottom-up process but the policy does not neglect the important of top down national government. ...

- These are the two sides of the smart specialisation coin. Implicit in this is the need for better co-ordination mechanisms between regions and national governments for allocating resources in an environment of structural change and uncertainty, risk, and information asymmetries.// innovation driven growth
- Another characteristic of the smart specialisation approach is that it aims to deal with one of the weaknesses of government intervention in industrial and innovation policy, that is the "diffused agency" problem since it focuses on entrepreneurs and co-ordination of policy over a broad range of stakeholders (regions, national actors) and between top-down and bottom-up initiatives (See Box 2 and Chapter 4).

Finally, in lagging regions context, the role of STPs might help compensate the weak institutions by enabling a local strategy shaping from a bottom-up process (e.g. bridging public-private and/or private-private collaboration). However, STPs alone would not create efficient impact and sustain long term process. Policy initiative from central government to stimulate local collaboration, increase research in local related industries and educate high-skilled graduate would pave the path for a better impact and long term development.

In summary, the paper has provided a systemic approach to initiate S3 in the lagging region of Thailand. The case can be an example experience for other lagging regions that have similar context. Future research should consider using a different methodology approach or applying the framework with developed regions to compare the different outcomes and translate the findings to a policy approach.

Context contribution part:

The aim of smart specialisation policy is to move beyond path extension. To achieve diversified specialisation a region needs to promote new path development, e.g. diversify the economy into technologically more advanced activities that move up the ladder of higher knowledge complexity compared to the present level in the region. However, to move local industry further, regions required high level of diversified industrial structure and innovation capacity. Taking regional context in to account, Songkhla can be classified as specialised and low innovation capacity region, similar to other peripheral regions in southern and Eastern Europe. This type of region have limit options to pursue new path development because a low level of system differentiation do not have the sufficient critical mass of actors types and networks, as well as good enough quality of institutions that are required to underpin such systems (Asheim, 2018).

Even though, the country initiated innovation policy since early 2000s, until now the problems to pursue new path development in Thailand context arise in different levels; national, regional and at firms and individual. For example, the country NIS system is X, the region level has less opportunity to initiate bottom-up policy. Firms has low level of innovation capacity and people mindset toward innovation is low. Even though, the country initiated innovation policy since early 2000s (e.g. STP development), until now the problems is still occur. Prior research shows that the relatively low innovative performance of Thailand – compared to the Asian NIEs – is partly due to the lack of adequate policies that target such weaknesses (Arnold et al., 2000; Bell, 2002; Intarakumnerd et al., 2002; Intarakumnerd, 2005). It is because the government lack of making systemic assess e.g. xxxxxxx. Policy recommendation would highlight on xxxx for an efficicent impact and sustain development.

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