THAILAND: FUTURE OF INNOVATION

10th NIA สำนักงานนวัตกรรมแห่งชาติ

Innovation Foresight Institute

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Preface

Innovation has long been recognized as a driving engine for economic growth. After the global financial crisis, Thailand has turned the attention to the innovation-driven growth strategy, instead of the export-oriented growth strategy, and recently became an upper middle-income economy. According to the Tenth National Economic and Social Development Plan, covering the period of 2007-2011, the strategy was deployed nation-wide with the focus on economic development and competitiveness. Since adopting this strategy, the concept of innovation has evolved and been broadly adopted as a means of sustainable development.

During the last decade, the innovation landscape in Thailand has been transformed greatly due to a range of disruptions and transitions. The country is experiencing the transitions in demography, with an increase in life expectancy and a decrease in fertility. The growth of urbanization, which offers many opportunities, is introducing, on the other hand, a broad range of challenges in terms of economic and social development. Moreover, the population which was predominantly typified as having a majority rural and poor population has recently changed to the one that is almost equally balanced between urban and rural populations. All these create profound impacts on the country. In this regard, a range of new initiatives and a shift in the paradigm are required to prepare Thailand for a better future.

In response to those transitions, the National Innovation Agency (NIA), was introduced and piloted a range of programs, from area-based innovation to foresight application. In this report, the insights and experiences learned from the pilots were presented and shared for the better understanding of how Thailand strengthens the innovation system.

National Innovation Agency (NIA)
Ministry of Higher Education, Science, Research and Innovation of Thailand

The National Innovation Agency ("NIA") was initially established under Thailand's Ministry of Science and Technology on October 1, 2003. To further facilitate self-governance and flexibility of its operation, on September 2, 2009, NIA was restructured to a Public Organization, and was renamed as the National Innovation Agency (Public Organization), while remaining under the umbrella of the Ministry of Higher Education, Science, Research and Innovation.

Our Role

NIA is an innovation funding agency, which undertakes a broad-based and systematic approach in facilitating innovation development in Thailand, both in terms of making improvements and pioneering new initiatives.

We coordinate and work closely with the industries both at the policy and operational levels. We also promote innovation culture and strive to build up a national innovation system, with a broader aim to transform Thailand into an innovation-driven economy.

# Kluaynamthai Innovative Industries District (KiiD):

Past, Present, and Future of Kluaynamthai

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Past

For more than 5 decades, Kluaynamthai district has played a significant role in economic, social and cultural aspects. National conglomerates such as logistics (Port Authority of Thailand), the media (Channel 3), Science and Astronomy (Science Center for Education or Bangkok Planetarium) are located in this area. Thanks to these institutions, Kluaynamthai district has been recognized as an innovative area since then.

However, nowadays, the mode of production tends to change rapidly, that is to say from industrialization to customization. Innovative industries responding to the specific needs of diverse customers are being created more and more. Since they are replacing mass productions, the existing industries in this district hardly keep the attention of investors and property developers comparing with other districts in Bangkok. The big companies based in this area seem increasingly less popular because of the rapid change of economic, social, and technology. Since they are conglomerates, it is likely that they are having a hard time adapting themselves to these rapid changes. This situation may lead on to losing their competitive edge. Simply stated, their products are no longer the choice of consumers who look for innovations that fulfill their specific requirements. Their businesses are slow and falling into decline for this reason.
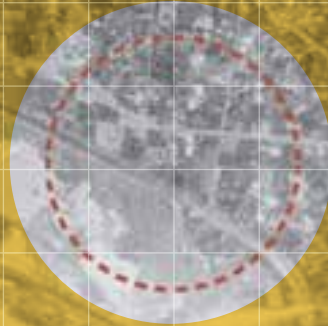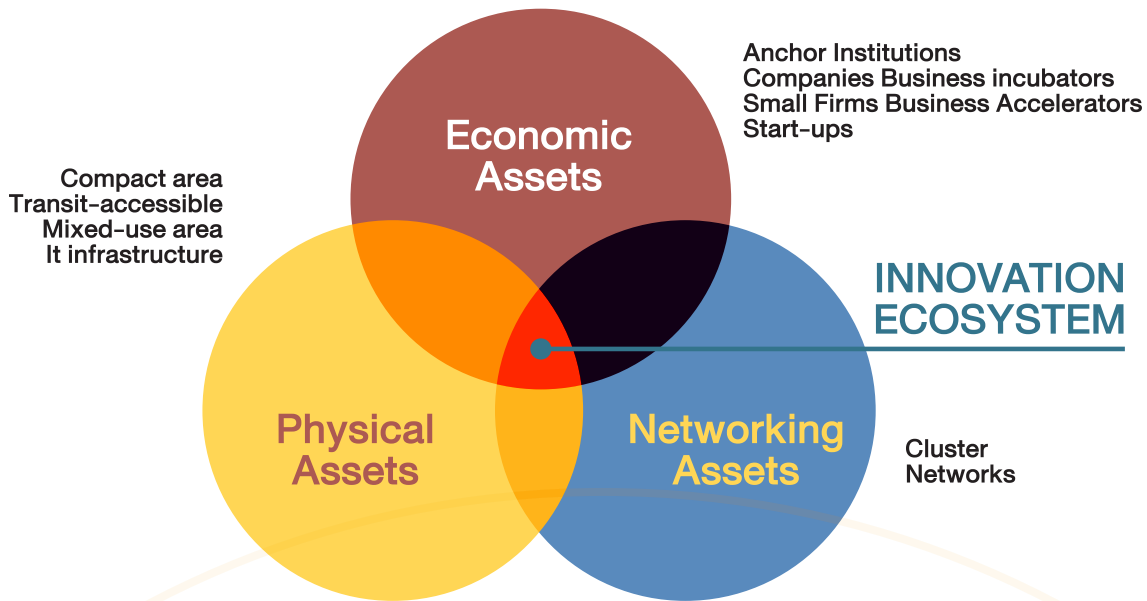
Present

The 12th National Economic and Social Development Plan, which aims to enhance start-ups' ability to make use of innovation and digital technology to create the value of products and services, was announced in 2017. Since then, the existing industries located in Kluaynamthai district, Bangkok, have been interested to develop themselves into innovation-based industries. Furthermore, in order to restore the district and make it an economic center again, the project "Kluaynamthai Innovative Industries District" or KiiD, was proposed. Such idea has been studied by School of Architecture, Bangkok University since then. Funded by the National Innovation Agency (NIA), KiiD was aimed at implementing the sustainable district development plan driven by innovations. The goals are 1) attracting start-ups to this area, 2) enhancing the quality of life, and 3) creating innovations. KiiD is recognized as a new engine of growth that will boost the country's economy with high-tech industries.

Such district development plan could enhance good quality of life without abandoning the district identity, existing skill, wisdom, local businesses, and communities. It is believed that it can lead to sustainable development in the long run.

Nevertheless, to achieve the aforementioned goals, an innovative ecosystem must be created as it will enhance new jobs and activities that support innovators' lifestyle that is active twenty-four seven. In order to achieve the goal of becoming an innovative district, four aspects of the ecosystem must be suitably prepared: 1) Work: Innovative Industries Workplace, 2) Live: Services and Support Areas, 3) Play: Park and Recreation Facilities, and 4) Learn: Learning and Skill Improvement Facilities. In the phase of the study, we, therefore, evaluated three existent assets of the innovative ecosystem: physical assets, economic assets, and network assets.

Economic Assets

Anchor Institutions
Companies Business incubators
Small Firms Business Accelerators
Start-ups

Compact area
Transit-accessible
Mixed-use area
It infrastructure

INNOVATION ECOSYSTEM

Physical Assets

Networking Assets

Cluster Networks

Picture02: Innovation Eco-system Framework

1 Physical assets

According to the digital platform of the district created during the 1st phase of study, we can see that there are statistical numbers and diversity of buildings, activities, the number of open and green spaces, including vacant lands and buildings. These informative data are very valuable for economic and environmental development. Also, it seems obvious that the diverse transportation system provided within/nearby this area can bring lots of people to the district easily and quickly. There are many modes of transportation, namely BTS Skytrain, MRT Subway, 3 Expressway gates, and many feeders. Moreover, not only does IT infrastructure wholly cover this area, ample recreation activities can enhance good quality of life as well. Due to a low cost of living, residences and offices in this area are affordable for young entrepreneurs who are starting their business.

2 Economic assets

An economic asset is highly significant as it can identify the area's identity and affect the potential businesses. Kluaynamthai district is a mixed-use area providing innovators with working, living, learning, and playing spaces. According to a survey, we found that 2,000 businesses consist of several national industries, e.g. logistics, petroleum, and media. Almost 1,700 companies are small and medium-sized enterprises. However, at the moment, there are a number of start-ups (1.72% of an entire business) conducting their business in this area. As the number of new businesses is increasing, we are taking on the challenge of developing this area into an innovative district. There are some other elements that can enhance economic activities such as Incubation Centers, Research and Knowledge Units, and Industry Transformation Center

3 Network assets

To execute the proposed district development plan, a collaboration with stakeholders in the district is required. The stakeholders should agree on a common goal and shared benefits plan which can lead to further collaborative activities in the future. Creating innovations in such activities can strengthen and boost economic value. KiiD project partners who have contributed their energy, ideas, and knowledge are comprised of Bangkok University and other research units, local industries network (e.g. logistics and media), the Industries Transformation Center, co-working and makerspace network and local communities. Each partner has a different role. For example, academic i nstitutions and research labs will incubate innovators and innovative ideas. The makerspace can support start-ups in producing the working prototypes for their products. The existing industries can provide business opportunities and boost such innovations.

All pieces of data on three assets are digitized and visualized as a map called KiiD's mapping. Additional data in a later stage will be stored on the District Data Warehouse established as the district database. The innovative ecosystem of these three assets as well as a digital database can help formulate a strategic plan and support accuracy of decision making on every further stage of the district development.

Picture03: KiiD digital mapping

Future

Kluaynamthai district is located on Rama 4 road. A number of huge real estate projects are working on their construction projects while many projects were completed successfully, e.g. One Bangkok, Samyan Mitrtown, FYI Center, K Village, and W District. Besides the said projects, there are another 2 projects proceeding in this innovative district amid Chulalongkorn University, Siam, and Pathumwan area. These developing projects leading to Rama 4 road will become a new economic center and innovative corridor of Bangkok. In addition, this route connects directly with other districts which are considered to be the high potential areas for innovative city: Bangkrachoa, Punnawithi, Nang Lerng, and Khlong San.
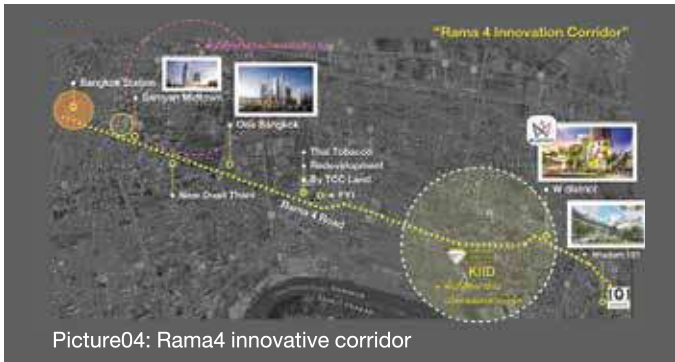
Picture04: Rama4 innovative corridor

To implement this future perspective, we should start with a small physical development like "innovative skywalk". This could be a pilot project connecting an innovation hub in Bangkok University with a makerspace in the Industry Transformation Center. The former takes a major role in the incubation area for start-ups while the latter takes a supportive role for innovators in creating their prototypes. The proposal to create a physical skywalk could link the innovators in the university to the prototype making area. Therefore, it is believed that this pilot project will help push an experimental innovation to a futuristic innovation in the industry.

Besides, in order to attract interest from investors and tourists, the initial plan of this development project was aimed at bringing high density area of economy, society, and tourism on Sukhumvit road together. An existing Skytrain and the proposed Skywalk system will attract more people to the Kluaynamthai Innovation Hub on Rama 4 Road. This new route will expand to a river bank which belongs to the Port Authority of Thailand. 1,600 Square Kilometers of such area will be a new economic zone. The facilities for the international conference, a highly automated port, and the high-class tourist attractions will be constructed in the future as planned. Moreover, this innovative route will be built across the Chao Phraya River to Bang Krachao which is known as Bangkok Green Lung. A new center for business development furnished with recreation activities/facilities would attract start-ups and investors who look for an affordable area.

Apart from such proposal for physical development, economic and networking activities should be executed as well. District committees representing each stakeholder in the network must be gathered together. They will cooperate to implement the district development plan. An awareness of Innovation district should be raised in order to communicate the concept of KiiD widely. Not only is the understanding of district's development developed into residents, but it also attracts start-ups who have an interest in the identity of this area. Furthermore, strengthening program for start-ups will be arranged to streamline the competitive ability of young entrepreneurs. Digital marketing, New media, and Online commerce are examples of topics to be included in such an incubation program.

However, the future of Kluaynamthai and the innovation city, Bangkok, cannot be proceeded by just any single organization. This development project requires considerable energy, creativity, knowledge, and collaboration among government agencies, educational institutions, existing industries, and local communities to make the change happen. We strongly believe that this project can drive Kluaynamthai into the Innovative Industries District, and lead Bangkok into the capital city of innovation.

Picture05: the skywalk connects the innovation hub to the maker space.

Upcoming Innovation Trends in Digital Agriculture, Agricultural Services and Novel Farming Businesses of Thailand

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Abstract

Agriculture is one of the most important foundations of Thailand's economy. One third of the labors are in the agricultural sector, and agricultural productivity contributes approximately 9% of Thailand's gross domestic production (GDP). To stay in a competitive position, both regional and global scales, Thailand's agricultural sector needs to embrace technological development and innovation to continuously improve productivity. This requires supports from both governmental and public organizations. Understanding the upcoming innovation trend is therefore necessary for such organizations in order to develop proper policy direction. This study analyzes various aspects of information regarding the situations of three groups of businesses related to the agricultural sector, namely, digital agriculture, agricultural service and novel farming. , The methodology for trend analysis was suggested by Amy Webb, in order to determine the upcoming innovation trends in Thailand. Results showed that automated agriculture, data

analysis by machine learning, artificial intelligence for image analysis, blockchain and digitizing aroma and taste will be the future trends in the digital agricultural business. To facilitate these trends, a national center of agricultural data should be established and more digital talents must be attracted to the country. A platform for the high speed delivery of agricultural products and food, automated food delivery, a platform foragricultural service on demand, agricultural chatbots and niche food and agricultural services will all be among the upcoming trends in the agricultural service business. Achieving these trends requires standardization of cyber security and open digital space for business trials. For novel farming business, six trends were determined, which are: big plant factories for economy of scale, plant factory for high-value herbs, closed-type indoor insect farms, urban farming, the harvesting of vegetables on demand and breeding of organisms for novel farming systems. These trends can be supported by establishing associations that will bridge the gap between researchers and investors. Overall, results from this study provide some insights regarding the future trends of digital agriculture, agricultural services and novel farming businesses in Thailand. They should be helpful for any governmental agencies, private companies and startups to develop policies for upcoming disruptive changes in the agricultural business landscape.

Innovation Trends   **Digital Agriculture**   **Agricultural Service**   **Novel Farming**

1. Introduction

Agriculture is among the backbones of Thailand's economy. Although agriculture contributed only 9% of the country's gross domestic product (GDP), as much as 32% of labor forces are in agricultural sector. Comparing to a neighborhood country like Vietnam, the efficiency of labors in Thailand's agricultural sector is lower (Ministry of Digital Economy and Society, 2017). This contradicts to the fact that density of agricultural machines in Thailand is ranked #36 of the world, higher than Vietnam (#39). It has been suggested Thailand's agricultural sector lacks information and communication technologies (ICT) (Chantapong and Dhebkham, 2018). Improving ICT involves utilization of data which must be transformed into digital form. Therefore, Thailand needs to build capacity for developing innovation in digital agriculture business to stay in the competitive position among other countries.

Disruptive technological changes are becoming a common theme as we are at the beginning phase of the fourth industrial revolution (Schwab 2018). Recently, new forms of farming technology, such as plant factory (Indoor Farming), insect farm and algae farm, have emerged and disrupted traditional agriculture. Most of these new farming technologies are characterized by a strict environmental control system which allows the grower to produce agricultural product at the highest quality regardless of climatic condition. These types of farming are collectively called "Novel Farming" (Agfunders, 2018). In Thailand, novel farming technologies have received a lot of attentions from local investors and governmental agencies. Many startup companies related to novel farming technology are established. National Science and Technology Development Agency (NSTDA) and Government Pharmaceutical Organization (GPO) have also recently invested in a prototype of novel farming system for medicinal plant production.

Innovation is the key to success in every business sector including agriculture. In Thailand, a number of governmental agencies, such as Agricultural Research Development Agency (ARDA), Thailand Research Fund (TRF) and NSTDA, provide supports for research and development of innovation in agricultural sector. Funding from the those agencies resulted in 457 patent applications in 2017. Notably, there are only 11 patent applications related to digital agriculture, agricultural service and novel farming businesses. Given the importance of the three business groups in agricultural sector nowadays, it is necessary and urgently to develop proper policies for stimulating more innovations from these areas of businesses. In this work, upcoming innovation trends in digital agriculture, agricultural service and novel farming, has been analyzed. We hope that the results from this work will benefit governmental agencies, private companies and startups in developing policies for supporting innovation and surviving in today's disruptive era.

2. Methodology

2.1 Trend Setting

The majority of data used in this study was from 2017 until March 2019. Protocol for trend setting are based on the book "The Signals are Talking: Why Today's Fringe is Tomorrow Mainstream" written by Amy Webb with some minor modifications (Webb 2016). The protocol consists of six steps. The first step, called "Fringe Finding", involves the survey for most recent data regarding the topics of interest which are digital agriculture, agricultural service and novel farming businesses to create a fringe sketch (a scratch page that list all the informationto get an overview of the current situation). This step explores new events, surprising results and something that never happen in topics of interest. Data from other businesses that might be indirectly related to the topics was also considered. Second step is to connect all the information together using the tools called CIPHER (C = Contradiction, I = Inflection, P = Practices, H = Hack, E = Extreme and R = Rarities). Data was analyzed into these six patterns and then the preliminary trends were proposed. Third step is called "ask the right question" where researchers pretend to disagree and ask question to refute the trends.

To avoid bias towards the results, a meeting was organized where all stakeholders from education sector, government sector, private sector, and the entrepreneurs related to the three business groups were invited and vote if they are agree with the proposed trend. There were 49 participants attended the meeting. The fourth step is to estimate when the proposed trends will arrive in Thailand according to the country's context. At this step, the participants of the meeting were asked about their opinions on the arrival of the trends that they agreed in the third step. if they were asked when they think this trend will arrive. There are were five choices which are, now (less than 1 year), short term (1–3 years), medium term (3–5 years), long term (more than 5 years) and cannot happen in Thailand. The fifth step is to create 4 different types of scenarios, namely, optimistic, pragmatic, pessimistic and catastrophic. After this step, strategies for supporting innovation according to the trends were proposed. Finally, the sixth step is to pressure test the trend strategies using a set of question called F.U.T.U.R.E (see detail in table 1).

Abbreviations	Full Words	Questions
F	**Foundation**	Do you have support from key stakeholder?
U	**Uniqueness**	Are the trend strategies unique?
T	**Track**	Can you track the outcome of the trend strategies?
U	**Urgent**	Is there a sense of urgency regarding the trend strategies?
R	**Recalibrate**	Can the proposed trend strategies evolve?
E	**Extensible**	How extensible is your trend strategies?

Table 1 Details of F.U.T.U.R.E question set

2.2 Focus Groups and Participants

This research applied Participatory Action Research: PAR to draw the stakeholders to play roles as the informants. The researchers managed focus group for participants to discuss and share their opinions. The first focus groups were organized on 25 October and 25 November of 2018. Thirty entrepreneurs and twenty stakeholders attended the first focus groups which divided into four groups. These focus groups intended to gather their comments and experiences on the situations of digital agriculture, agricultural service and novel farming businesses. Then discussion groups were organized on 4–5 April 2019 after the researchers collected the data and sat the trends. There were 29 entrepreneurs and 20 stakeholders attended. The objectives of these last two focus groups were to validate the data using reviews triangulation by let participants vote if they are agree with proposed trends and how long does it take for the trends to become mainstream in Thailand.

3. Results and Discussion

3.1 Digital Agriculture Business

Labor shortage in agricultural sector has long been a major problem in Thailand and all other developed countries. In England, a project called "Hands Free Hectare" explored the possibility of completely automated farm by using machines such as tractor, drone and harvester to cultivate cereal without any human intervene. The area of cultivation was surrounded by fences to prevent human entering. Humans only controlled the whole farm operations by using software. The project was successfully done even though the yield is a little below par. Interest in automated system for farm work is also high in Australia. Australian Centre for Field Robotics (ACFR) was established since 1999 and so far has successfully developed a number of farm robots. All of these imply that agricultural sector is approaching automated era.

In 2017, big players in agriculture industry make some similar moves. John Deere acquired Blue River Technology, a startup company possessing artificial intelligence image analysis technology for precision herbicide application. BASF acquired many parts of Bayer including the digital assets. One of these is Xarvio, the digital platform for supporting farming. In 2018, Xarvio released a free application for identify weeds by image called Xarvio Scouting. Another big player, DowDupont acquired Granular, a startup company expert in management software for agriculture. The main purpose of this acquisition is to have Granular team improve the satellite image analytic system owned by the company. Therefore, it is obvious that image analysis technology will be a major trend in digital agriculture business. This trend will be s upported by the progress of artificial intelligence technology which enhances the potentiality of image analysis software.

Food fraud causes damage in global food industry for approximately 30–40 billion dollars every year (Bindt, 2016). In Thailand, it has been reported that 50% of vegetable labeled "Organic Thailand" sampling from supermarket contain pesticide residues (ThaiPAN 2019). This raises concerns among consumer regarding the food safety. Many companies exhibit interest in use of blockchain technology for improving consumer trust on food. Blockchain is a data storage technology which can protect data from unauthorized modification. It is therefore suitable for storing information in food supply chain. IBM is a first mover in this area. In late 2018, the first commercial platform for storing information on food supply chain that utilizes blockchain technology, IBM Food Trust, was launched. Walmart, a big retailer company in USA, announced that lettuce producer who wants to sell in Walmart will be soon required to use IBM Food Trust. It is therefore conceivable that blockchain might become a standard requirement for food industry in the future.

Standardization of aroma and taste is always a challenging issue in food and agriculture industries. Given the qualitative nature of aroma and taste data, it is very difficult to establish a reliable standard for both characteristics without transforming data into digital and measurable forms. Indeed, sophisticated machines, such as gas chromatography and high pressure liquid chromatography, can analyze the constituents of food and agricultural produces and transformed the data into digital form. But these machines are expensive and require well-trained technician for operating and maintenance. A few startup companies proposed more business viable solutions for digitizing aroma and taste data. In 2018, Aromyx, a startup company from Silicon Valley, released "EssenceChip", a small plate containing numerous aroma sensing molecules. EssenceChip can be placed at the sample to collect the data and then inserted into the plate reader machine where the aroma data can be transformed into digital form. This technology seems to be favored among investors as it won the first prize for startup technology competition in World Agri-Tech Innovation Summit 2019.

No.	Trends	Percentage of Agreement	Estimated Trend Arrival (years)
1	Automated Agriculture	100%	1–3
2	Data and Image Analysis by Artificial Intelligence	100%	1–3
3	Blockchain for Agriculture	100%	1–3
4	Digitizing Smell and Taste	93.7%	>5

Table 1 Trend summary in digital agriculture business (n = 49)

3.2 Agricultural Service Business

Euromonitor International has reported 2019 consumer trends, one of which called "I want it now!" (Angus and Westbrook 2019). This trend describes the behavior of consumer nowadays where everyone has a busy life and whenever they want some services, they need them instantly. Startup companies related to food and agricultural produces delivery service understand this trend and set the goal to execute the delivery as soon as possible. For example, Miss Fresh E-Commerce, an online grocery delivery company in China, currently delivers foods to buyer within 2 hours after ordering. The company is currently strengthening its supply chain system and aims to execute the delivery within half an hour in the future (Zhou, 2017).

Shortage of labor in service work sector stimulates the development of automated delivery system. There are startup companies that have been developing and testing robot for delivering food for a few years already. One of them is Kiwi Campus which develops Kiwibot, an automated robot for last mile food delivery. Kiwibot has been delivering food in Berkley California since 2017. A big retailer company like Amazon is also soon to start automated drone delivery service in less than a year (Vincent and Gartenberg, 2019). In Thailand, True Corporation has successfully developed robot for coffee delivery in coffee shop.

Smallholder farmers always struggle to get access to agricultural machineries due to the high cost and low availability of the machine in certain period of growing season. The concept of sharing economy can solve this problem. Most of agricultural machineries are used for only a short period of time giving opportunity to the owner for lending the machine to serve others. A startup company in Denmark develops an online platform "FarmBackup" where those who own the machines can meet with those want to use the machines. In Thailand, there is a mobile application "Talad" which also used the concept of sharing economy to allow farmers access to agricultural services on demand without having to own any machine.

Chatbot technology is commonly used across many industries. It safes the labor works and allow fast conversation response to satisfy customers. In agricultural sector, chatbot is being used in the same way. WeGrow, a startup company in cannabis industry, has developed chatbot for assisting cannabis cultivation such as selecting equipment, growing techniques and solving problems. Customers feel like they are talking with personnel assistance. WeGrow's chatbot also features artificial intelligence which continuously improves customer experience. The idea of using chatbot in the same aspect has been receiving attention by stakeholders in agricultural sector of countries such as India, Brazil and Kenya.

Consumer's behavior is increasingly diversified due to the accessibility to news and information related various topics such as health, animal welfare and scandal. This led to niche consumer markets such as vegan, vegetarian and locavore (those who preferred eating local food). Vegan restaurants exist globally and size of vegan population is dramatically increasing every year. In Thailand, there is a great chance for vegan market to grow as Thailand has been ranked #3 for a friendly destination of vegan in Asia in 2016 by PETA Asia. Medical cannabis is another emerging niche market in Thailand. Legalization of cannabis use for medicinal purpose supports the developing of cannabis industry. All these different niche markets have specific regulations and requirements. It is therefore expected that niche food and agricultural service will become a major trend in a few years.

No.	Trends	Percentage of Agreement	Estimated Trend Arrival (years)
1	Online Platform for Selling and High Speed Delivery of Agricultural Products and Foods	97.9	1–3
2	Automated Food Delivery	80.9	>5
3	Online Platform for Agricultural Service on Demand	100	1–3
4	Agricultural Chatbot	93.6	1–3
5	Niche Food and Agricultural Services	100	1–3

Table 2 Trend summary in agricultural service business (n = 49)

3.3. Novel Farming Business

Plant factory is defined as a closed system for plant cultivation in which the environmental factors inside are tightly controlled. In 2017, Plenty Inc, a plant factory startup company, raised 200 million USD, a highest amount of money ever raised in farm technology startup. Plenty Inc plans to build 200,000 square feet of plant factory in Abu Dhabi. Another big deal in occurred between FreshBox Farm and Emirates Flight Catering where both companies agree to form a joint venture in order to build a largest plant factory in Dubai, United Arab Emirates. It seems that all the startup companies in this area are going towards the huge farm size to benefit from economy of scale.

Insect consumption is gaining acceptance from a wide range of consumers. Many insect farm startup companies produce insect for both human and animal consumptions. US and Canadian governmental agencies have officially approved the use of insect as a constituent of feed for aquaculture. Big insect farm companies utilize closed system with advanced technologies for controlling environments to meet the regulations. In contrast, most of insect farms in Thailand use semi-closed system which can be affected by adverse climatic condition. This could become an obstacle for maintaining quality of insect in the future. Although the cost for establishing a closed system is high, in long-term, it will sustainably eliminate the risk.

Urban farming has an advantage on shortening the transportation process and allow consumer to have fresher produce than traditional farm which is normally located in rural area. Additional benefits of urban farming include reduction of pollution from transportation and promoting interaction among individuals in a community. Urban farming can be done in places such as left-over space between buildings, rooftop and temporarily empty rooms. Furniture companies, such as IKEA, start offering furniture that can be used for growing plants. All the big cities, such as Tokyo, Hong Kong and San Francisco, have organizations supporting urban farming.

A number of companies, such as Farmers Cut, Infarm and B-Spouts, are using "harvest on demand" strategy for selling vegetables. This involves delivering living vegetable to the customers allowing them to decide when to harvest. An obvious benefit of fresh harvested vegetables is that the nutrients and vitamins will be fully preserved. However, this business model still needs to be proved if it is commercially sustainable.

Plants cultivars currently available in the market are bred for traditional farming conditions. It has been proposed that there should be a breeding program for creating plant cultivars that are suitable and produce high-yield under novel farming conditions. For example, commercial plant factory system usually has limited height. Therefore, the breeding program can aim to reduce plant height while maintaining a high yield character. There should also be breeding programs for other organisms involving novel farming system, such as insect, algae and mushroom.

Production of herbal plants in plant factory has recently received significant attention from governmental agencies in Thailand. This trend is supported by legalization of cannabis for medicinal use. Moreover, a number of researches related to production of high-valued substances from herbal plants grown inside plant factory condition have been reported. For example, a group of researchers in Japan reported a strategy for increasing amounts of precursor substances for cancer treatment drug in vinca by optimizing red light intensity (Fukuyama et al., 2015). This suggests the possibility of using plant factory for production of high-valued herbal compounds.

No.	Trends	Percentage of Agreement	Estimated Trend Arrival (years)
1	Online Platform for Selling and High Speed Delivery of Agricultural Products and Foods	97.9	1–3
2	Automated Food Delivery	80.9	>5
3	Online Platform for Agricultural Service on Demand	100	1–3
4	Agricultural Chatbot	93.6	1–3
5	Niche Food and Agricultural Services	100	1–3

Table 3 Trend summary in novel farming business (n = 49)

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Socio-economic Aspect of City Innovation Index

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The development of the alternative innovative city index

As most innovation indexes involve a focus on the national level, one of their limitations is that cannot accurately reflect or account for area-based innovation. Thus, such indexes might not be able to stimulate innovations that are more relevant in specific areas than they are at the national level. By considering existing innovative city indexes that have been developed in Western context, they can fill gap in national innovation indexes, but unfortunately they pay particular attention only to boosting the urban economy. Thus, it was necessary to create a different index that is more sensitive to the context of the Global South, where society is un-just, unsustainable and fragmented. This was an entry point for the National Innovation Agen-cy, Thailand, in collaboration with the Chiang Mai University School of Public Policy, to cre-ate new innovative city index that aimed to stimulate inclusive, sustainable and connected innovative city development.

The aim of the Innovative City Index for Stimulating Inclusive, Sustainable and Connected City Development is to motivate key stakeholders in the city to collaboratively enhance innovation ecosystem in cities that facilitate inclusive, sustainable and connected growth. The main expectation is that, after the city is able to reflect on the measurement, it would be able to understand its strengths and its pain points and be able to better balance economic growth and socio-cultural and ecological values using innovations.

At its heart, this index is influenced by two key concepts: the 'Innovation Ecosystem' and the 'UN's Sustainable Development Goals (SDGs)'. With regards to the former, this in-dex sees innovation much like a tree that could grow in the context of a supportive ecosys-tem (Mercan and GÖktaŞ 2011; Mulas, Minges and Applebaum 2015). According to this view-point, it isn't the national level that provides this ecosystem, as it is too big to be able to in-clude innovators operating in small pockets within society, particularly those operating at its margins. Unfortunately, support at the national scale in the context of the Global South also tends to open a window of opportunity for large corporations, who are economically and polit-ically connected to policy makers and politicians and are able to seize or even monopolize such opportunities for innovation. Thus, as Katz and Wagner (2014) argue, the normative as-sumption of this index is that fertilised ecosystems is only possible at the smaller scale: i.e. in cities or districts.

To dig deeper into what a good innovation ecosystem should look like, this index de-velopment starts from a review of existing innovative city indexes namely CITIE, developed in the UK by Nesta, Accenture and the Future Cities Catapult, the Innovation Cities™ Index, proposed by 2thinknow, Boosting Tech Innovation Ecosystems in Cities, proposed by the World Bank, and the Innovation Districts, initiated by the Brookings Institution. We synthesized these indexes and found that they share common features about the determinants of innova-tion ecosystems. Our index proposes that there are three synthesized factors that determine good innovation ecosystems. They are: (1) policy and governance; (2) infrastructure and economic assets; and (3) human capital and knowledge. Thus, the role of public, private and educational sectors are all considered, whereas citizens (including start-ups, small and medium enterprises (SMEs), social and green enterprises), communities and active civil soci-ety organizations are positioned as trees that should be supported and empowered by an ecosystem if they are able to become bright future innovators.

The latter concept; SDGs, is particularly important in this index. The SDG no.11 ad-vocates for sustainable cities and communities and prioritises inclusiveness, sustainability and connectedness, which are not adequately perceived by all the aforementioned indexes. In our view, the real contribution of the SDGs is that they reinterpret the notion of sustainable development to go beyond only environmental concerns to also include a focus on social jus-tice, economic equal distribution, political and cultural recognition, the parity of participation, and the connections between these various aspects (Bouckaert, Chawdhry, Fraser-Moleketi, Meuleman, and Pizani 2018; Albrechts and Seymour 2005; World Bank 2018). To articulate SDGs in this index, thus, helps us to achieve a balanced and interactive innovation ecosys-tem that simultaneously prioritises the inclusive, sustainable and connected values underpin-ning innovation.

In this vein, innovation is conceptualized here not only in terms of a new product or service, but also in terms of a new process, especially for coping with old problems and con-straints, as inspired by Humphrey and Skvirskaja (2015), Katz and Wagner (2014), and Mulas, Minges and Applebaum (2015). Also, in this conceptualization, innovation identified using this index can be commercial, social and green. Thus, it isn't just start-ups and SMEs that can be counted as innovators, but also social enterprises, green enterprises, communities or even civil society organizations. What matters is if they could help drive inclusive, sustainable and connected innovation in a particular city.

Basic information on the index

The index has four general features. Firstly, this index compounds with indicators determining (1) the default of capable ecosystem to be an innovative city and those determining the fertile ecosystem that creates the possibilities for being more (2) inclusive, (3) sustainable and (4) connected innovative city. The proportion of these indicators is set equally amongst four di-mensions (36 indicators in total are divided into 9 indicators per each). The aim is to guide the development of an innovative city in a way that is inclusive, sustainable and connected.

Secondly, this index is derived from a synthesis of existing international city innova-tion related indexes and asking how they fit in the context of the Global South. To sum up, the framework we developed assumes that the ecosystem that supports innovative development in a city should be comprised of three key factors: (1) policy and governance, (2) infrastructure and economic assets, and (3) knowledge and human capital. These three factors would, in turn, require support from the public, private and educational sectors. The details of the 36 indicators are provided in table 1.
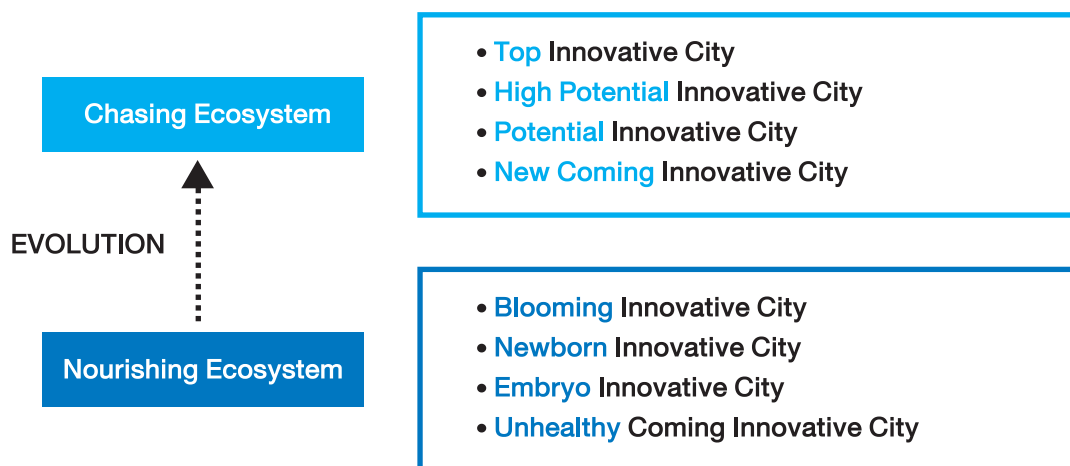
Table 1 A summary of the 36 indicators

|	Policy & Governance	Infrastructures & Economic assets	Knowledge & Human capital
For the default of being an innovative city	The public sector (including central, regional and local gov–ernments as well as public en–terprises and other public or–ganizations) aim to promote the city as an innovation hub	The ease of production, doing pilot testify, doing business, and finding knowledge work–force	The role of educational institutions in providing knowledge or information that is useful to the development of an innovation
	The support of innovative enterprises by the public sector	Existing spaces for learning and exchanging	The role of educational institutions in providing training courses related to innovation development for enterprises
	The partnerships amongst the public–private–education sectors motivating innovation development	Opportunities for innovative enterprises created by the private sector	The role of educational institutions in working with enterprises as a mentor
For an innovative city that is inclusive	The support to social enterprises in developing social innovation by the public sector	The support to social enterprises in developing social innovation by the private sector	The support to social enterprises in developing social innovation in educational institutions
	The support to civil society organizations in developing social innovation by the public sector	The support to civil society organizations in developing social innovation by the private sector	The support to civil society organizations in developing social innovation by educational institutions
	The support to communities (e.g. community enterprises, elderly groups, youth groups and voluntary groups within a community) in developing so–cial innovation by the public sector	The support to communities (e.g. community enterprises, elderly groups, youth clubs, voluntary groups within a community, and so on) in developing social innovation by the private sector	The support to communities (e.g. community enterprises, elderly groups, youth clubs, voluntary groups within a community and so on.) in developing social innovation by educational institutions
For an innovative city that is sustainable	To support innovation development by the public sector that does not make or reduces a negative impact to environment, health and social wellbeing in general	To support innovation development by the private sector that does not make or reduces negative impact on the environment, health and social wellbeing in general	To support innovation development by educational institutions that does not make or reduces a negative impacts to the environment, health and social wellbeing in general
	To support innovation development by the public sector that is not a one short, but rather thinks about long–term out–comes	To support innovation development by the private sector that is not a one–time arrange–ment, but rather thinks about long–term outcomes	To support innovation development by educational institutions that is not a one–time arrangement, but rather thinks about long–term out–comes
	To support innovation development by the public sector that concerns the balance between conservation of local wisdoms, identities and resources and resilience to current changes	To support innovation development by the private sector that concerns the balance between conservation of local wisdom, identities and resources, and the resilience to current changes	To support innovation development by the education institutions that concerns the balance between conservation of local wisdom, identities and resources, and the resilience to current changes
For innovative city that is connected	The provision of free Wi–Fi in the public spaces by the public sector	The variety of transportation systems within the city and their efficient links to outside	The building of networks between educational institutions in the city and those from outside for the co–creation of the innovation that benefits the city
	Useful data sharing and two way communicative platforms proposed by public agencies that are outstanding in promoting innovation development	Data sharing by private organizations that are useful for innovation development, and the provision of efficient broadband internet	Useful data sharing and two way communicative platforms proposed by the educational institutions that are outstanding in promoting innovation development
	The support for exchanging and learning amongst innovators by the public sector	The emergence of business networks that support innova–tors in the city	The support for exchanging and learning amongst innovators by educational institutions

Thirdly, each indicator has its score at 6 and that can be calculated the final and total score at 216. The score is not designed to indicate either pass or fail, but instead it helps check the readiness of the city and helps to stimulate self–improvement. All in all, the result of the measurement can be classified into 8 labels of evolution: 'unhealthy' (1 – 27), 'embryo' (28 – 54), 'newborn' (55 – 81), 'blooming' (82 – 108), 'new coming' (109 – 135), 'potential' (136 – 162), 'high potential' (163 – 189), and 'top' (190 – 216). In line with these metaphors, the first four labels are called the 'nourishing ecosystem', meaning that the city still needs to focus on its inner development. The higher scores are classified as a 'chasing ecosystem', meaning that the city is ready to open itself to the world as a competitive, innovative city. More detail can be found in figure 1.

Figure 1 Labels of measurement that reflect the readiness of the city and stimulate self–improvement

Chasing Ecosystem

- **Top** Innovative City
- **High Potential** Innovative City
- **Potential** Innovative City
- **New Coming** Innovative City

EVOLUTION

Nourishing Ecosystem

- **Blooming** Innovative City
- **Newborn** Innovative City
- **Embryo** Innovative City
- **Unhealthy** Coming Innovative City

Lastly, this index can also help us to understand whether existing innovation ecosys–tems are inclusive, sustainable, or connected, as shown in figure 2. The score of each specif–ic evaluation can also be classified into 8 stages, as per the above figure.

Figure 2 The possible results of the measurement of each particular dimension

Top "Inclusive" Innovative City

Top "Sustainable" Innovative City
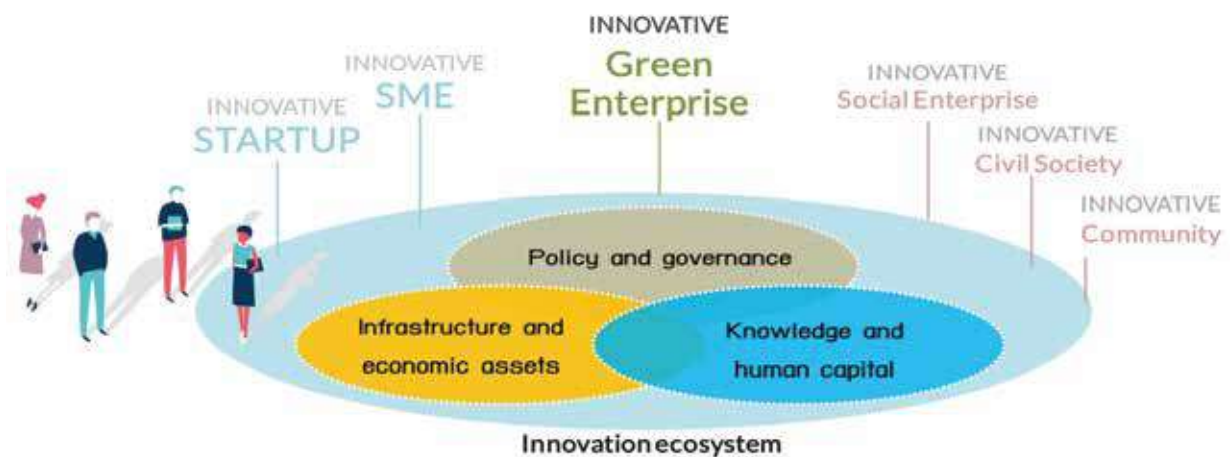
Top "Connected" Innovative City
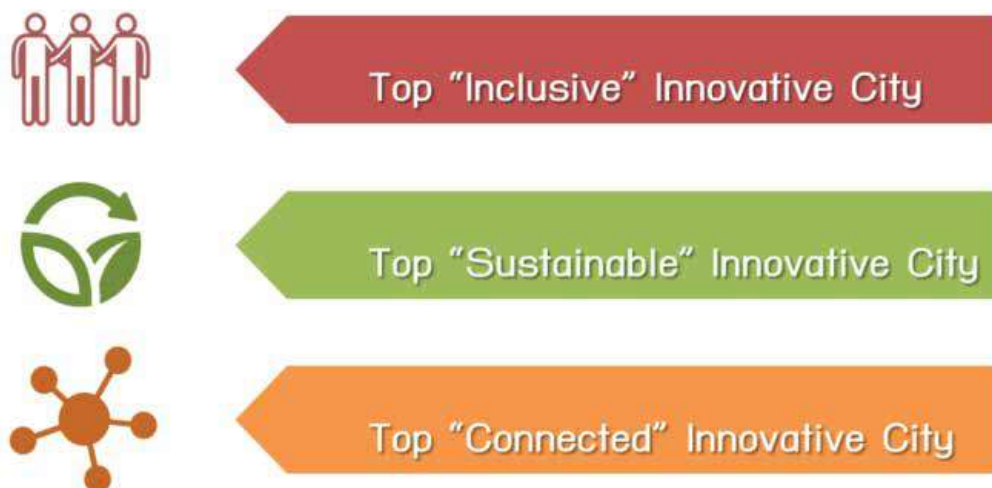
The definitions of the index framework

The term *"innovative city"* in this index refers to a city that can create an ecosystem that is friendly and which supports the development of innovation, whether in the form of a product, service or new process (as a new way to cope with old problems). The term "innovative city that is inclusive" refers to a city whose ecosystem is fertile for growth, not just for startups and SMEs, but also social enterprises, civil society organizations and communities as agents for social innovation.

The term *"innovative city that is sustainable"* is used in this index to refer to a city whose ecosystem can support green enterprises to develop innovation that is friendly to the environment, people's health and society as a whole. Support for innovation development in this sense also includes attempts to foster long-term outcomes and balancing concern with the conservation of local wisdoms, resources and identities and fostering resilience to current changes. Figure 3 seeks to capture all of these various dimensions.

### Figure 3 An innovative city that is inclusive and sustainable

The term "innovative city that is connected" refers to a city whose ecosystem is fertile for innovative development and which prioritises the connectedness of data, physical boundaries and innovators (by creating spaces for exchange, learning and networking).

The application of the index in Chiang Mai as a pilot city

A key consideration when we were developing our data collection instrument was that we must bridge the divide between quantitative and qualitative data to make this index lively, meaningful, encourage, and insight as shown in the figure 4. As a consequence, we relied upon questionnaires and structured interviews with a range of stakeholders. We also compiled checklists that would structure the data collection and relied on online channels and participa-tory observation. With regards to the interview, we realized that some issues could not be ad-dressed by just one informant, so we also included the focus group method to gather such aggregated data/information. To make this index user friendly, we classified data and

information into two different types including "number" and "lessons" influenced by the approach called "reflexive indicator culture" of Bhuta, Malito, and Umbach (2018). For the number, it de-rives from either primary statistical analysis or secondary statistics collected and analyzed by trustable agencies, while the lessons are taken from stories from the grounds which we call them as the "city diamond" or "city pride" to make a sense that their quality would be well-recognized.

Figure 4 Key principle for designing the index
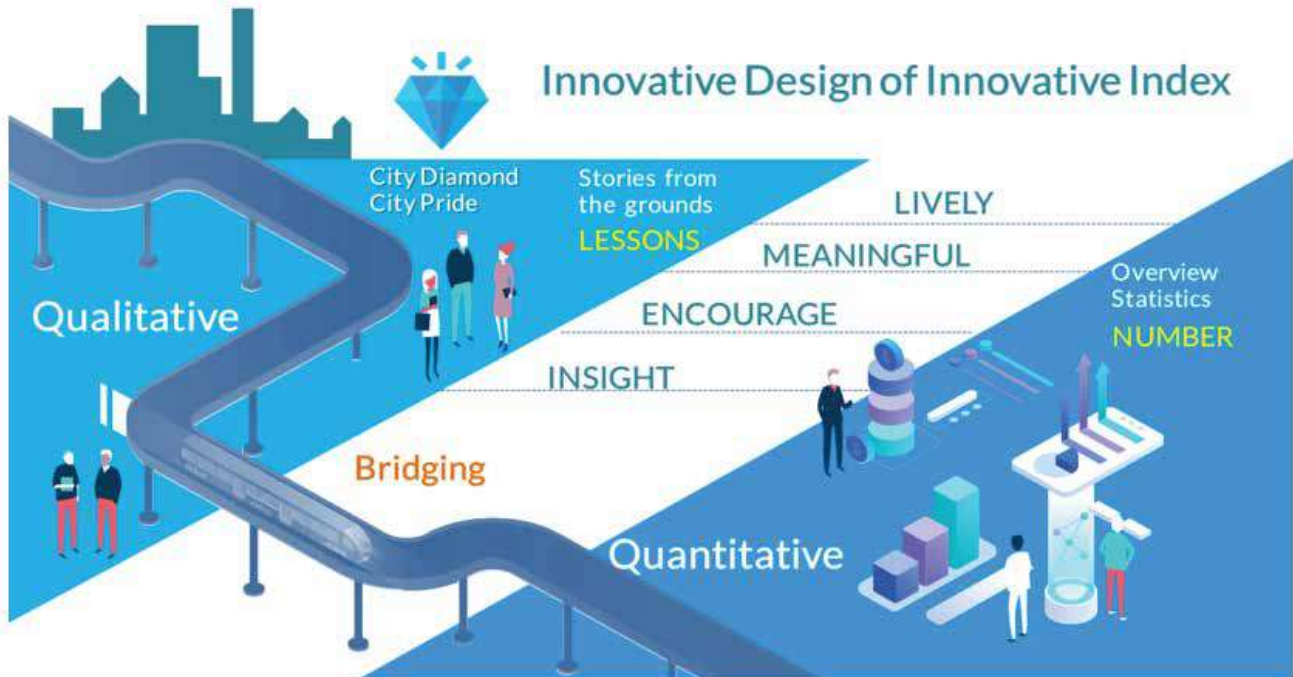
To test the index, we applied it to the real-world context. We used Chiang Mai, located in the north of Thailand, as a pilot study. It is a well-known city in South East Asia and a vi-brant place for startups, new SMEs, social and green enterprises, and civil society organiza-tions initiate new projects here. Like many other metropolitan cities, Chiang Mai is cosmopoli-tan and home to people from all over the world, including a large number of digital nomads. There are also plenty of co-working spaces here, which serve as playgrounds for innovators. However, the city is unlike most cities in the Global North in so much as it located in a country where the issue of inequalities is ranked as the number one of the world based on Credit Suisse Global Wealth Report in 2018 (considering gaps between the rich and the poor). Thus, innovation development here faces particular challenges, which are shared by most cities in the Global South.

The outcomes of the application of the index in Chiang Mai

The outcomes of the measurement show that Chiang Mai can be classified as a "Potential Innovative City", as its score is 145 (out of a total of 216), which can be translated into a score of 67.13 out of 100. The evaluation, thus, indicates that this city is, to some extent, ready to welcome innovators and is open to the new movement of innovation development. To con-sider each dimension, the city can be said to have "High Potential" for its well-established de-fault (to meet the basic standards of being good innovative city with a score of 45/54, or 88.33/100) and for its connectedness (score at 46/54 or 85.18/100). However,

Chiang Mai can only be said to be "New Coming" for its sustainability of innovation development (as score is dropped at 40/54, or 74.07/100), and it is merely a "Newborn" city when it comes to inclusive-ness, as its score is low (at only 14/54, or 25.93/100).

Figure 5 The outcomes of the application of the index in the case of Chiang Mai
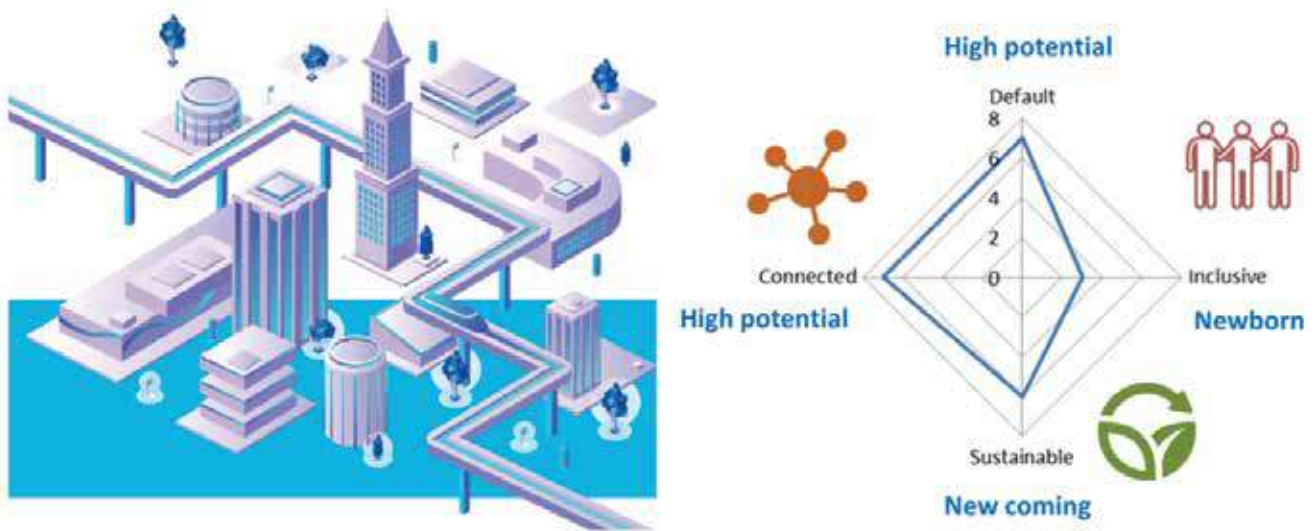
From the above, it can be seen that this index can reflect both an overview outcome and the particular ones. This is useful in allowing the city's key stakeholders to think ahead about what strengths they have and what weaknesses or challenges that they still need to cope with in pursuit of a better future. By recognizing inclusive, sustainable and connected dimensions of innovation development capacity, the outcomes could guide the city on issues that are usually ignored so that it can enhance them and improve its score in the next round of evaluations.

Conclusion

The development of this alternative innovative city index is an attempt to pave a way towards the re-interpretation of an innovation, a city and an index. This index is developed by keeping in mind that its reflections should be able to encourage cities to stimulate innovation that pays particular attention to inclusiveness, sustainability and connectivity. In doing so, the city needs to enhance its innovation ecosystems by focusing on both quantitative and qualitative com-ponents, i.e. both number and lessons.

The main implication of this index is how social outcomes should be more focused on by city governors, policy makers or other authorities. The index itself cannot change policy and administrative cultures that tend to focus more on the impacts of an innovation on eco-nomic growth. At the very least, it would help if strategic or scenario planning is made to ad-dress weaknesses of the city reflected from the index especially in the dimensions of inclu-siveness and sustainability.

Thailand's Directions for Social Innovation

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Abstract

At present, Thailand is gearing toward all sectorial reforms i.e. economic, social, environmental, politics, telecommunications, energy, agriculture, health and education. Thailand's developmental framework is based on the 20-Year National Strategy (2017 – 2036), the National Economic and Social Development Plan, and the Sufficiency Economy Philosophy. In addition, Sustainable Development Goals (SDGs) must be considered in order to achieve the sustainable reform of the country. Through social innovation, the people can enable business network, enhance product value, increase production, support basic infrastructure, and foster workforce. This work presents the analysis to determine the social innovation factors and specific directions priorities for Thailand in 9 social sectors: 1) Environmental Stewardship, 2) Food, Water and Energy Nexus, 3) Government & Education, 4) Finance, Employment & Social Welfare, 5) Sustainable Agriculture, 6) Urbanization, 7) Healthy Futures, 8) Tourism & Culture, and 9) Disaster Services. Documentation

studies from the policies of Thai ministries, research agencies, governmental organizations and international agencies were performed. The documentation studies for social innovation appropriate for Thailand context revealed that there are strong correlations in the area of "Environmental Stewardship" and "Government & Education". This indicated that Thailand and the global population realized the importance of human capital and the developments should have environmental conservation in mind. The results from the documentation studies were then further discussed and analyzed by national and international experts from academia, research agencies, government and private sectors to determine the social innovation direction that benefit the Thai context for 2019–2021 as well as support the SDGs. The results revealed 50 social innovation directions for the 9 social sectors. These directions were then analyzed and prioritized based on the 40 national and internal experts through a series of interviews and focused group discussion activities. The first priority direction each of the 9 social sectors are 1) Municipal Solid Waste; 2) Self–dependent in energy for the community; 3) Public Service Innovation; 4) Micro Financing for Social Enterprise; 5) Organic Food, 6) Smart City Vision; 7) Aging Society & Community; 8) Sustainable community and cultural–based tourism; and 9) Flood Management, respectively.

Social Innovation, Policy Direction, SDGs

Introduction

Currently, Thailand has been reforming all sectors such as economic, social, environmental, politics, telecommunications, energy, agriculture, health and education. The ultimate goal is for developing Thailand to achieve the slogan of "Stability, Prosperity, and Sustainability" according to the Thailand 4.0 direction. Thailand's developmental framework is also based on the 20–Year National Strategy (2017–2036), the 12th National Economic and Social Development Plan, and the Sufficiency Economy Philosophy. In addition, the strategic reform directions will have to be consistent with the Sustainable Development Goals (SDGs) to keep up with the changing world situation. In this competitive era, the challenge is in facilitating the country development through the "Extension of Technology and Innovation to the People". Through social innovation, the people can enable business network, enhance product value, increase production, support basic infrastructure, and foster workforce. The main objective of this research is to determine specific directions and topics to support Social Innovation for Thailand and the local Thai society aligning with the direction of Sustainable Development Goals. The aim is to equally improve the quality of life for the people in the 9 Social Sectors: 1) Environmental Stewardship, 2) Food, Water and Energy Nexus, 3) Government & Education, 4) Finance, Employment & Social Welfare, 5) Sustainable Agriculture, 6) Urbanization, 7) Healthy Futures, 8) Tourism & Culture, and 9) Disaster Services. The 9 social sectors are defined by Thailand National Innovation Agency (NIA). NIA is the leader in fostering innovation for Thailand's national development. NIA has launched the Social Innovation Platform from 2017–2020 where each year NIA will champion Social Innovation as follows: 2017 – The Year of Social Innovation Platform Establishment; 2018 – The Year of Supporting Innovation by Social Issue–based; 2019 – The Year of Social Innovation Deployment; and 2020 – The Year of Social Innovation Leadership. From this research, the recommendation for the social innovation direction will be applied to the NIA Social Innovation Platform.

Document Analysis
- Focused on 9 Social Sectors
- Thailand Ministries
- 12th National Economic and Social Development Plan
- Research Agencies
- SDGs

National Workshop Focus Group
- Narrow down topics
- Direction Ranking
- Topic Ranking
- Propose Support Mechanism

International Workshop Focus Group
- Social innovation directions and ranking on each topic to support the SDGs for Thailand
- Supporting mechanisms for the social innovation project development and deployment

**Figure 1: Research Framework for the Analysis
of Social Innovation Direction for Thailand**

Figure 1 displayed the research framework for the analysis of the Social Innovation Direction for Thailand. The research methodology was divided into 3 parts. Part 1 is the document analysis of policies from the Thailand Ministries, the 12th National Economic and Social Development Plan, Thailand Research Agencies and the SDGs. From the document analysis, Social Innovation Topics/Directions relating to the 9 social sectors (1. Environmental Stewardship, 2. Food, Water and Energy Nexus, 3. Government & Education, 4. Finance, Employment & Social Welfare, 5. Sustainable Agriculture, 6. Urbanization, 7. Healthy Futures, 8. Tourism & Culture, and 9. Disaster Services) from each policies of the governmental agencies will be extracted, listed, tallied and grouped based on similar topics. The relationship between the policies of the Governmental Agencies and the 9 social sectors will be evaluated. In Part 2, numerous listed social innovation directions from the documentation studies will be narrowed down by the focus group. A national workshop was organized with the aim to narrow down the social innovation topics, topic/direction ranking, and proposed the supporting mechanism of the social innovation directions. Thirty Thai experts from disciplines relating to the 9 social sectors participated in the focus group activities at the national workshop. The experts were from government, academia, and private sectors. Then in Part 3, the international workshop was organized to determine the social innovation directions and ranking on each topic to support the SDGs for Thailand based on the international expert perspectives. In addition, the supporting mechanisms for the social innovation project development and deployment were analyzed. The participants of the international workshop were from international/regional agencies such as ASEAN secretariat, UNDP, GIZ, and USAID.

Results & Discussion

In this work, Thailand's Directions for Social Innovation to Support Sustainable Development Goals were determined from the documentation studies of the policies of Thailand Ministries, research agencies, governmental organizations and international agencies. Table 1 described the relationship between the topics from the policies of the governmental agencies and the 9 social sectors. Documents from 18 agencies were analyzed which were Ministry of Agriculture and Cooperatives, Ministry of Natural Resources and Environment, Ministry of Energy, Ministry of Education, Ministry of Culture, Ministry of Science and Technology, Ministry of Public Health, Ministry of Tourism and Sports, Ministry of Social Development and Human Security, Ministry of Information and Communication Technology, Ministry of Digital Economy and Society, Ministry of Commerce, Ministry of Labour, Ministry of Industry, The 12th National Economic and Social Development Plan (2017- 2021), National Science and Technology Development Agency (NSTDA), National Science Technology and Innovation Policy Office (STI) and Health Systems Research Institute (HSRI). In addition, Table 2 showed the relationship between the topics/direction relating to the 9 social sectors and the 17 Sustainable Development Goals. Then, the topic/directions relating to the 9 social sectors were plotted from the number of frequencies that were extracted from the documentation studies of the government agencies and SDGs (Figure 2). It was revealed that there are more correlations in the area of "Environmental Stewardship" and "Government & Education" at 22.58% and 14.52%, respectively. This indicated that Thailand and the global population realized the importance of human capital and the developments should have environmental conservation in mind.

Table 1: Relationship between 9 social sectors and the policies of Thailand Governmental Agencies

Relationship of 9 Social Sectors with Thailand Policy of Governmental Agencies	1. Environmental Stewardship	2. Food, Water and Energy Nexus	3. Government & Education	4. Finance, Employment & Social Welfare	5. Sustainable Agriculture	6. Urbanization	7. Healthy Futures	8. Tourism & Culture	9. Disaster Services
1. Ministry of Agriculture and Cooperatives	●		●		●	●			
2. Ministry of Natural Resources and Environment	●	●	●			●			●
3. Ministry of Energy	●	●	●						
4. Ministry of Education	●		●			●			
5. Ministry of Culture			●			●		●	
6. Ministry of Science and Technology	●	●	●		●	●			
7. Ministry of Public Health			●				●		
8. Ministry of Tourism and Sports								●	
9. Ministry of Social Development and Human Security			●	●					
10. Ministry of Information and Communication Technology			●	●					●
11. Ministry of Digital Economy and Society			●	●					●
12. Ministry of Commerce			●		●	●			
13. Ministry of Labour				●					
14. Ministry of Industry	●								
15. The 12th National Economic and Social Development Plan (2017– 2021)	●	●	●	●	●	●	●	●	●
16. National Science and Technology Development Agency (NSTDA)	●	●	●		●	●	●	●	
17. National Science Technology and Innovation Policy Office (STI)	●		●	●	●		●		●
18. Health Systems Research Institute (HSRI)							●		

Table 2: Relationship between 9 social sectors and the Sustainable Development Goals (SDGs)

Relationship of 9 Social Sector with Sustainable Development Goals	1. Environmental Stewardship	2. Food, Water and Energy Nexus	3. Government & Education	4. Finance, Employment & Social Welfare	5. Sustainable Agriculture	6. Urbanization	7. Healthy Futures	8. Tourism & Culture	9. Disaster Services
1. No Poverty			●	●					
2. Zero Hunger			●	●	●		●		
3. Good Health and Well Being	●		●	●			●		
4. Quality Education			●						
5. Gender Equality			●	●					
6. Clean Water and Sanitation	●	●					●		●
7. Affordable and Clean Energy	●	●							
8. Decent Work and Economic Growth				●				●	
9. Industry, Innovation and Infrastructure				●		●			
10. Reduced Inequality			●						
11. Sustainable Cities and Communities	●					●			●
12. Responsible Consumption and Production	●			●	●				
13. Climate Action	●	●					●		●
14. Life Below Water	●	●							●
15. Life on Land	●	●							●
16. Peace Justice and Strong Institution			●			●			
17. Partnerships for The Goals			●						
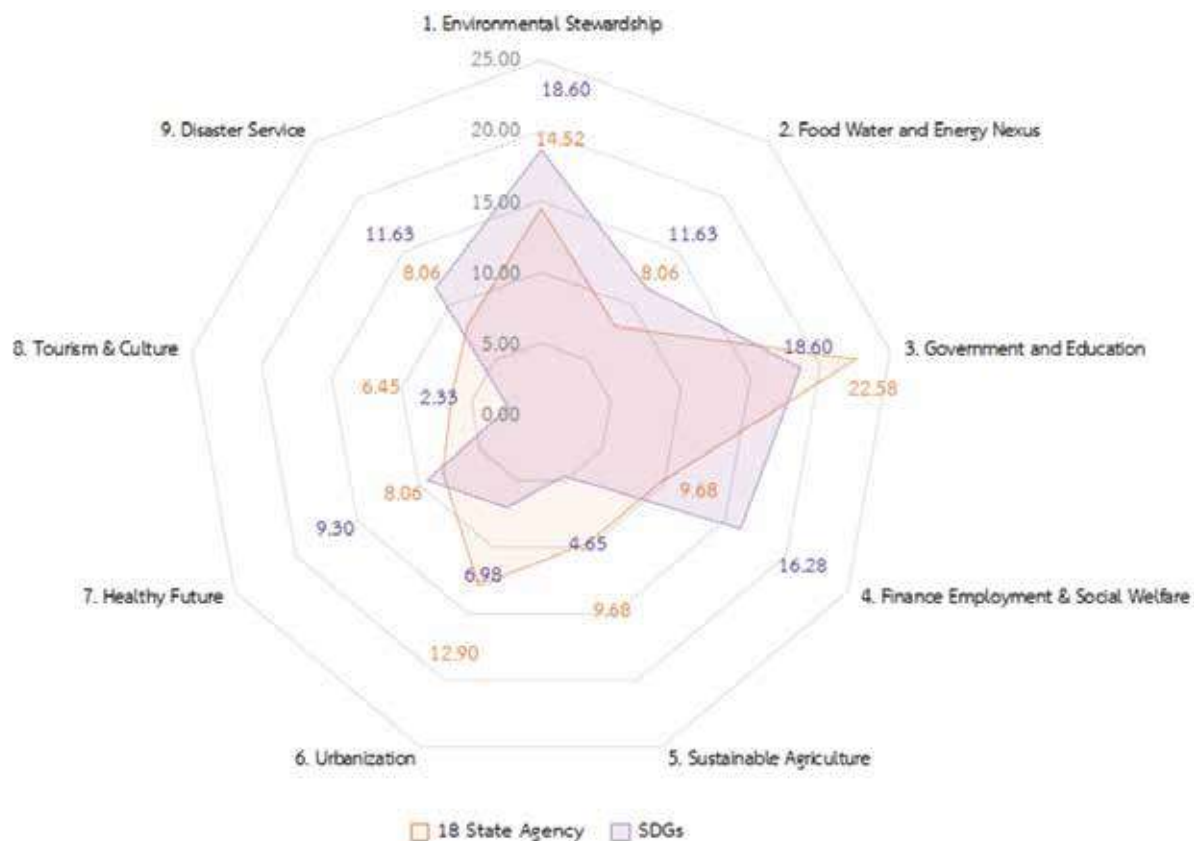
**Figure 2: Analysis of Social Innovation Directions of 9 Social Sectors
from Policy of Thailand Government Agencies
and Sustainable Development Goals**

The results from the documentation studies were discussed and analyzed in the "National Workshop on Thailand's Directions for Social Innovation to Support Sustainable Development Goals" which was held on June 22, 2018. The participants of the National Workshop were from academia, research agencies, government and private sectors. The goal was to narrow down the topics in 9 social sectors and determine the social innovation direction to benefit the Thai context for 2019–2021 as well as support the SDGs. The 30 national experts were separated into 3 groups where each group discussion directions from 3 social sectors. Group 1 focused on Environmental Stewardship; Food, Water and Energy Nexus; and Sustainable Agriculture. Group 2 focused on Government & Education; Urbanization; and Finance, Employment & Social Welfare. Group 3 focused on Disaster Services; Healthy Future; and Tourism & Culture. During the discussions, the social innovation topics/ directions from the documentation studies were analyzed. After the focus group activities in the National Workshop, the social innovation directions were narrowed down to 50 for the 9 social sectors listed in Table 3. In addition, the social innovation support mechanisms were derived which were Social Credit ; Smart Community/Village; Tax Incentive and Corporate Social Responsibility (CSR) focusing on Social Enterprise.

Table 3: Relationship between 9 social sectors and the Sustainable Development Goals (SDGs)

| Environmental Stewardship	Food, Water and Energy Nexus	Sustainable Agriculture
1. Waste management i.e. batteries, plastic wastes, ocean waste 2. Community wastewater treatment with clean energy 3. Solution to Smog issue i.e. Reduction of Forest burning and agricultural waste burning 4. Air pollution warming system (zoning, warning, monitoring)	1. Complete cycle of usage for local raw material (producing, using, selling) 1. Self-dependent in energy for the community 2. Hybrid system for power generation to reduce issues with fuel management 3. Water management i.e. Underground water bank, clean energy for irrigation 4. Food Safety i.e. cleanliness, quality, contamination 5. Access to food, water, energy throughout the supply chain (production – consumption)	1. Solution to oversupply of agricultural product 2. Remote Agriculture Management System i.e. IoT, SCADA, Mobile, Smart farm 3. Improve quality of agricultural product and organic farming – complete cycle 4. Rent and share farming machinery 5. Promote precision farming i.e. growing, water, fertilizer, pesticide and harvest 6. Promote tools/machinery development for measuring agricultural product 7. Promote technology to extend product shelf-life
Government and Education	**Urbanization**	**Finance, Employment & Social Welfare**

1. **Lifelong Learning**
  1.1. Education for all ages i.e. children, student, working age, elderly
  1.2. Technology for convenience in teaching and student i.e. automatic translation device
  1.3. Enhancing skills in jobs and careers
  1.4. Competition/Patents
2. **Government**
  2.1. Sandbox demonstration area
  2.2. Public service innovation
  2.3. Social credits; evaluation system linking with employment
  2.4. Social welfare i.e. public service, health, transportation
  2.5. Innovation for procurement and government accounting
  2.6. Public service with Application focus on convenient to user and general public
	1. **Smart City**
	  1.1. Smart Home
	  1.2. Digital Residence
	  1.3. Security
	2. **Transportation**
	  2.1. Public transportation
	  2.2. Application transportation communication
	  2.3. call vehicles with specific price; Water transportation system; Travel maps; Transportation payment
	3. **Land Usage**
	  3.1. Urban planning/City Management;
	  3.2. Solution to misuse of land;
	  3.3. restriction for land usage; land usage database to provide information to buyer and land developer
	4. **People**
	  4.1. Elderly technology and social services (Affordable Health Technology) i.e. Health monitoring wristband
	5. **Data Sharing**
	  5.1. Idea donation; give/share beneficial data
		1. **Finance:**
		  1.1. Establish Community Fund
		  1.2. Finance warning system i.e. Investment analysis or payment warning
		2. **Employment:**
		  2.1. Labor management (Reduce Cost & Investment; Increase Education Value)
		  2.2. Promote career innovation and Skills-capacity building
		3. **Social Welfare:**
		  3.1. Provide Education, Job development, Provide opportunity
		  3.2. Enhance innovation for a better quality of life for the disabled, elderly, minority, ex-convicts, homeless

Disaster Services	Heathy Future	Tourism & Culture
1. Disaster preparedness 2. Warning system with Application	1. Promote, monitor, prevent, restore health in the community (municipality/sub district) 2. Capacity Building: health promotion personnel 3. Develop health management mechanism (standardize, sustainable with good governance) 4. Technology development i.e. Elderly care technology, Technology to reduce reliance on other people	1. Capacity building and networking for the tourism industry 2. Conservation, restoration and translation of Cultural Heritage 3. Tourism Management 4. Integration of Tourism (Wellness Tourism, Sport Tourism, Agro-tourism, Food Tourism) 5. Development of tourism with STI for increasing value and quality 6. Design induced innovation for tourism and culture 7. Enhance cultural relationship and bring Thai brand/image to international stage

Table 4: Ranking of Social Innovation Directions of 9 Social Sectors from the Analysis of National and International Expert Group

Social Sector	Thailand's Social Innovation Direction		Score
1. Environmental Stewardship	Rank 1	Municipal solid waste	46.15%
	Rank 2	Waste Water	23.08%
	Rank 3	Agriculture Waste	16.67%
	Rank 4	Air soil pollution	11.54%
	Rank 5	Sound Pollution	2.56%
2. Food, Water and Energy Nexus	Rank 1	Self-dependent in energy for the community	31.76%
	Rank 2	Hybrid system for power generation to reduce issues with fuel management	25.88%
	Rank 3	Water management i.e. Underground water bank, clean energy for irrigation	16.47%
	Rank 4	Production/usage of local content & technology Local	12.94%
	Rank 5	Sharing Economy	10.59%
3. Government & Education	**Government**		
	Rank 1	Public service innovation	33.54%
	Rank 2	Equity and accessibility	24.22%
	Rank 3	People participation	17.39%
	Rank 4	Citizen centric/ Public entrepreneurship	8.07%
	Rank 5	Sandbox/ Experiment Space	7.45%
	Education		
	Rank 1	Lifelong learning/ Creative learning	25.50%
	Rank 2	Learning to learn/adaptive learning	18.79%
	Rank 3	Learning by doing	10.07%
	Rank 4	Inclusive education	8.72%
	Rank 5	Teaching driving innovation	7.38%

Social Sector	Thailand's Social Innovation Direction	Score
4. Finance, Employment & Social Welfare	**Finance**	
	Rank 1 Micro financing for social enterprise	46.15%
	Rank 2 Innovative financing	23.08%
	Rank 3 Public procurement efficiency and open data	16.67%
	Rank 4 Ease of business registration	11.54%
	Rank 5 Harmonize cash transfer system	2.56%
	Employment & Social Welfare	
	Rank 1 Employment for vulnerable group	17.19%
	Rank 2 Youth force to co-create next generation for development	14.06%
	Rank 3 Skills/Capacity Building	12.50%
	Rank 4 Encourage 2 path thinking (1. specialized as employee; 2. Self Employed)	10.94%
	Rank 5 Eco system to support self-employment	7.81%
5. Sustainable Agriculture	Rank 1 Organic Food	25.93%
	Rank 2 Smart Farming/ Plant Factory	20.37%
	Rank 3 Improve quality of agricultural product and organic farming – complete cycle	14.81%
6. Urbanization	**Technology**	
	Rank 1 Smart City Vision	19.23%
	Rank 2 Universal Design for infrastructure and transportation	17.95%
	Rank 3 Gentrification: Community empowerment and adaptation to be ready for change	12.82%
	Rank 4 Non-motorized transport	11.54%
	Rank 5 Car sharing/Bike Sharing	10.26%
	Big Data and Management	
	Rank 1 Smart collection on traffic pattern and public transit	21.25%
	Rank 2 Public transit information management	17.50%
	Rank 3 PPP- Public Private Partnership (data sharing)	16.25%
	Rank 4 Application and mechanism for sharing economy for SME	12.50%
	Rank 5 Crowd sourcing	10.00%
7. Healthy Futures	Rank 1 Aging society & community	21.25%
	Rank 2 Telemedicine	18.75%
	Rank 3 Thai traditional medicine	15.00%
	Rank 4 Better regulation and enforcement for road safety	10.00%
	Rank 5 Quality of care by health worker	8.75%
8. Tourism & Culture	Rank 1 Sustainable community and cultural-based tourism	33.33%
	Rank 2 Digital tourism application for tour guides and tourists	25.00%
	Rank 3 Enhance cultural relationship and bring Thai brand/image to international stage	11.90%
	Rank 4 Support relationship cross countries	9.52%
	Rank 5 Data access and safety for tourists	8.33%
9. Disaster Services	Rank 1 Flood management	24.32%
	Rank 2 Monitoring and warning system with ICT	20.27%
	Rank 3 Planning and budgeting	17.57%
	Rank 4 Resilience Plan	16.22%
	Rank 5 Healing/Recovering	13.51%

The second workshop, "International Workshop on Future of Social Disruption and Sustainable Development Goals (SDGs) (Thailand's Directions)" was held on August 31, 2018. The workshop focused on the brainstorming and discussion of the international expert perspectives to highlight and rank the important and significant social innovation directions, topics and supporting mechanisms. The 10 participants were from international/regional agencies such as ASEAN secretariat, UNDP, GIZ, and USAID which brought the international perspective to the social innovation direction analysis. In fact, all the international agencies also followed the directions from the SDGs. The focus group activities resulted in the ranking and prioritizing of Thailand's Social Innovation Directions for the 9 social sectors. Only top 5 ranked social innovation directions and scores were showed in Table 4. Further analysis of Thailand's Social Innovation Directions also revealed that the directions can be categorized into 9 areas: Technology, Social Participation, Resource Management, IoT, Education, Finance, Policy and Service. Figure 3 showed the overlay of the 9 social innovation sector directions according to the 9 category areas. Based on Figure 3, the Social Innovation Sector paired with the first rank category area were: Environmental Stewardship – Technology (25.59%); Food Water and Energy Nexus – Resource Management (19.11%); Government & Education – Social Participation (33.12%); Finance Employment & Social Welfare – Resource Management (25.78%); Sustainable Agriculture – Resource Management (23.30%); Urbanization – Resource Management (28.64%); Healthy Future – Service (21.74%); Tourism & Culture – Resource Management; and Disaster Service – Service (22.62%). Overall, appropriate Resource Management would be the most important categorized area for the social innovation directions.
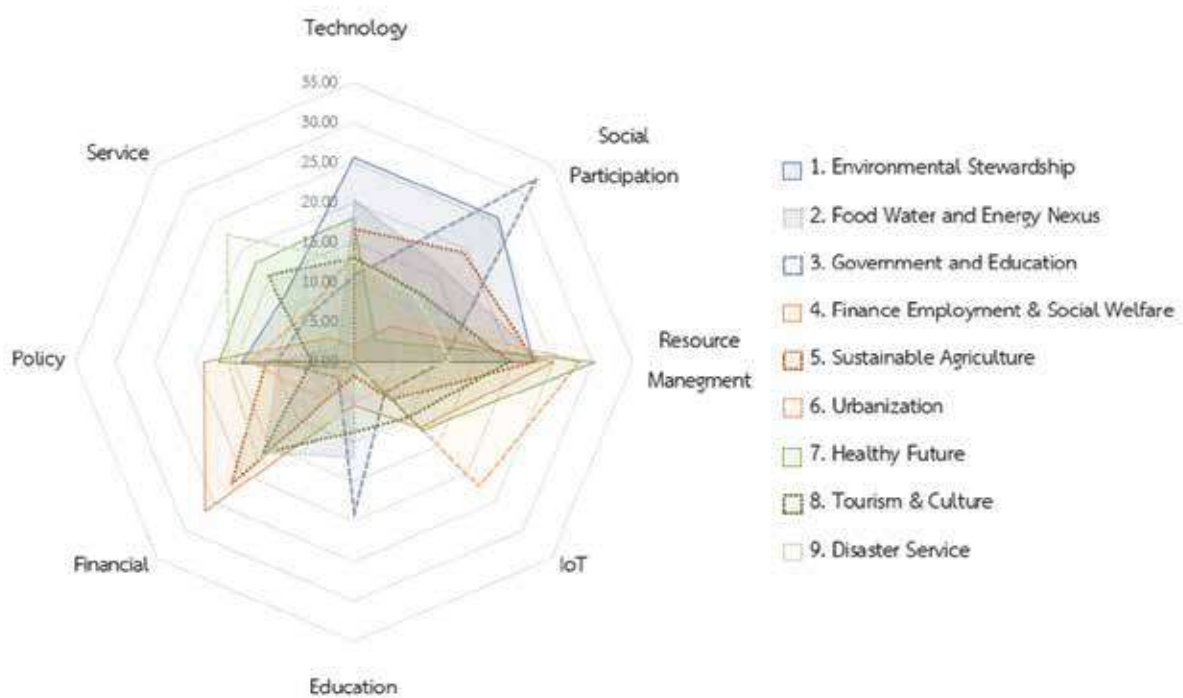
Figure 3: Analysis of Social Innovation Direction Classifications from 9 Social Sectors

Conclusion

Social innovation factors and specific directions priorities under Thailand context was evaluated and determined for 9 social sectors: 1) Environmental Stewardship, 2) Food, Water and Energy Nexus, 3) Government & Education, 4) Finance, Employment & Social Welfare, 5) Sustainable Agriculture, 6) Urbanization, 7) Healthy Futures, 8) Tourism & Culture, and 9) Disaster Services. The documentation studies revealed that the social innovation have strong correlations in the area of "Environmental Stewardship" and "Government & Education". Therefore, Thailand realized the importance of human capital with environmental conservation in mind. Further analysis was made by 40 national and international experts from academia, research agencies, government and private sectors to determine the social innovation direction which benefit the Thai context for 2019-2021 as well as support the SDGs through a series of interviews and focused group discussion activities. The first priority direction each of the 9 social sectors are 1) Municipal Solid Waste; 2) Self-dependent in energy for the community; 3) Public Service Innovation; 4) Micro Financing for Social Enterprise; 5) Organic Food, 6) Smart City Vision; 7) Aging Society & Community; 8) Sustainable community and cultural-based tourism; and 9) Flood Management, respectively. Resource management of the priority directions would be important to facilitate social innovations for Thailand.

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Alternative Future – Use of Foresight Tools to Depict the Futures of Public Organizations

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Abstract

This research aims to identify the foresight techniques typically utilized by international futurists through an extensive review of literature on futures studies and foresight. The expected output is a collection of nine foresight tools that can be used to educate the public about futures studies and foresight. Research methods in this study are: 1) documentary research that involves reviewing scholarly and scientific articles published in journals indexed in the ISI Web of Science and

SCOPUS from 2013–2018, and 2) trials of the selected foresight tools with the Office of the Prime Minister of Thailand. The first research method provides us with the nine foresight techniques currently popular among foresight scholars and practitioners. The second research method allows the researcher to improve the foresight tool box and develop a set of recommendations for Thai public sector.

Strategic Foresight, Public Sector Management, Scenario Analysis

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1. Introduction

Foresight is "a process which involves intense iterative periods of open reflection, networking, consultation, and discussion, leading to the joint refining of future visions and the common ownership of strategies (Harper, 2003, 1)." Foresight tools can be used exclusively to provide "mental maps of possible futures" and relevant strategic approaches (CEEHPN, 2012, p.4 as cited in Vah Jevsnik & Toplak, 2014). They can also be used to complement other methods to provide hard data for policy makers to utilize in strategic planning (Popper, 2008). In theory, foresight offers scenarios of alternative futures, which may or may not happen. However, by creating "mental maps of the future" and proposing possible scenarios "outside the box," foresight enables critical thinking about steps to be taken, should a specific scenario become a reality (Vah Jevsnik & Toplak, 2014).

Several methods—both qualitative and quantitative—have been used to conduct foresight. Popper and others (2005) examined a sample of 130 foresight exercises conducted in 15 European countries and found six most common methods, including literature review, expert panels, scenarios, trend extrapolation, futures workshops, and brainstorming.

Vah Jevsnik and Toplak (2014) observe that researchers in science and technology and some subfields of economics have been exposed to a wider range of foresight methods than researchers in the social sciences and humanities. Currently, while researchers in every discipline are becoming aware and concerned about contemporary global challenges, not all are oriented towards the future. Some particularly in the social sciences have more often opted for similar approaches to gather data about the development of social processes, such as Delphi (Komac, 2000).

The purposes of this article are two-fold. First, it will identify a set of most common foresight methods found in past research works. Instead of focusing on the methods used in actual foresight exercises (e.g., Popper & Popper, 2005), this article extensively reviews past research works published in internationally recognized journals in the ISI Web of Science and Scopus indexes. Second, this article will present key findings from the use of foresight methods to develop future scenarios in 20 years for the Office of the Prime Minister of Thailand (Thailand's OPM). This article will conclude with recommendations of how Thailand's OPM can use information generated by the foresight exercises to design its organizational development plan. Implications for public sector organizations will also be discussed.

2. Common Methods in Foresight Research: A Systemic Literature Review

Lu and others (2016) point out that more than 80 percent of the research articles written in English on foresight can be found in three academic journals: Futures, Technological Forecasting and Social Change, and European Journal of Futures Research. Based on this, research articles from the three journals were selected for a systemic literature review. The main selection criteria are; (1) the articles must be published between 2013 and 2018; and (2) they must be empirical studies using quantitative or qualitative foresight methods. These criteria yielded 921 articles for this study.

Using word frequency analysis, the 921 publications were classified into six themes as shown in Table 1. From this dataset, the largest number of studies currently under review (207 articles or 22%) fall within the environmental issues, particularly climate change and the consequences on human settlements. Other themes have roughly equal numbers of research articles. Comparatively, the annual growth of publications in each theme indicates an increased use of foresight methodology in social issues, such as security, welfare, education, organizational management, and quality of life (Figure 1). In other words, foresight research now extends beyond scientific and technological topics and have the potential to open up space for innovative social scientific questions and methodology (Jewitt et al., 2017). This observation runs contrary to the arguments made by Komac (2000) and Vah Jevsnik and Toplak (2014) about the lack of attention among social scientists and humanists to foresight and futures studies.

Theme (s)	No. (%)	Common Method (s)
• Environmental sustainability	207 (22%)	1.1 Scenario 1.2 Trend extrapolation 1.3 Visioning
• Security, welfare, and education	170 (18%)	2.1 Scenario 2.2 Visioning
• Economy and industry	159 (17%)	3.1 Scenario 3.2 Simulation 3.3 Trend extrapolation
• Emerging technologies	134 (15%)	4.1 Science fiction 4.2 Roadmapping 4.3 Backcasting
• Future of work and organization	127 (14%)	5.1 Delphi 5.2 Scenario 5.3 Visioning 5.4 Bibliometrics
• Lifestyle, city, and quality of life	124 (13%)	6.1 Scenario 6.2 Trend extrapolation
Total	**921 (100%)**	

Table 1. Results of Systematic Literature Review

	Y2013	Y2014	Y2015	Y2016	Y2017	Y2018
1.Environmental sustainability	23	34	36	42	34	38
2.Security, welfare, and education	10	12	22	23	43	60
3.Economy and industry	8	19	20	31	43	38
4.Emerging technologies	23	28	33	20	19	11
5.Future of work and organization	5	6	7	32	39	38
6.Lifestyle, city, and quality of life	4	3	22	25	34	36
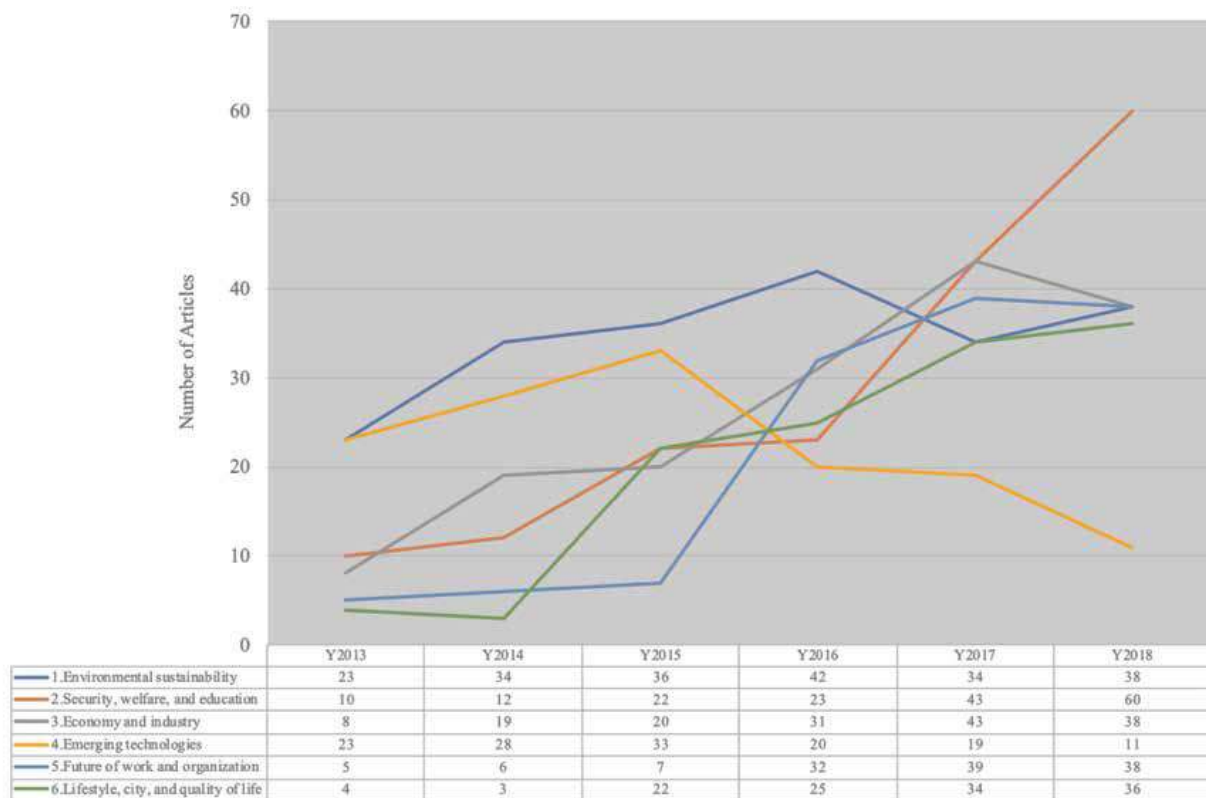
Growth of Foresight Research Articles by Theme

Another important finding from this systemic literature review is a set of foresight methods frequently used in the selected research articles. Nine common foresight methods can be identified based on Table 1: visioning, Delphi, scenario, science fiction prototyping (SFP), trend extrapolation, simulation, roadmapping, backcasting, and bibliometrics. However, it must be noted that some of these methods (e.g., visioning, scenario, trend extrapolation) are used as umbrella terms for a variety of similar methods. For example, "intuitive logics" (qualitative scenario–building technique) and "probabilistic modified trends" (quantitative scenario analysis) are placed under the "scenario" label.

Further, some foresight methods appear more often than others (Table 1). Scenario, visioning, and trend extrapolation are commonly used in almost all themes, except emerging technologies. Delphi is the most popular method in studies on the future of work and organizations, but does not appear elsewhere. Similarly, bibliometrics, simulation, science fiction prototyping, backcasting, and roadmapping can only be found in specific themes. Simulation in particular is used exclusively in economic and financial studies, while science fiction prototyping, backcasting, and roadmapping are confined to technology–oriented publications.

3. Foresight Exercises for the Office of the Prime Minister of Thailand (Thailand's OPM)

After putting together a foresight toolkit from the systemic literature review, the three common methods in the future of work and organizations theme were used to map out the future scenarios and challenges for Thailand's OPM. This foresight project consisted of three stages and lasted six months from December 2018 – June 2019 (Figure 2). Table 2 describes participants, techniques, and expected outputs at each stage.
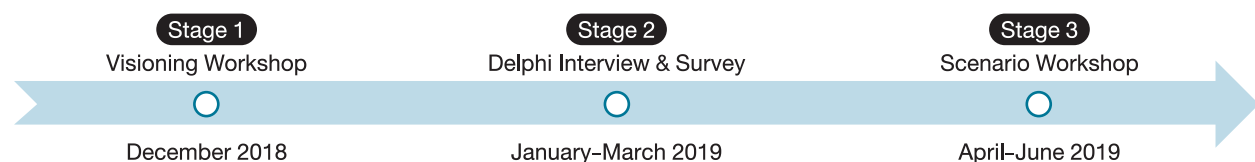
Stage 1	Stage 2	Stage 3
Visioning Workshop	Delphi Interview & Survey	Scenario Workshop
○	○	○
December 2018	January–March 2019	April–June 2019

Figure 2. Timeline for Thailand's OPM Foresight Project

Stage (s)	Participant (s)	Technique (s) used	Planned Output (s)
Stage 1 Visioning Workshop	• Planning & policy division staff (25 persons) • Planning & policy analysts (20 persons)	• Brainstorming	• Vision statement • Core values • Long-, medium-, and short-term goals
Stage 2 Delphi	• Permanent secretary and top executives (42 persons)	• In-depth interview • Survey	• Driving forces
Stage 3 Scenario Workshop	• Mid-level executives (10 persons) • Planning & policy division staff (25 persons) • Planning & policy analysts (20 persons)	• Horizon scanning • Scenario building and analysis • Narrative writing	• Four scenarios for strategic planning process

Table 2. Participants, Techniques Used, and Planned Outputs for Thailand's OPM Foresight Project

The Office of the Prime Minister of Thailand (Thailand's OPM) is a departmental agency led by a permanent secretary. As a central executive agency, its main function is to assist the prime minister in formulating, planning, managing, and monitoring government policies. Before 2002, OPM was responsible for many sub-agencies that are involved in high-level agenda setting and budgeting in the national government, namely the Cabinet Office, Bureau of the Budget, Office of the Civil Service Commission, and the National Economic and Social Development Board. The 2002 government reform moved these sub-agencies out of OPM, leaving it with much less important policy-making functions.

In light of its declining importance in the government agenda setting circle, OPM also faces seismic changes in the country's socioeconomic structure, ranging from the rapidly aging workforce, data-driven society, to disrupting digital technologies. In December 2018, the author was invited by the OPM permanent secretary to guide her personnel through a series of foresight workshops (Table 2). Results of the workshops are as follows:

Stage 1: Visioning Workshop

A one-day workshop was held in December 2018 to determine OPM's vision statement, core values, and goals. The resulting vision statement emphasizes inter-agency collaboration and public service innovation (Figure 3). Participants envisioned OPM in 20 years to be a central executive agency that promotes collaboration among government agencies and innovative government practices. Based on this vision, OPM was likened to a theme park where diverse attractions, such as rides and games, work in unison to entertain visitors. These attractions are similar to OPM's various sub-agencies that do not share the same functions, but can help complement each other. In order to serve as incubator for public service collaboration and innovation, OPM must embrace transparency, agility, creativity, and integrity as its core values. For the short-term goal, OPM would be expected to provide a data management platform that integrates both internal and external databases. The medium-term goal requires OPM to serve as a leading organization that incubates collaborative initiatives among different government agencies. For the long-term goal, OPM would become a halocracy in which organizational members are data literate and work in teams, instead of organizational silos.

20-YEAR VISION
Incubator for Public Service Collaboration and Innovation

CORE VALUES
Transparency, Agility, Creativity, Integrity

GOALS
- **Short-term goal:** Integrating internal and external databases
- **Medium-term goal:** Leading both vertical and horizontal intergovernmental collaboration
- **Long-term goal:** Becoming a halocratic and data-driven agency

Figure 2. Vision, Core Values, and Goals for the Office of the Prime Minister of Thailand

OPM's remaining agencies after 2002 are the National Identity Office, the National Decentralization Commission, the Official Information Commission, Bureau of Inspection, Regional Supervision Office, and Anti-Corruption Operation Center.

Stage 2: Delphi

The Delphi method in this study consisted of two parts. First, the OPM permanent secretary and top executives were interviewed about OPM's future challenges and opportunities. These interviews were recorded, transcribed, and analyzed using word frequency analysis technique. The issues that were mentioned and discussed by the OPM top executives most often were included in a survey questionnaire. Next, the top executives were given the questionnaire and asked to rank each focal issue on the questionnaire based on its impact on OPM and degree of uncertainty surrounding the issue. The survey responses in Table 3 were then plotted in the x–y plane (Figure 3). In theory, focal issues in the "Important" and "Critical" quadrants are normally selected for scenario analysis. However, in this study, only two critical issues (i.e., government agenda and digital technology) were used to construct future scenarios for Thailand's OPM. Both are issues that were identified by the top executives as "high-impact and highly uncertain" events.

Stage 3: Scenario Workshop

In a two–day workshop, 55 OPM personnel were given an assignment to build and analyze their agency's future scenarios based on the two critical issues from Stage 2. At this stage, the two critical issues were combined into a matrix (Figure 4). Each axis represents two opposite polarities of each critical issue. The four resulting quadrants depict different, but possible, "future landscapes" in which Thailand's OPM may find itself operating in 20 years' time.

Table 3. Delphi Survey Responses

Figure 3. Delphi Survey Responses Plotted in the x–y Plane
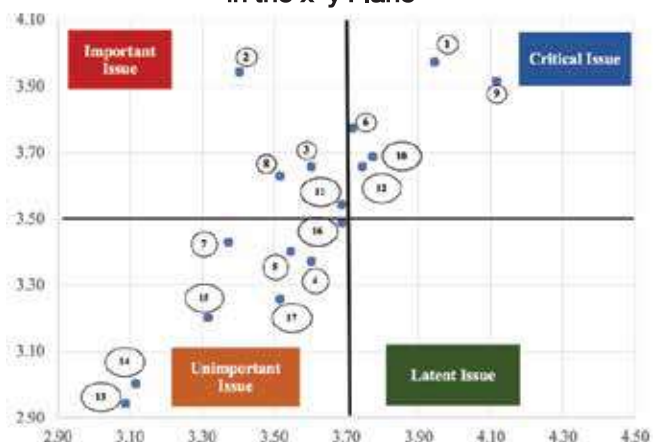
During the workshop, participants were also asked to provide short narratives for each "future landscape." In Scenario A, the government sector in Thailand would be confronting a variety of new and complex issues without the "right technological solutions." Digital technologies would still remain underdeveloped and too expensive. In this scenario, OPM is expected to be overloaded and ineffective in helping the prime minister perform his duties. Scenario B represents a preferred future landscape in which the government utilizes advanced digital technology to run the country. Government administration in this scenario would take a non-bureaucratic form, making it agile and effective. However, OPM would face considerable competition from other agencies. In Scenario C, no changes occur in government administration and digital technology. Government agencies, including OPM, would continue to be inefficient and ineffective. Finally, Scenario D portrays an image of an outdated bureaucratic government empowered by advanced digital technology. Although public policies and programs are formulated and evaluated based on real-time data, government agencies continue to work in their respective silos. Inter-agency collaboration would be extremely challenging in this scenario.

Figure 4. Four Scenarios for Thailand's OPM
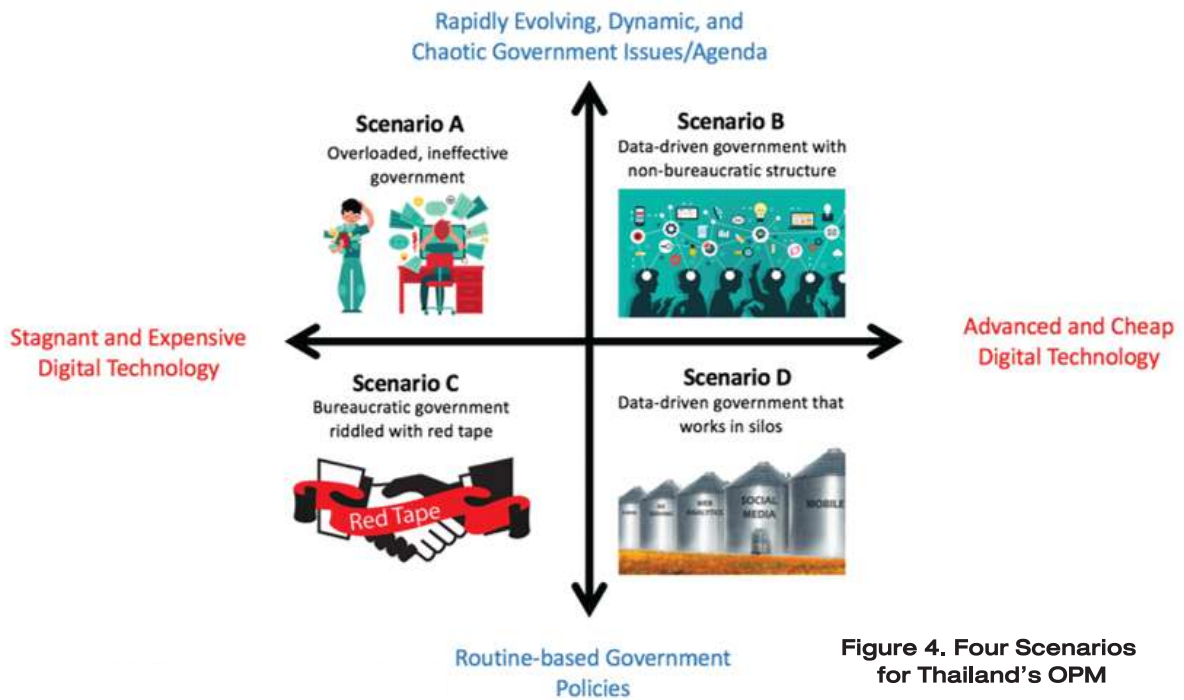
4. Summary and Recommendations

Apart from presenting the nine methods frequently used in foresight studies, this article has demonstrated that social scientists and humanists have increasingly utilized foresight to illustrate alternative futures for a wide array of social and economic phenomena. This article also discusses the results from using three foresight tools (visioning, Delphi, scenario) to develop four scenarios in 20 years for the Office of the Prime Minister of Thailand. Although these scenarios were created in the context of Thailand's OPM, several recommendations can be made regarding the futures of public organizations in general:

- The government sector, particularly in developing countries, should first attempt to develop a common database system integrating all disparate and siloed databases for policy formulation, monitoring, and evaluation purposes. Concurrently, digital transformation of all government databases should be pursued. The rush to embrace digital transformation without proper data security measures could put sensitive data at risk;

- Ultimately, digital technologies only serve as instruments for policy formulation, execution, and evaluation. In reaping full benefits of the 21st-century technologies, organizational cultural transformation in the government sector must precede digital transformation. Team-based management, collaborative culture, and proactive policy actions in particular should be nurtured and firmly established; and

- In the near future, the government sector will face more complex phenomena, which Herbert Simon famously labelled as "ill-structured problems" in 1973. While Simon claimed that "ill-structured problems" could be solved in the same way as "well-structured problems," recent empirical and theoretical works proved otherwise. Ill-structured problems in the 21st century in particular will require innovative solutions. This means that for public sector organizations, bureaucratic hierarchy, outsourcing, or even performance-based management will soon become obsolete. The future landscapes identified with foresight techniques can help us design new solutions for the 21st-century ill-structured problems.

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THAILAND:
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EMPOWERING THAILAND INNOVATION