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Foresight for science and technology parks in the context of smart specialisation

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Abstract:

In recent decades, science and technology parks (STPs) have acquired significant academic and political interest due to their potential to develop regional innovation capacities. Despite their popularity, the impact of STPs has been discussed critically in the literature. One reason behind their unclear impact relates to a lack of alignment between the strategies of STPs and their respective regional contexts. This article contributes to this discussion by demonstrating that the concepts of smart specialisation strategies (S3) and innovation system foresight can help design STP's innovation strategies that are in alignment with the regional context. This study develops and implements a foresight exercise design to align the function of the STP with the regional context of the Prince of Songkla University Science Park in Thailand. The foresight exercise contributes to policy recommendations for the regional authorities and the STP's management, focusing on three pillars: collaboration and networks, vertical policy coordination, and the prioritization of specific technology fields related to the existing industry. Theoretically, the article contributes a new approach to S3 initiation in which STPs play a crucial role.

Keywords: Foresight; smart specialisation strategies; science and technology parks; developing countries.

1 Introduction

A growing literature shows that to realise STPs' intended functions in developing regional innovative capacity, they need to re-orientate their strategies to match the need of the regional economy (e.g., Poonjan and Tanner 2020; Etzkowitz and Zhou 2018; European Commission 2013; Rodríguez-Pose and Hardy 2014). The European Commission (2013) suggests that STPs need to establish a long-term strategy of continuously monitoring their strategic environment to determine whether their functions require adjustment to better address the needs of the regional economies. While this argument is not new, theoretical knowledge and, in particular, practical experience in re-orienting STPs' innovation strategies as a response to regional specifics is still limited. Our study focuses on this research gap.

In another stream of literature, that of Smart Specialisation Strategies (S3), the regional specifics have been of core interest to processes of developing regional innovation policies. S3 approaches acknowledge a given region's current strengths and weaknesses as the starting point for developing new initiatives to promote regional economic development (Foray, 2016; OECD, 2013).

In response to the research gap, we investigate the concept of S3 as an approach to developing regional innovation policies and STP innovation strategies, which align the STPs' functions with their respective regional contexts. Therefore, this article aims to investigate the theoretical and methodological links between the innovation strategy of STPs and the S3 concept. To do this, we use the concept of innovation system foresight as an instrument to develop regional policies and STPs' innovation strategies following the S3 approach. We pose the following overall research question: how can foresight be used as an instrument for developing S3 that aligns the function of an STP with its regional context? Our theoretical starting point is a recently developed conceptual framework (RIS-STP) that draws on findings from a review of the extant STP literature on how STP performance is influenced by regional contextual factors (Poonjan & Tanner, 2020). The framework highlights the importance of various factors in the regional innovation system (RIS) for STPs' performance.

This study is based on a case study of the Prince of Songkla University Science Park (PSUSP) in Songkhla[1] Province, Thailand. To ensure the policy relevance of the study, the practical research questions were formulated in dialogue with key stakeholders of the PSUSP and the Songkhla regional authorities, as follows:

[1] The name of the university is spelled 'Songkla', but the province name is spelled 'Songkhla'.

- What promising technology developments can be selected for Songkhla province's focus sectors over the next ten years?
- What global megatrends will impact the development of those sectors over the next ten years?
- What important regional policy and STPs management instruments can support the development of promising technologies for those sectors over the next ten years?

The article is organised as follows. Section 2 describes the theoretical linkages between the key concepts of STP development, the regional context, and S3. Section 3 addresses methodological considerations and the foresight approach for STP in the light of S3. Section 4 reports and discusses the results of the case study and foresight exercise. Section 5 concludes the findings and summarises the article's theoretical contributions and policy implications.

2 Theoretical framework

The theoretical motivation for highlighting the importance of regional contextual factors for STP development derives from the concept of regional innovation systems (RIS). The RIS framework views innovation as a systemic process that involves various regional and non-regional actors (e.g., firms, universities, intermediary organisations such as STPs, policy-makers, and financial institutions) interacting with each other (Todtling & Trippl, 2005). RIS is an appropriate framework for analysing STPs. RIS incorporates all the relevant components for regional innovation processes and innovative capacity-building and can be applied in any type of region (e.g., peripheral, metropolitan, or specialised regions). Moreover, the RIS approach argues that there is no 'one-size-fits-all' innovation policy strategy (Todtling & Trippl, 2005). Therefore, understanding the characteristics of a given RIS is highly valuable for designing STPs' innovation strategies. Finally, the relevance of drawing on the RIS approach is further supported by empirical studies, confirming that regional contextual factors impact the performance of STPs (e.g., Albahari et al. 2013; Phelps and Dawood 2014; Tsamis 2009).

Given the importance of regional contextual factors for STPs' performance, we apply the RIS–STP framework (Poonjan & Tanner, 2020) as a primary guideline for designing regional policies and STP management instruments that can align the functions of STPs with their regional contexts (section 4.3). The RIS–STP framework uncovers regional conditions that can influence STP performance, namely urbanisation, the availability of financial support, the existence of universities and research institutes, the industrial structure and institutional settings, together with extra-regional networks and STPs' internal factors (Figure 1). Following the S3 logic, the importance of each factor, together with insights from the interviews, are used to outline potential regional policies and STP management instruments in the foresight exercise (section 4.3)

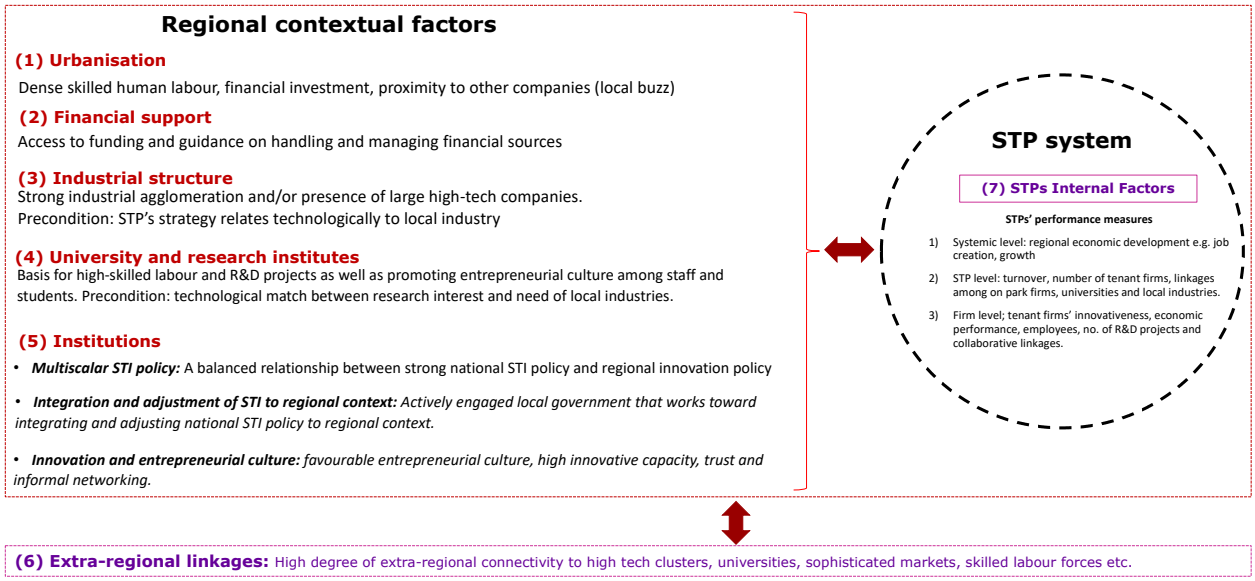

Figure 1. RIS-STP framework of factors influencing STP performance: regional contextual factors (1–5), extra-regional connectivity (6), and STP internal factors (7). From Poonjan and Tanner (2020).

2.2 Smart specialisation strategies (S3)

Smart specialisation strategies (S3) are policy prioritisation frameworks that aim to develop regional economies by '*helping regions to identify their research and innovation resources to build critical mass in areas of comparative advantage*' (Uyarra, 2019, p. 2). Like the RIS approach, S3 recognises that regions have very different characteristics and that their competitiveness can be further developed based on their respective strengths and weaknesses in levels of innovation, knowledge bases, and institutional configurations (Piirainen et al., 2017; Foray & Goenega, 2013). Given this, linking the S3 concept to STP strategies helps align the function of STPs with their regional contexts (i.e., RIS). However, theoretical and methodological concepts that link STPs and S3 are not yet well established in the academic literature. We have found only one study that discusses the functions of STPs in S3 initiation (Nauwelaers, Kleibrink, & Stancova, 2014). Consequently, we develop an approach for identifying potential focus areas for STP innovation strategies and relevant S3 regional policies. Based on previous framings of S3 (Foray, 2019; OECD, 2013), we summarise the approach with reference to two principles.

The first principle of S3 is to concentrate public resources on specific priorities based on a region's capabilities, competencies, and potential development in a global perspective (Foray, 2018; Grillitsch, 2016). Foray (2018) suggests that priorities must be chosen not at the sector level but at the level of those activities that transform existing sectors through a particular direction of development.

The second principle of S3 is to follow the logic of the 'entrepreneurial discovery processes. This process has been described as participatory, including a broad range of stakeholders who are best placed to know where the growing markets are and what research would best satisfy the region's business and social needs (Foray et al., 2012). Promoting entrepreneurial discovery processes encourages local links among universities, firms, governments, and relevant actors to integrate and structure the potential development. Another important point is that the S3 should follow a bottom-up logic rather than be decided top-down.

The advantage of linking the S3 concept to STP strategies is twofold. First, S3 thinking can help overcome a frequent criticism of STPs, namely their alleged neglect of the regional context in their strategies (Etzkowitz & Zhou, 2018; Phelps & Dawood, 2014). Zooming in on the existing strengths and weaknesses of a region and adapting and adjusting the STP strategy and functions to the characteristics of the particular regional context might reduce the risk of having an island of innovation infrastructure that cannot fulfill its role in the RIS.

Second, STPs can also play an important role in implementing and materialising a region's S3 strategy. For example, in regions that lack the local preconditions for innovation, STPs can provide appropriate innovation ecosystem activities and attract relevant local actors to the process of entrepreneurial discovery (Nauwelaers et al., 2014). In developing countries such as Thailand, STPs are often publicly managed, providing an opportunity for national and regional policies to integrate S3 with STP policy, thus complementing other policy dimensions (e.g., industrial and education policy).

Finally, since regions are not closed economic and policy systems but embedded in wider national and global systems, STPs can compensate by providing an extra-regional outlook creating channels for policy development, knowledge sourcing, and market opportunities (Barzotto, Carlo, Felicia, Sandrine, & Tomlinson, 2019). We, therefore, also incorporate exogenous factors in the foresight design. An overview of the framework and how it is embedded in national and global systems is provided in Figure 2.

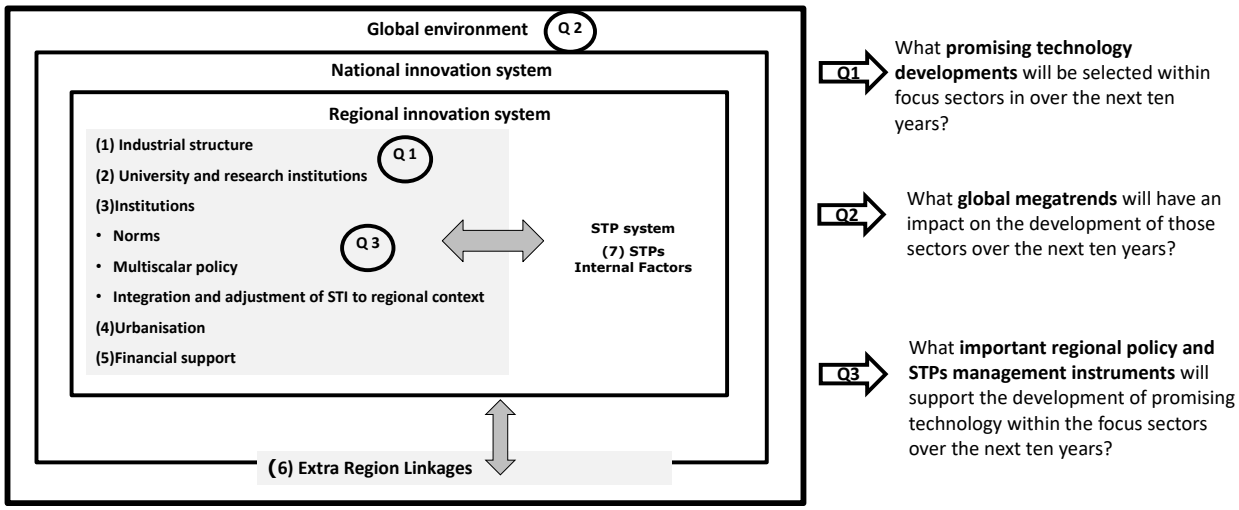

Figure 2. The RIS–STP and innovation system foresight framework for S3.

Based on the conceptual framework presented in this section and the practical aims of this study, we have outlined three practical research questions for the foresight exercise (Q1-Q3 in Figure 2). The first question regarding promising technological developments in selected sectors in Songkhla over the next ten years reflects the S3 practice of identifying specific priorities of potential technology development that build on the region's capabilities and competencies. This coincides with the regional industrial structure and the competencies of universities and research institutions in the RIS-STP framework and the STP's focus sectors. The second question addresses the most important global megatrends influencing the focus sectors over the next ten years. The third question is split into two parts, addressing both the regional policy and the STP management instruments that will support the development of promising technologies within the focus sectors over the next ten years. This question is linked to the regional contextual factors given by the RIS.

3 Foresight for smart specialisation, context of the case study, and methodology

3.1 Innovation system foresight for smart specialisation

As mentioned above, the entrepreneurial discovery process promotes a bottom-up approach conducted by relevant regional stakeholders to identify activities that have the potential to revitalise the local economy. Such processes are also the key feature of the concept of science and technology foresight (Martin & Johnston, 1999). Foresight allows policy-makers to identify how trends can influence a system, which helps them prepare the strategies they need to cope with in the future (Battistella & Pillon, 2016). As the understanding of innovation and innovation policy has developed, foresight has taken a

more systemic turn, leading to the concept of innovation system foresight (Andersen and Andersen 2014). Innovation system foresight can complement S3 in four ways.

First, innovation system foresight operates in a systemic context and takes not only the emerging technologies into account but also the relevant socio-economic factors in the specific context. The innovation system foresight framework emphasises the need to map the innovation system context and, as such, includes reflections on regional strengths and weaknesses and is therefore well aligned with the S3 framework (Grillitsch, 2016).

Second, S3 aims to identify thematic priority areas leading to new innovative activities in regions. In this sense, innovation system foresight complements S3 by providing an approach to identifying potential areas of development based on existing ideas in existing regional specialised areas and new market opportunities (Gheorghiu, Andreescu, & Curaj, 2016). Third, foresight activities can accelerate the process of networking by directly involving the relevant regional stakeholders in the process. Finally, S3 identifies and implements strategies that boost regional economic development with an action plan (Foray, 2019) similar to the key feature of foresight.

In summary, this section argues that foresight is a suitable approach for STP strategic planning in a smart specialisation context, as it combines the systematic exploration of future regional development strategies with a participatory process.

3.2 The context of the Prince of Songkla University Science Park and Songkhla province

The example chosen for this study is the PSUSP, located in Songkhla Province. Songkhla is a major province in the southern region of Thailand and borders Malaysia. Its population is 1.43 million. The leading university in the southern region, Prince of Songkla University (PSU), hosts the region's STP. Small and medium enterprises run most economic activities in Songkhla. The manufacturing industry concentrates on rubber, seafood, and wood production. The PSUSP focuses on four sectors as part of a strategic plan to promote local innovative activities. These sectors are rubber, seafood, palm oil, and biomedical technology.

The rubber and seafood sectors have complete value-chain systems in the province, including several big local firms, yet collaboration among local actors is not well established. Although the palm-oil sector in Songkhla is relatively weak (the industry value chain is incomplete, and there are no big firms) compared to other provinces (e.g., Chumphon and Surat Thani), palm oil was selected as a focus sector for the STP because the university has a well-established knowledge base on this topic. Similarly, the biomedical sector in Songkhla benefits from PSU's research expertise and supportive infrastructure (e.g., the faculty of medicine at the university hospital and related research

institutions). However, the sector is confined to academic groups, of which some become entrepreneurs. Our interviews with university researchers revealed that international collaboration in the biomedical field (and possibly other fields as well) is limited because Songkhla is in a high-risk area subject to travel warnings from foreign governments.

Overall, Songkhla's key strengths are its location next to Malaysia, the presence of a major university, and the agglomeration of the seafood and rubber clusters. However, Songkhla faces the typical challenges of lagging regions. The interviews with local stakeholders revealed that the province has a low level of innovative capacity because most firms are small, and their priorities revolve around cost reductions rather than technology upgrades. Furthermore, the dominant sectors of agriculture and fishing are labour-intensive, and their technological capability rarely improves. Lastly, collaboration among local actors is weak, and the industrial policy is inefficient (Intarakumnerd & Chaminade, 2007).

3.3 Foresight process

Methodologically, this study is based on a generic innovation system foresight approach (Andersen & Andersen, 2014). As already noted, the PSUSP has selected four industry sectors and technologies as focus areas: rubber, seafood, palm oil, and biomedical technology. A time horizon of ten years was chosen. The analytical level of the study was multi-scalar and focused on policy instruments at both the regional (or provincial in this case) level and the STP level. Empirically, the study draws on three sources: 1) desk studies of government, business reports, and business articles; 2) structured interviews; and 3) a two-round Delphi survey. The interviews were carried out either as phone interviews or during visits to Songkhla. The interview questions were designed based on the RIS–STP framework. As an alternative to workshops, a Delphi method was selected for three reasons. First, limited resources and geographical distance made it impossible to invite the relevant stakeholders to a workshop. Second, the Delphi method provides consensus information from a panel of experts without bringing them together physically, thus saving time and cost (Rowe & Wright, 1999). Third, the anonymity of the Delphi method allows respondents to express viewpoints and disagreements in cultural contexts of relatively great power distances and uncertainty avoidance. It also helps dilute the social issues that can hamper effective communication (Andersen & Rasmussen, 2014; Rowe & Wright, 1999).

The first step in the foresight process was a comprehensive desk study to gain knowledge about each sector and identify relevant actors. In the next step, we interviewed eighteen relevant local actors to understand the current situation and trends for each specific sector in the province. The interview candidates were identified and selected to cover key stakeholders and expertise within one of the four focus sectors of PSUSP and with general knowledge about the regional context of Songkhla. They represented science park staff,

university researchers, staff and managers of local firms, and local entrepreneurs. We used the insights from the desk study and expert interviews to formulate the first round of the Delphi survey, which aimed to establish an overview and prioritise issues in four themes, namely 1) the most important technologies and business areas in the four focused sectors, 2) external megatrends that affect the four sectors in Songkhla, 3) possible regional innovation policy instruments, and 4) possible STP management instruments to promote industrial development in the four sectors. As in selecting interview candidates, the Delphi candidates were local stakeholders (i.e., university researchers, staff and managers of local firms, and local entrepreneurs) with expertise in PSUSP's focus sectors. As far as possible, we included the same respondents in both the interview and the two rounds of the Delphi survey (Table 1). In the second Delphi round, we combined the selected statements on important technologies and business areas with the selected issues on megatrends, management instruments, and regional policy instruments. The interviews showed that the palm-oil sector was only weakly present in the region compared to the other three sectors. We identified only four regional actors in this sector, only one of whom completed the survey. This led us to exclude the palm-oil sector from the analysis and the final round of the Delphi survey. The results of the Delphi survey were analysed using a simple statistical method, i.e., mean and standard deviations were used to provide an overview of the central tendency of the results.

Table 1: The number of informants from interviews and Delphi surveys.

Sectors	Number of interviewees	Respondents contacted in first Delphi round	Completed responses in first Delphi round	Completed responses in final Delphi round
Biomedical	5	13	9	6
Palm oil	3	4	1	-
Rubber	5	14	7	7
Seafood	5	11	4	2

4 Case study: Prince of Songkla University Science Park

This section presents the results of the foresight exercise and the discussion on integrating innovation system foresight with the RIS–STP framework to design and implement S3 for the PSUSP.

4.1 Promising areas of technology and business

We developed four sets of statements on promising areas of technologies and business for the four selected sectors based on the desk study, interviews with key actors, and the first round of Delphi surveys. This iterative process produced fourteen statements for the biomedical sector, eight statements for the palm oil sector, sixteen statements for the rubber sector and thirteen statements for the seafood sector (Poonjan, 2021). In the two rounds of Delphi surveys, the respondents assessed each statement concerning the two criteria of relevance: first, whether each area of technology or business was of interest to existing firms in Songkhla; and second, whether there were existing capabilities in core or related knowledge fields in Songkhla. As mentioned, we omitted the palm-oil sector from the Delphi survey.

First observation of the responses is that all statements have a relatively high score regarding both criteria, which indicates that the proposed statements are relevant (see Figure 3). Only three statements have an average score below 3 (moderate) for the criteria 'existing capabilities in core or related knowledge fields in Songkhla province'.

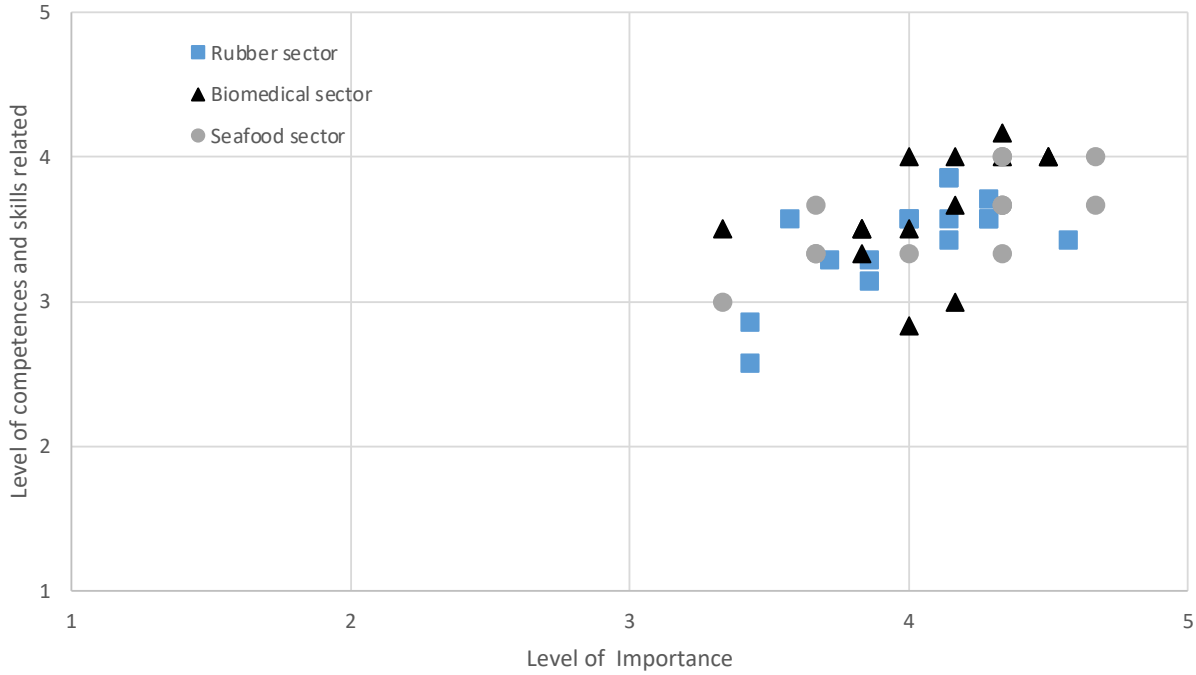

Figure 3. Statements of interest to existing firms and represent existing capabilities in core or related knowledge fields in Songkhla.

In general, the responses in the biomedical sector demonstrate a higher degree of consensus than those in the rubber and seafood sectors. The reason for this could be the variety of respondents in the seafood and rubber sectors. The biomedical sector is a new sector that emerged among university researchers. Thus, these respondents are primarily limited to researchers, entrepreneurs, and firms with close connections with the university. The seafood and rubber sectors are more mature, and respondents from those

sectors are more diverse. The top three highest-scoring promising technology statements based on the two axes of Figure 3 are listed in Table 2.

Table 2: The highest scoring promising technologies statements.

Sector	Statements
Biomedical	B9 Telemedicine using application on smart device B10 Senior home services B4 Smart devices for an ageing population
Rubber	R3 Process innovation to reduce costs in rubber processing R8 Rubber in automotive applications (e.g., green tyres or rolling resistance tyre compounds) R14 Rubber wood: develop unique product designs (e.g., toys or furniture)
Seafood	S5 Substitute raw materials from seafood with other bio-based raw materials that are compatible with existing production systems S10 Develop new value-added products for senior people (e.g., bio-calcium enriched tuna) S11 Develop new value-added products for health and beauty markets (e.g., high protein, low carbohydrate snacks)

4.2 Global megatrends

A set of thirteen global megatrends (see Table 3) was developed based on the desk study, interviews, and the first round of Delphi surveys.

Table 3: List of global megatrends. H marks high importance, o marks medium to low importance.

Megatrend	Biomedical	Seafood	Rubber
MT1 Global warming and climate change	o	o	o
MT2 Environmental sustainability	o	o	**H**
MT3 Expansion of China's global influence	o	o	o
MT4 Emerging competition in Southeast Asia	o	**H**	o
MT5 Increased urbanisation	o	o	o
MT6 Ageing society	**H**	o	o
MT7 Automation and artificial intelligence (AI)	**H**	o	**H**
MT8 Increased interest in health, wellness, and well-being lifestyle	**H**	**H**	**H**
MT9 Increased digitalisation	o	**H**	o
MT10 Sharing economy	o	o	O
MT11 Blockchain technology	o	o	O

MT12 Rising demand for customisation and personalisation of goods	o	o	O
MT13 Increased quality of education	o	o	O

In the first round, all three sectors were presented with the same list of megatrends (MT1–MT13). In the second round, we adjusted the number of global megatrends based on the first round results. Consequently, each sector was presented with different lists of five to six megatrends. The top-three global megatrends assessed to have the highest impact on the development of each of the three sectors in Songkhla are marked with 'H' in Table 3.

In hindsight, two of the megatrends, MT7 and MT9, may reflect the same overall megatrend. This leaves the combined 'digitalisation and automatisation' megatrend, together with the MT8 (lifestyle) megatrend, as the most important across the three sectors. The three sectors each have a third megatrend of high importance that reflects challenges that are specific to each sector.

While the Delphi survey indicated the most important megatrends, the interviews provided insights into how each megatrend will influence the development in each sector. MT8 is highly ranked across all three sectors, and respondents assessed that the trend would shape consumer lifestyles in the future, causing increased demand for products and services related to health and well-being. Additionally, respondents from the biomedical sector argued that the trend of an ageing population would result in higher public and private demand for products and services for the elderly.

As for the combined megatrend (MT7 and MT9), the respondents noted that the rapid global technological development in digitalisation, automatisation, and AI would require firms and the university to enhance their competencies to align and catch up with global developments. Concerning the biomedical and rubber sectors, the respondents argued that the global development of AI calls for new competencies and research in robotics. A respondent from the seafood sector noted that increased digitalisation might require innovative packaging of seafood products including QR code to track and trace origin or fishing method. Respondents from the rubber sector highlighted the need for technological development to be aligned with environmental concerns (MT2), namely rubber recycling and waste reduction in the production process. Lastly, the respondents from the seafood sector emphasised the emerging competition (MT4) from, for example Cambodia or Vietnam that, due to cheaper labour and plentiful natural resources, will constitute a risk. Together these megatrends indicate a direction for development and transformative efforts, as suggested by Foray (2018).

4.3 Regional policy instruments and STP management instruments

The list of policy instruments was derived from the desk study, interviews, and the RIS–STP framework. We generated twelve suggestions for regional policy instruments and nine suggestions for STP management instruments. See Tables 4 and 5. The purpose was to tailor the possible policy instruments to regional preconditions and link them to the promising area of technology. In the second round of Delphi surveys, we adjusted and reduced the list of regional policy instruments from twelve to seven by removing the lowest-scoring items. We merged the policy statements related to promoting collaboration (RP6–RP8) into one (RP13), and we removed RP9–RP11 due to very low scores. All STP management instruments were included in the second round because there were no clear low-ranked instruments. In Tables 4 and 5, 'H' marks the highest ranked statements of regional policy and STP management instruments for each sector.

Table 4: List of regional policy instruments. H marks high importance, o marks medium to low importance.

	Biomedical	**Seafood**	**Rubber**
RP1 Improve transportation and communication infrastructure	o	o	o
RP2 Increase research in biomedical/seafood/rubber and related knowledge fields at universities	o	o	**H**
RP3 Educate highly skilled graduates with competences and skills relevant to the industry	o	o	**H**
RP4 Promote a culture of entrepreneurship and innovation	o	**H**	o
RP5 Develop competences and skills in biomedical/rubber/seafood and related industries	**H**	**H**	o
RP6 Promote collaboration among companies			
RP7 Promote collaboration between private companies and researchers from the PSU			
RP8 Promote collaboration with actors outside the Songkhla province			
RP9 Increase availability of funding for developing new products or implementing new processing technologies	*o*	*o*	*o*
RP10 Public procurement to stimulate regional demand and market opportunities in the biomedical/rubber/seafood industry	*o*	*o*	*o*
RP11 Local government initiatives to integrate and adjust national STI policy in Songkhla province	*o*	*o*	*o*
RP12 National government initiatives to translate and adjust national science, technology and innovation policy in Songkhla province	**H**	o	o
RP13 Promote collaboration among innovative actors both inside and outside Songkhla province	**H**	**H**	**H**

Table 5: List of STP management instruments. H marks high importance, o marks medium to low importance.

	Biomedical	Seafood	Rubber
SP1 Support university-industry relationships	**H**	**H**	**H**
SP2 Support and develop science park facilities (e.g., laboratories and co-working spaces)	**H**	**H**	o
SP3 Facilitate the creation of new businesses through incubation programmes	o	o	o
SP4 Support networking and collaboration with actors outside Songkhla province (both nationally and internationally)	**H**	o	**H**
SP5 Specialise and prioritise specific technologies and knowledge fields related to local industries	o	**H**	**H**
SP6 Promote and improve the quality of university research	o	o	o
SP7 Provide intellectual property rights services	o	o	o
SP8 Stimulate innovative behaviour among local companies	o	o	o
SP9 Provide assistance and guidance on how to apply for and access funding	o	o	o

In general, the experts considered all the included regional policy instruments as important. They especially emphasised the need for policies promoting collaboration. This confirms the results of the interviews in indicating a weak regional innovation culture and a weak tradition of collaboration both among firms and between them and the university. Moreover, the highest-ranked RP in the biomedical sector (RP12) highlights a need for national government initiatives) to promote the emerging field of the biomedical sector, which tends to be less formalised or recognised compared to the traditional sectors of rubber and seafood (Gerdsri, Kongthon, & Puengrusme, 2017). In addition, the situation of unrest in the southern border provinces has limited international collaboration, which also requires action from the national government.

As with the regional policy instruments, the respondents emphasised the STP management instruments concerning the promotion of collaboration for university-industry relationships (SP1) and support for networking and collaboration with actors outside Songkhla province (both nationally and internationally) (SP4). Additionally, the respondents emphasised the support and development of STP facilities (e.g., laboratories and co-working spaces) (SP2) and the specialisation and prioritisation of specific technologies and knowledge fields related to local industries (SP5). In the context of provincial regions, where firms do not prioritise R&D activities or have R&D departments, supportive facilities (e.g., laboratories and co-working spaces) are important for assisting

and stimulating innovation. Moreover, specialisation in a focused area can guide investments and help leverage existing resources (e.g., university expertise, laboratories, and capabilities within the province).

4.4 Key findings

The practical aim of this case study has been to investigate policies for the STP management and the regional authorities to develop an S3. We have demonstrated a process to identify promising developments in technology and business on which the implementation of S3 in Songkhla province can be based. Additionally, we have identified some key global megatrends that most likely will influence these developments. Furthermore, and perhaps most importantly, we have identified some key instruments for regional policy and STP management to support these developments.

The statements regarding the 'promising areas of technology and businesses' were formulated using an iterative process involving desk study, interviews, and Delphi surveys. The development of the statements was thus based on knowledge about the pre-existing core and related technologies in the region and therefore follows the rationale of S3 (Barzotto et al., 2019). The results from the foresight exercise have enabled us to identify and provide input regarding the prioritisation of technologies that have the most significant potential for future development and sufficient knowledge and skills that are ready to be exploited. Furthermore, the global megatrends can be exploited in combination with promising technology areas to identify market demands and R&D opportunities and the need for broad policy planning. These results can stimulate strategic discussions that incorporate this potential development in the Songkhla province's current research and business development. This corroborates findings elsewhere (Uotila & Ahlqvist, 2008).

A key finding regarding regional policy and STP management instruments in the Songkhla region is the need for better coordination between the actors. That includes promoting collaboration between innovative actors inside and outside the region and supporting university-industry relationships. This corroborates findings in the literature on S3, which demonstrate that the need for cooperation is high, especially in less-developed regions (Barzotto et al., 2019; Marques & Morgan, 2018; Trippl, Zukauskaite, & Healy, 2019). Low levels of collaboration have been shown to be a common feature in less-developed regions characterised by weak RIS (e.g., scattered innovation actors, weak innovation capacity in SME firms, mutual mistrust and a weak culture of cooperation), and highly centralised policy structures (Barzotto et al., 2019; Marques & Morgan, 2018; Trippl et al., 2019). The results from the foresight exercise in Songkhla likewise indicate that regional policy and STP management instruments should actively strengthen the RIS on these dimensions.

Additionally, in the case of Songkhla, our study indicates a need for better coordination of policies regionally and nationally to stimulate local innovation. This coordination also seems necessary to generate policies that better impact longer-term development. Another key implication regarding regional policy is that competencies and skills need to be developed in the sectors that are the focus of this study (particularly, the biomedical and seafood sectors) and in related industries. This resonates with a similar need for STP management to specialise in and prioritise resources for specific technologies and knowledge fields related to local industries and the need to develop matching STP facilities. This is congruent with recommendations for STPs in Europe (Nauwelaers et al., 2014).

The findings' broader policy reflections indicate that STPs can play two significant roles in S3 implementation. First, STPs can strengthen fragmented local networks, foster linkages and related variety between sectors where a critical mass already exists, and activate extra-regional linkages to counteract outdated local specialisations. Second, STPs should synergise their internal assets with the existing regional resources (e.g., develop STP facilities to complement local specialisation).

5 Conclusion

This study departed from a discussion in the literature on the lack of coherence between the innovation strategies of STPs and their respective regional contexts. The study has aimed to contribute to this discussion by analysing how foresight can be used as an instrument for developing S3 that aligns the function of STPs with their regional contexts. Furthermore, through a case study, the article has focused on an STP in the specific context of a less-developed region in a developing country, namely Songkhla Province in Thailand.

The article has demonstrated a RIS foresight process in which the RIS-STP framework has enabled a systemic assessment of the RIS of Songkhla Province and subsequently provided a foundation for a regional S3 policy and an STP innovation strategy. Furthermore, the RIS-STP framework was instrumental in guiding the design and the practical research questions of the interviews and the foresight exercise.

The findings of the foresight exercise identify three pillars on which the regional innovation policy and the innovation strategy of the STP can build their further strategic work. The three pillars are i) increase collaboration and strengthen networks in the region; ii) improve policy coordination between the national and regional levels; and iii) develop competencies and skills in biomedical, rubber, seafood, and related industries in Songkhla province. Where all pillars were identified by incorporating the regional context (conceptualised through the RIS-STP framework) into the foresight exercise, the identified

technology areas in the last pillar were a classic outcome of the Delphi method. In this respect, the foresight exercise became a tool that helped align and bridge the strategy and functions of the STP with the regional context. The results thus indicate that combining the RIS-STP framework with the principles of S3 in a foresight exercise can contribute to a firmer anchoring and alignment of STP strategies with the regional context.

Earlier regional foresight exercises, whether on science parks or S3, have mainly used workshops to involve local stakeholders (Fikirkoca & Saritas, 2012; Foray, Keller, & Bersier, 2018; Harper & Georghiou, 2005). In opposition to this, we found that a Delphi-based foresight approach is also useful, especially in a cultural context such as Thailand, where hierarchical and social pressures can hinder actors from expressing their opinions. The actual case study was characterised by modest participation and representation of actors in the RIS. However, this is a typical characteristic and typical methodological challenge in less-developed regions with weak RIS. As such, the approach in this article provides an example that can be replicated and tested under similar conditions.

Future research might apply the framework to a different context and/or alter the process. The Delphi-based approach we proposed can be considered as the initial step of foresight concerning policy-making and facilitating the implementation of S3. However, to transfer the results into practice, the final decision-making on policy prioritization can be complemented by workshops or other activities that enhance the interaction between local actors and potentially increase the commitment to implement the results in the concrete policies. Finally, we hope that our article will stimulate more research and discussion regarding the flexible and robust tool for initiating and implementing S3 under the restraints of limited resources and time.

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