INSIGHTS ON DIGITALIZATION OF THAILAND INDUSTRY

Digital Roadmap for Aging Society, Agriculture, and Tourism

2017

WHITE PAPER

Insights on Digitalization of Thailand Industry

Digital Roadmap for Aging Society,
Agriculture, and Tourism

White Paper
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First and foremost, acknowledgment to the Ministry of Science and Technology (MOST), the National Innovation Agency (NIA), and the National Electronics and Computer Technology Center (NECTEC) for their invaluable inputs, support and guidance towards developing the digital roadmap. Sincere appreciation to the Ministries overseeing the three key sectors in scope. The Ministry of Public Health (MOPH) for their generous support and guidance in shaping the digital solutions for aging society in Thailand. The Ministry of Agricultural and Cooperatives (MOAC) for their support in crafting digital solutions for more efficient and connected agricultural sector in Thailand. Last but not least, the Ministry of Tourism and Sports (MOTS) for their expertise and collaboration in identifying digital solutions and initiatives to enhance Thailand's tourism competitiveness. Special recognition to the e-Government Agency which has closely provided guidelines and support to formulate electronic service-related initiatives.

Sincere appreciation to various public and private stakeholders, especially those who graciously participated in multiple expert interviews and workshops to voice their concerns, put forward their ideas and collectively formulate initiatives and the digital roadmap. Gratitude towards Thai and international startup communities, who shared their passion and experiences, and provided their views on the way towards transforming Thailand into a regional digital hub. And lastly, to the joint Huawei and Roland Berger team, who conducted and facilitated the analyses for the successful development of the White Paper.

FOREWORD

Dr. Pichet Durongkaveroj
Minister of Digital Economy and Society

Thai government has been focusing on the development of digital economy and society in order to enhance country's competitiveness in manufacturing, service, and other sectors. It is clear that Thailand is in need to adopt digital technology and innovation to address key challenges faced and unlock the potential in various industries.

This insight report has integrated the opinions and ideas from both public and private experts on digitalization of Thailand aging society, agriculture, and tourism. Key enablers to drive the development, including startup fostering environment and ICT infrastructure, are also investigated and addressed interestingly.

I believe that the initiatives and roadmap presented in this report will be useful as a development guideline for relevant stakeholders of the three sectors and insightful for general readership.

Signature

Dr. Pichet Durongkaveroj
Minister of Digital Economy and Society

Dr. Atchaka Sibunruang
Minister of Science and Technology

Thai government has recently announced the ambitious national development model called "Thailand 4.0", laying out the new growth direction for Thailand to become a high-income economy by using of technology and innovation. The Prime Minister, General Prayut Chan-o-cha, has highlighted three sectors of high economic and social importance, Aging society, Agriculture and Tourism, to be top development priorities. The Ministry of Science and Technology has then taken the direction and worked closely with Huawei Technologies (Thailand) and Roland Berger to develop this report with the main objectives to provide understandings and potential roadmap on digitalization of the three sectors.

I would like to take this opportunity to express my gratitude to all the contributors and collaborators who have been a part of this work. I am hopeful that the insights provided in this report will be beneficial to any reader from public or private organizations and help Thailand to head on the right direction towards becoming a digital nation.

Signature

Dr. Atchaka Sibunruang
Minister of Science and Technology

Executive Summary

Thailand should put full priority on leveraging digital technologies to drive the country forward. The digitalization of services and processes are the most important factors in transforming aging society, agriculture and tourism sectors. The three sectors provide unique and impactful opportunities for change and innovation.

Aging Society

The world is experiencing a massive demographic change and Thailand is not an exception. Since 1985, the number of Thai elderlies increased three times to reach 10.7 million in 2015. The demographic shift is putting pressure on healthcare expenditure with rising government contribution. Elderlies in Thailand face many challenges including limited access to healthcare services, rising chronic diseases, increasing isolation and financial dependency. Digital technology provides an opportunity to effectively address these challenges using different solutions.

As a first key step, the development of National Health Information System serves as backbone for digital healthcare for elderlies. The centralized platform and patient portal collects, shares and analyzes real-time medical data on a national level. The platform collects critical healthcare data, including life-long records of individual patients. Development of real-time healthcare portal ensures continuity and enhances quality of care, while big data analytics permits more effective disease prevention and policy design.

Secondly, Telehealth allows providers to deliver health-care services to patients remotely using ICT technology. Telehealth facilitates collaboration between medical personnel and improves access to high-quality healthcare for elderlies in rural areas. It also permits healthcare providers to remotely monitor health conditions and manage chronic diseases for elderlies.

Thirdly, adoption of Smart Home and Robotics including home sensors (e.g. fall sensors, inactivity sensors), smart Internet of Things (IoT) appliances and care robots at elderlies' homes enhances safety. Smart Home also improves convenience and independence of elderlies.

Lastly, Digital Social Interaction solutions include online communities and digital platforms, as well as lifestyle apps and cognitive games. Using these digital tools can promote socio-economic contribution, healthy lifestyle and improve quality of life for elderlies.

Agriculture

Agriculture is one of the most important industry for the Thai economy and society. It utilizes one-third of the nation's workforce while contributes to only 9% of country's GDP. Farmers in Thailand are highly scattered and production efficiency is low. For example, Thailand is one of the largest rice producers in ASEAN but production is lower than regional peers. Digital technology can play a pivotal role in facing key efficiency challenges. Several digital technologies have been identified and grouped into four solutions to address current issues.

The first fundamental step is the development of centralized National Agricultural Information System (NAIS) which can serve as a national agricultural data and knowledge depository. NAIS provides better access to a comprehensive range of agricultural information to key stakeholders including government, agribusiness, NGOs, and general public.

Secondly, it is critical to adopt Precision Agriculture (PA) solutions, using digital technologies to optimize plant farming operation and boost production yield. PA technologies combine sensors and imagery, connectivity, robotics and automated machineries. An integrated solution centrally managed by a farm management software can help farmers optimize operations, save costs, and utilize workforce more efficiently.

Thirdly, it is important to adopt Precision Livestock Farming (PLF) technology, using digital tools to improve productivity and enhance livestock welfare. PLF uses multiple digital technologies led by tracking instruments, sensors, connectivity, farming software, and robotics and automated machineries. As a result, producers can control breeding process, save feeding cost, and increase overall production.

Lastly, there are several digital distribution solutions which can boost agriculture trade on a national level. e-Commerce agriculture marketplace helps farmers to connect directly with end users, expand market reach and improve margins. On the other hand, Smart Supply Chain solutions allow farmers and producers to efficiently track and trace products distribution cycle, control quality and manage inventory.

Tourism

Tourism is among the key drivers of Thai economy, contributing to 17% of the country's GDP and employing 10% of labor force. To become a tier-1 destination, Thailand should resolve several challenges including concentration of tourists in a number of key cities, slow adaptation to the travelers' online preferences, lack of convenience and flexibility along touch-points, and safety issue. These challenges can be addressed with digital technology which can transform Thailand into a smarter tourism destination. Latest travel tech innovations have been analyzed and grouped into four main digital solutions.

First, the entire tourism ecosystem will benefit from the development of a National Tourism Information System for centralized collection and distribution of tourism-related databases. Based on the comprehensive information available, key insights can be extrapolated with Big Data analytics, allowing for effective government policy design. At the same time, opening these data to public ("Open Data") could foster the growth of local travel tech startups and support the growth of SMEs.

Secondly, development of a National Trip Planning Platform creates a one-stop national information platform that consolidates online tourism contents and provides relevant trip planning suggestions to tourists. It also enables the use of advanced digital marketing campaigns tailored towards tourists' background and preferences.

Thirdly, Smart Tourism Destination is related to building the infrastructure that integrates digital technology to enhance attractions, transportation, and payment facilities. Tourists can enjoy enhanced convenience in transportation and have more immersive experience during their visits in Thailand. The concept aims to add value to the existing tourism offerings through integration of technology, in order to better facilitate and enrich tourists throughout touch-points.

Lastly, Public Safety and Security System consists of four interrelated sub-systems, covering immigration and border security, surveillance system, convergent security command center, and emergency alert system. The solution aims to provide safe and secured environment for tourists and to reinforce Thailand as a safe destination.

Key Enablers

Four key enablers have been identified to realize the digitalization plan including broadband infrastructure, cloud infrastructure, innovation and human capital. Improvement on these four key dimensions is required to unlock the substantial benefit of digitalization for aging society, agriculture and tourism.

Firstly, broadband infrastructure is critical to support the development of digital solutions and adoption of digital tools. Thailand is lagging behind in broadband coverage and speed with particular room for improvement in rural areas. It is important for Thailand to improve coverage, affordability, speed and adoption of fixed and mobile broadband.

Secondly, cloud infrastructure offers flexible and cost-effective alternative to store and manage large data sets. Thailand should focus on improving cloud infrastructure, supporting expansion of cloud services, and encouraging cloud service adoption by both businesses and government agencies. To become a regional digital hub, Thailand needs to attract leading global players to allocate their cloud servers in the country.

Thirdly, innovation is the creation and implementation of ideas and technology which are critical to support the sustainable development of the nation. It involves establishing and reinforcing startup ecosystem and supporting the growth of Research and Development (R&D) efforts. Thus, Thailand should emphasize on developing innovation-fostering environment as the key to support the growth of digitalization.

Lastly, improving human capital is important to enhance overall Thai competitiveness. Inefficient math and education curriculum and limited English proficiency hinder human capital development. Students and working professionals should be equipped with up-to-date ICT skills to be ready to adopt and benefit from the latest digital technologies. It is critical to strengthen the education system and integrate new trainings for a future-ready workforce.

Overall, Digital transformation across these three fundamental sectors for Thailand will address key challenges and improve sustainable long-term development. Technological advancement and adoption will support Thailand to become a regional digital hub for innovation, with a pool of world-class digital talent and continuous launch of new digital products and services.

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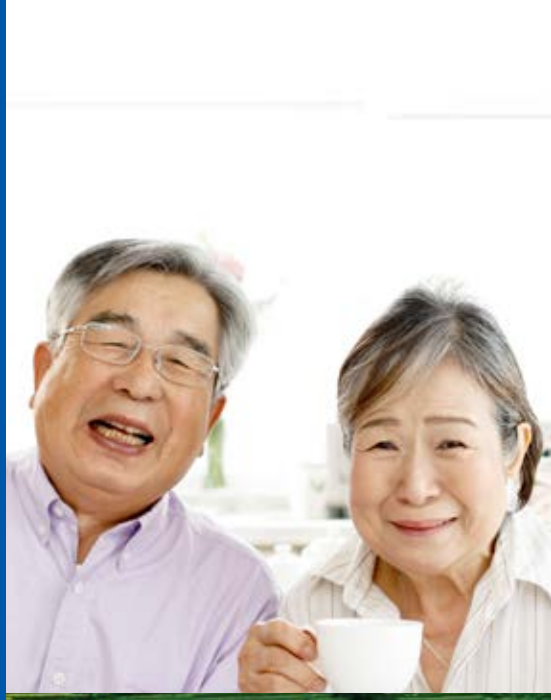
CHAPTER 1

Introduction



Digital transformation is the key driver towards high-income, knowledge-based Thai economy

Thailand has achieved a remarkable social and economic progress over the last four decades, from a low-income to an upper-income country. In the 80s and 90s, prior to the Asian crisis, the economy grew with more than 7% per annum, primarily driven by industrialization of key sectors and increasing trade volumes. As a result, poverty declined drastically and social welfare improved on a national scale.

However, in the last 10 years, Thailand has experienced a turbulent economic development. Average growth has slowed to 3.5% per annum since 2005. Annual GDP fluctuated due to global economic slowdown, volatile commodity prices and internal instability. Thailand is facing several national challenges, among them rising household income disparity, aging population, environmental issues, unemployment and low quality of education.

To address these challenges and fulfill its ambition to become a high income, knowledge-based economy, Thailand needs to embark on a new digital revolution. The role of digitalization has profoundly changed from simply a driver of marginal efficiency, to the main source of disruption and innovation.

Digitalization offers tremendous opportunities for Thailand, opening up possibilities to improve social welfare, develop competitive products and services, and transform various sectors in the economy. Digital technologies related to Big Data, automation, connectivity and digital customer interfaces, foster innovation and encourage creation of new business ventures.

By adopting digital technologies, challenges faced by Thai individuals and businesses can be addressed. At an individual level, digitalization offers access to information, new economic opportunities and improve social interaction. Digitalization can support the development of rural households, reducing national income inequality. At a business level, digitalization offers opportunities to scale operations, improve efficiency and innovate. It supports value creation and captures new revenue diversification opportunities.

Overall, digitalization can help Thailand face challenges of aging population, reduce income inequality and improve competitiveness of Thai business. Finally, Digital Thailand will empower government institutions and private companies to improve governance and transparency, in order to eliminate corruption.

The Thai government has already embraced the importance of digitalization. The long-term digital ambition is laid out in Thailand's 20-year strategic plan for attaining developed country status through broad reforms. Thailand's digital vision includes "a transformed country that maximizes the use of digital technologies in all socioeconomic activities", in order to "develop infrastructure, innovation, data, human capital, and other digital resources that will ultimately drive the country towards wealth, stability and sustainability".

There is already progress on implementing the digital vision. This includes the implementation of smart city pilots, development of digital master plans and ICT infrastructure improvements. These are the first stepping stones of a long digital journey. Going forward, Thailand should focus on digitalization of key sectors in the economy and improvement of key enablers like innovation, human capital and broadband infrastructure.

This White Paper serves as a complementary tool supporting the national vision for Digital Thailand. It provides digitalization insights for businesses and government leaders in Thailand on three key sectors for the economy: aging society, agriculture and tourism. The White Paper offers business and government leaders in Thailand a detailed digitalization roadmap with implementation initiatives for the next 5 years. It captures global and Thai specific trends and challenges. It also showcases international best practices and assesses the current digital maturity in Thailand.

Recommended actions are suggested to guide stakeholders in each sector on the key next step to reshape Thailand future through digital technology. All recommendations have been aligned with leading government and business stakeholders with the ultimate goal to reach a consensus on the digital future for aging society, agriculture and tourism.

CHAPTER 2

Approach and Methodology

The purpose of the White Paper is to provide digitalization insights for aging society, agriculture, and tourism. The three sectors have significant importance for the economic and social development of Thailand. The adoption of digital technologies will disrupt these sectors and open up new opportunities for innovation and sustainable growth.

The scope of the White Paper is narrowed down to digital technologies which can be adapted in Thailand within a five years horizon. The report is focused on enabling digital solution with emphasis on Big Data, Internet of Things and cloud.

A comprehensive approach is developed to obtain consensus on the 5-year digitalization roadmap. It can be grouped into four distinguished building blocks including digital maturity assessment, industry analysis, expert alignment, and consensus building.

1. Digital Maturity Assessment

Thailand's digital maturity across the three key sectors was assessed and validated with industry experts. A framework with five stages of digital maturity was designed to assess the current maturity status. This is from "Static/Analog" stage assuming no digital progress to "Predictive/Engaged" stage assuming wide digital adoption and advanced predictive functionalities. Key government and private sector experts provided input and validated the digital maturity framework and assessment.

2. Industry Analysis

Thorough industry analysis was conducted to identify industry trends and best practices in digitalization for the three sectors. In order to identify gaps and determine key challenges and opportunities for Thailand, more than 100 case studies were detailed, with international benchmarks and KPIs listed. The key market trends and growth drivers were also analyzed.

3. Expert Alignment

The White Paper was developed with the support and active participation of local and international industry experts. More than 150 expert interviews were conducted throughout the development of the White Paper. Inputs and recommendations were collected from leading private companies, government experts, academics to active local entrepreneurs and business owners.

4. Consensus Building

In order to successfully build consensus, the detailed 5-year roadmap was validated with key public and private stakeholders. Many working groups were formed; and workshops were conducted to ensure the validation of the digitalization roadmap and all initiatives.

Extensive interviews and validation with key stakeholders in all three sectors were conducted to gain inputs and opinions on current challenges and opportunities for Thailand. Final validation rounds and workshops ensured a full consensus is reached among key stakeholders.

Close collaborations with the Ministry of Science and Technology, together with NIA and NECTEC, ensured alignment of the White Paper with overall digital direction of Thailand. Discussions with the Ministry of Public Health, the Ministry of Agriculture and Cooperatives, and the Ministry of Tourism and Sports along with relevant government agencies provided key inputs on existing nation development plans and goals.

The national e-Government agency (EGA) shared valuable inputs on the government's digital development plans and provided recommendations.

Various academics and NGOs representatives shared their opinions on the current challenges and opportunities of the sectors. Interviews with leading private players offered a better understanding of the current market situation, trends and existing digitalization initiatives. Private sector interviews pinpointed the key challenges of the private sector and provided suggestions on how private-public collaboration can be improved. Inputs from SMEs and startups clarified the challenges faced by small companies in Thailand.

Overall, expert opinions from key stakeholders across the three sectors were taken into consideration and embedded in the five-year roadmap and initiatives.

Key institutions

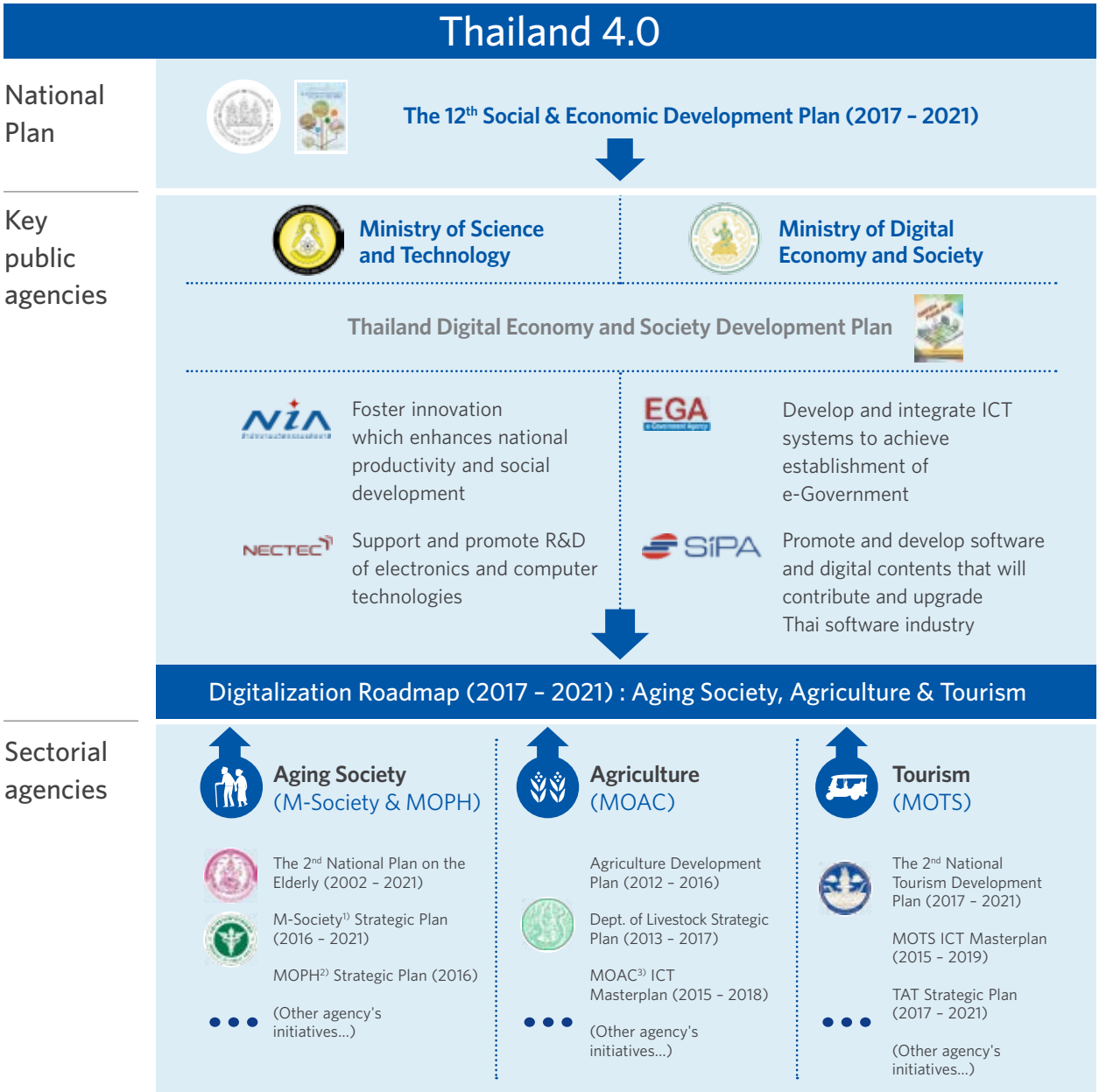
3 Business and Social Sectors	Aging Society	Agriculture	Tourism
Interviewed Public Sectors	EGA	EGA	EGA
Interviewed Academia/International Organizations/ Foundations/Business Associations		ADB, AIT Extension	PATA, ATTA
Interviewed Private sectors		CP, ricult, EVERGROW	Accor Hotels, agoda, amadeus

In drafting the digitalization roadmap, inputs from key government frameworks and master plans have been taken into account.

During the close engagements with ministries and public agencies, all relevant national master plans were reviewed in detail to ensure alignment with the national directions and priorities for each sector. Key government officials were involved in the process, including the Ministry of Science and Technology, the Ministry of Digital Economy and Society, the Ministry of Agricultural and Cooperatives, the Ministry of Public Health and the Ministry of Tourism and Sports. Their expert inputs and strategic directions were taken into account. All key ongoing public digital initiatives were leveraged for the digitalization roadmap.

The digitalization roadmap is supporting the vision and 10 developing strategies as a part of vision for Thailand 4.0. The report is fully aligned with the 12th Social & Economic Development Plan (2017-2021), focused on improving competitiveness, reducing inequality and promoting R&D. The roadmap is also synchronized with Thailand Digital Economy and Society Development Plan on transformation towards digital Thailand, taking full and creative advantage of new digital technologies.

The full alignment and understanding of national digital priorities allowed us to design the 5-year vision for transforming Thailand through digitalization (Vision 2021) which is detailed in the next page.



1) M-Society : Ministry of Social Development and Human Security,
2) MOPH : Ministry of Public Health,
3) MOAC : Ministry of Agriculture and Cooperatives

Under Vision 2021, digital technologies are the key tools used by the government, businesses and society to develop the country going forward. It is essential that Thailand embraces new digital opportunities to build competencies, strengthen development potential, create economic value and improve quality of life. These national priorities in the next 5 years form the following vision:

VISION 2021

"

Digitalization transforms Thailand towards connected society where everyone has enhanced accessibility to relevant information & services and leverages innovations effectively to drive Thais to become more self-reliant, reduce socio-economic inequality & boost competitiveness

"

connected society

Connect communities, in which individuals and businesses enhance cross-industry collaboration and exchange know-how and information with government institutions

accessibility to relevant information

Make data and information available and accessible to business and government leaders and society for education, decision making, and policy design purposes

innovations

Develop value-added products and services, which transform the country towards Smart Nation

self-reliant

Thai citizens equipped with skills and tools can broaden opportunities in generating new businesses and reduce economic dependency on others, including the government

socio-economic inequality

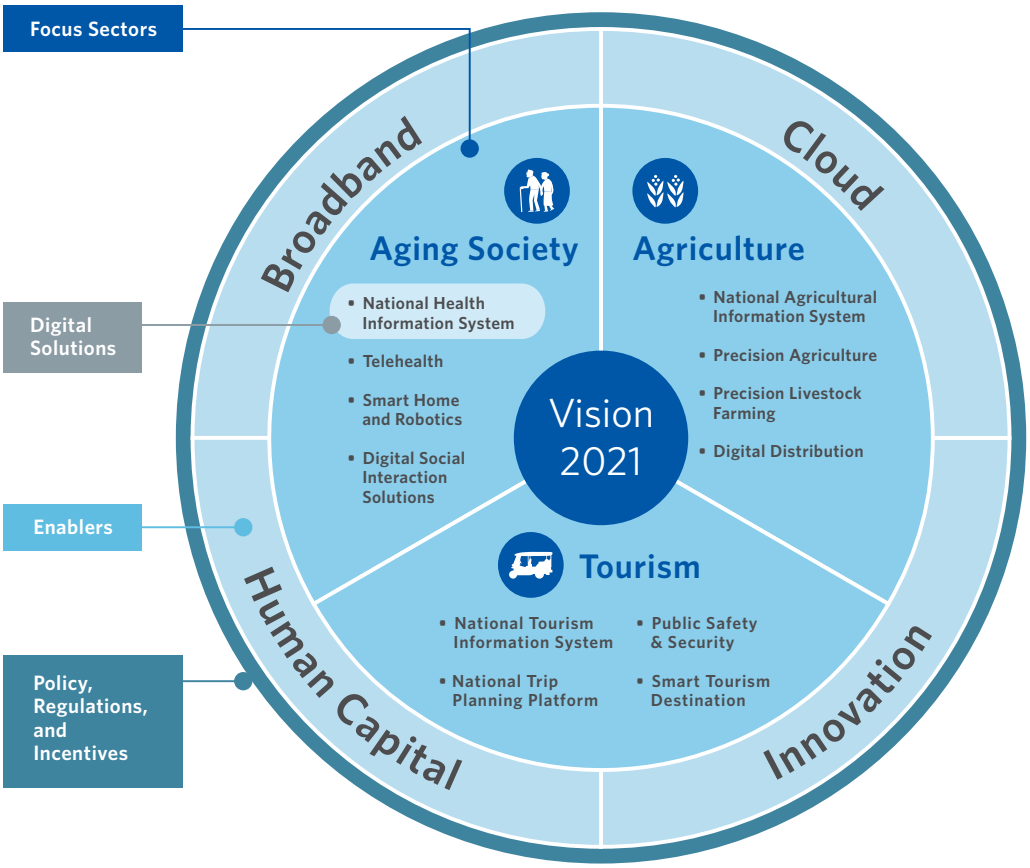
Thai citizens will have improved access to new products and services, enabled by digital technologies

competitiveness

Competitiveness will be improved across key sectors for the Thai economy and expansion to new markets

Vision 2021 encompasses the key guiding principles and goals in developing the framework for digitalization in an aging society, and of the agriculture and tourism sector.

The holistic framework includes the digital solutions relevant for the three focus sectors as well as key enablers. A comprehensive digital solutions list for each sector was developed based on expert interviews and international case studies. Each solution was analyzed thoroughly and detailed initiatives were designed per solution. Key enablers including broadband and cloud infrastructure, human capital and innovation were assessed with clear targets required for digitalization. The government policies, regulations and incentives were also reviewed with clear recommendations proposed.



Holistic views of digitalization of the 3 sectors

4 key enablers identified including broadband, cloud infrastructure development, human capital readiness, and innovation capabilities

39 initiatives detailed and organized across 4 distinct digital solutions per sector

The role of government and relevant organizations along with recommendations for policies and incentives detailed in each initiative

CHAPTER 3

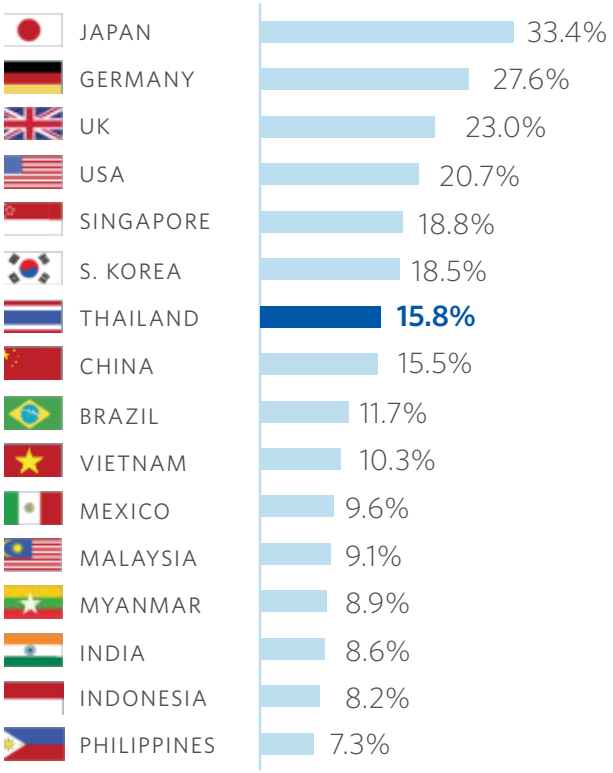
Digitalization of Aging Society

Thailand is experiencing population aging at an unprecedented pace

The world is facing massive demographic change. Most countries are experiencing continuous rise in the average age of the population. People are living longer, while the birth rate is continuing to fall. As these trends continue, global demographic structure will continue to shift towards more elderlies, relative to children and working-age population. In 1985, people aged 60 years and over accounted for 9% of the global population; in 2015 the figure reached 12% and, by 2030, the figure is projected to be 17%. Management of aging society has become a national priority for many governments around the world. The key question is how to improve quality of life for the elderlies in the most cost-effective way.

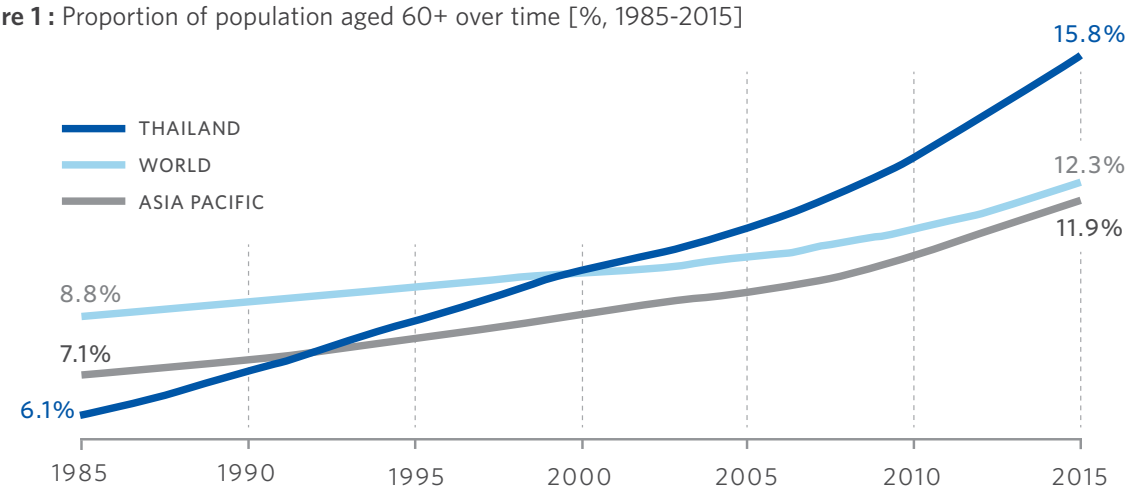
Thailand is not an exception to this global aging phenomenon. In the last 30 years, Thailand has witnessed very rapid pace of population aging. In 1985, there were 3.2 million people aged 60 years and over in Thailand, which accounted for 6% of the Thai population. Since then, the number of elderlies in Thailand has increased more than 3 times reaching 10.7 million elderlies in 2015. As seen in Figure 1, the proportion of elderlies in Thailand rose rapidly in the last 30 years and already surpassed both global and APAC averages. Elderlies now represent 15.8% of the Thai population, which is higher than most emerging market economies. However, the proportion of elderlies in the Thai population today is still behind developed economies such as Japan and the UK. (See Figure 2)

Figure 2 : Proportion of population aged 60+ in selected countries [%, 2015]



Source: The United Nations, Euromonitor

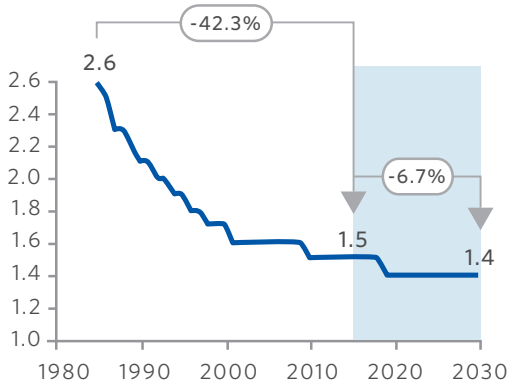
Figure 1 : Proportion of population aged 60+ over time [%, 1985-2015]



Source: The United Nations, Euromonitor

The two key drivers of aging population are the fall in fertility rate and the rise in life expectancy. Fertility rate in Thailand has fallen very rapidly in the last 30 years, driven by a number of social and economic factors. Rise in female literacy rate and higher workforce participation of female population have delayed marriage age and reduced number of births per female population. Industrialization and urbanization have also led to lifestyle changes, which reduce needs and preferences to have more children. For instance, there is reduced need for child labour to work in farms.

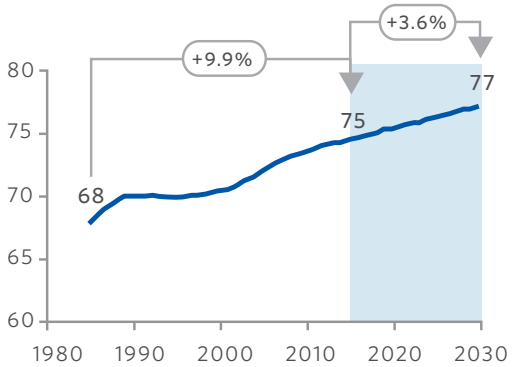
Figure 3 : Fertility rate in Thailand [Births per female, 1985-2030]



Source: Euromonitor

Life expectancy in Thailand has increased significantly over the last 30 years. The rise in life expectancy is driven by a number of factors. One of the main drivers is the technological advancements in healthcare, which allow more diseases and illnesses to be treated. Rising average income and investment in healthcare services in rural areas have also improved accessibility to and availability of healthcare services. In addition, living conditions are becoming more hygienic with overall improvement in sanitation and diet. These trends are expected to continue, which will increase life expectancy even further.

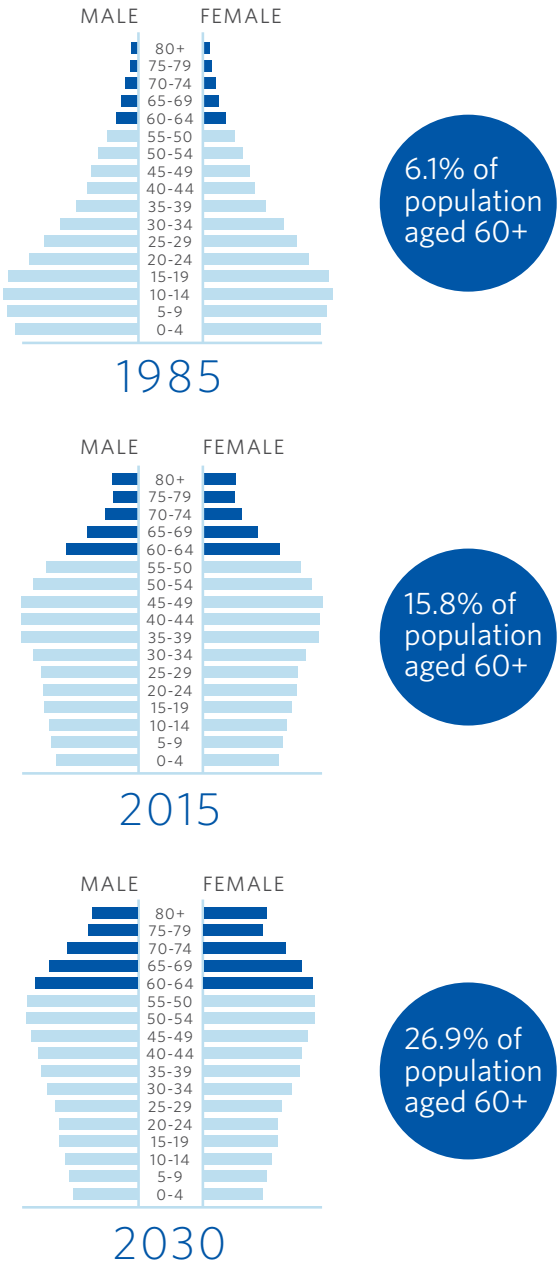
Figure 4 : Life expectancy at birth in Thailand [Years, 1985-2030]



Source : Euromonitor

The Thai population is expected to continue aging. The percentage of people aged 60 years and over will continue to rise in Thailand, further diverging from global and regional averages. According to estimation by the United Nations, elderlies are expected to account for 27% of Thai population in 2030, compared to 17% globally and 18% for APAC. The proportion of elderlies in Thailand will not only be one of the highest in Southeast Asia and Asia-Pacific, but will also be at par with the developed world. For instance, by 2030, the proportion of elderlies in Thailand will be similar to that of the UK, and the USA.

Figure 5 : Proportion pyramids for Thailand showing population split by gender and age groups



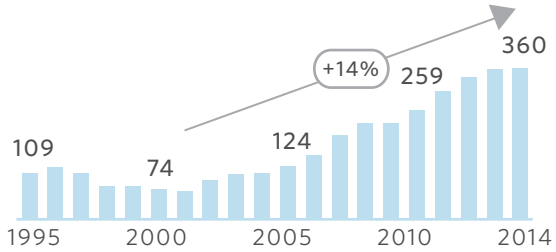
Source : The United Nations, Euromonitor

With rapid rise in the proportion of elderlies in the population, Thailand is facing multiple challenges. These challenges must be addressed to simultaneously minimize economic impact of aging society and ensure good quality of life for the elderlies.

1. Rising health expenditure with high state spending

Healthcare expenditure in Thailand has grown significantly over the last 20 years, especially since the introduction of Universal HealthCare Coverage Scheme in 2002. According to the World Health Organization, per capita healthcare expenditure increased nearly 5 times from USD 74 in 2000 to USD 360 in 2014. Healthcare expenditure as proportion of GDP has also increased from 3.7% in 2001 to 6.5% in 2014. As population continues to age, the trend of rising healthcare expenditure will also likely continue.

Figure 6 : Thailand total[1)] healthcare expenditure per capita [USD, 1995-2014]

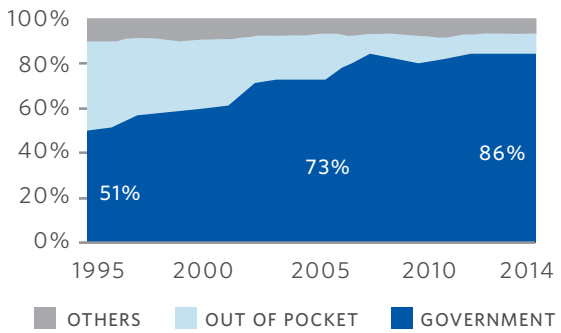


Source: The World Health Organization

1) Total includes both private and public expenditure

The government has borne a large portion of the rising cost. The percentage of state-funded healthcare has increased dramatically over the last 20 years (See Figure 7). In fact, Thailand now has one of the highest proportion of state-funded healthcare expenditure in the world (rank #15). Currently, 86% of healthcare expenditure is state-funded compared to 60% global average, and 66% APAC average.

Figure 7 : Thailand total healthcare expenditure by source [%, 1995-2014]



Source : The World Health Organization

2. Rising chronic disease prevalence

Physical health condition is one of the key factors affecting quality of life. The survey of elderlies, conducted by the National Statistics Office, indicates improvement in health conditions of elderlies based on self-assessment. In 2014, 45% of elderlies reported that their health conditions were good or very good, compared to 38% in 1994.

However, chronic diseases are still common among elderlies with hypertension and diabetes being two of the most common diseases. In fact, the prevalence of these chronic diseases has actually increased over the last 10 years. The percentage of elderlies with hypertension have risen from 20% in 2002 to 37% in 2014. Similarly, the percentage of elderlies with diabetes have increased from 9% in 2002 to 15% in 2014.

These chronic conditions are greatly influenced by lifestyle choices such as diet and level of exercise. Based on the survey by the National Statistics Office in 2014, less than a third of elderlies exercised regularly. The percentage of elderlies who exercise regularly has been falling over the last 10 years. Thai elderlies should be encouraged to be more pro-active in taking preventive measures to improve health conditions.

International comparisons also highlight opportunities to improve physical health of Thai elderlies. One of the figures often used to measure health conditions of elderlies is "healthy life expectancy", which estimates expected years of life in good health. According to the United Nations, the healthy life expectancy of Thailand population (63 for male, 69 for female) is higher than global average (60 for male, 64 for female), but is lower than the developed world (67 for male, 72 for female). In addition, The Global Age Watch ranks 96 countries based on health conditions of elderlies. Thailand is ranked #34, which is ahead of most emerging economies, but is still behind the developed world.

" Physical health of elderlies greatly affect quality of life. Chronic illnesses increase healthcare bills and limit the activities elderlies can do to enjoy themselves"

Geriatrician

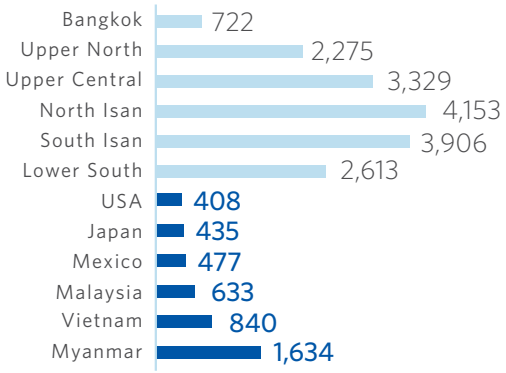
" It is critical to encourage healthy lifestyle , not only among elderlies, but among the entire population. Middle-aged population today will be the elderly population in the next ten to twenty years "

Doctor from leading state hospital

3. Poor availability and accessibility to healthcare services

In Thailand, more than 50% of elderlies live in rural areas, compared to global average of 42%. The Northern and the Northeastern (Isan) regions have the highest proportion of population aged 60+ years and over. Despite improvements in the last 20 years, healthcare infrastructure and personnel are often insufficient in the rural areas. For instance, in the northern part of the Isan region, there are 657 people per 1 hospital bed and 4,153 people per 1 doctor, compared to 203 people per 1 hospital bed and 722 people per 1 doctor in Bangkok.

Figure 8 : Number of total population per 1 doctor in selecter regions of Thailand and in selected countries [Latest available data]



Source : Thailand's MOPH, The World Health Organization, The OECD

Furthermore, elderlies face difficulties in accessing healthcare service. Local sub-district health promotion hospitals (SDHPH) are mostly staffed with nurses and volunteers. General Practitioners (GPs) are located in district-level community hospitals, and specialist doctors are usually only found in provincial hospitals. High travel costs and low mobility of elderlies make accessing doctors difficult. Consequently, many elderlies postpone doctor visits, regular check-ups and follow-up consultations.

"Although village volunteers can often help take elderlies to nurses in SDHPH, the closest GPs can take a day to get to for remote villages. Many travel from the country side and sleep on the floor in front of the hospital to get the queue cards and see the doctor in the morning, often for a few minutes of follow-up"

Doctor from leading state hospital

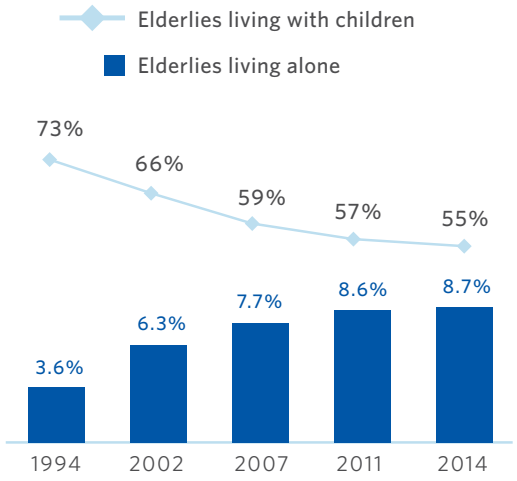
"Poor, rural and physical dependent elderlies are the most vulnerable. They face both physical and financial constraints to accessing the doctors"

Leading academic

4. Risky living environments

Urbanization and industrialization have led working-age population to move to cities for work, with many leaving behind parents in the countryside. As seen in Figure 9, more elderlies are living alone and less elderlies are living with children. Living alone increases risks of severe accidents. Elderlies may suffer from falls or heart attacks without their children or relatives being immediately aware.

Figure 9 : Proportion of elderlies living with children [%, 1994-2014]



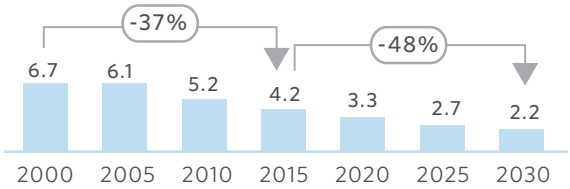
Source : Thailand National Statistics Office

In addition, large proportion of elderlies live in home environment with high risks of accidents. Handrails can help to reduce chances of severe falls. Yet, in Thailand, more than 90% of elderlies are living in houses where there are no handrails in bedrooms and bathrooms. Stairs and toilets are common places for accidents. In Thailand, 54% of elderlies still live in houses with traditional pit latrine toilets. These are harder for elderlies to use and increase risk of accidents. Furthermore, approximately 35% of elderlies in Thailand live in houses where bedrooms are not on the ground floor. The elderlies have to use stairs regularly, increasing chances of accidents.

5. Decline in elderly support ratio

Aging society has led to reduction in number of working population supporting each elderly population. The elderly support ratio, which measures the number of working-age population (aged 15 to 60) per 1 elderly, has drastically fallen from 6.7 in 2000 to 4.2 in 2015, and the ratio is expected to half by 2030 with 2.2 working-age people per 1 elderly. This will exert pressure on adequacy and quality of medical infrastructure and personnel. Government will need to increase spending efficiency, as number of tax-payers falls, while number of people suffering from chronic diseases increases. Elderlies' lifestyle will also need to change, as higher degree of independence will be required in daily living.

Figure 10 : Number of working-age population per 1 elderly population [2000-2030]



Source : The United Nations, Euromonitor

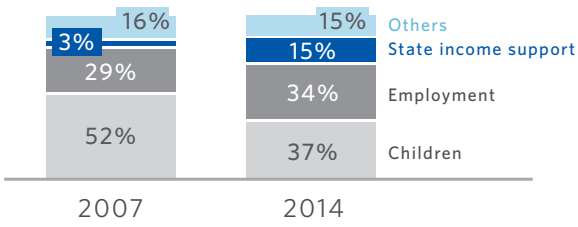
6. Financial dependency

There is large discrepancy in income levels across age groups. Thai elderlies are approximately 30% poorer, in terms of annual income, than the 40-44 year-old. This is in contrast to France and Australia where elderlies are estimated to be only 5% and 10% poorer than the 40-44 year-old age bracket.

Most elderlies still depend on children for financial support. 80% of elderlies still receive financial support from children and 37% of elderlies report income from children as the main source of financial support. In addition, elderlies' dependence on state income support has also risen (See Figure 11).

To help overcome the above challenges facing Thailand in the context of aging society, relevant digital technologies have been identified and grouped into four solutions.

Figure 11 : Thai elderlies split by major source of income



Source : Thailand National Statistics Office

A **National Health Information System (NHIS)** serves as backbone for digital healthcare for elderlies. It involves collection, sharing and use of real-time data stored in national platform. The platform stores critical healthcare data, including life-long records of individual patients. NHIS development ensures continuity and enhances quality of care, while data analytics permits more effective disease prevention and policy formulation.

B **Telehealth** allows healthcare providers to deliver healthcare services to patients remotely using ICT technology. Telehealth facilitates collaboration between medical personnel and improves access to high-quality healthcare for elderlies in rural areas. It also permits healthcare providers to remotely monitor health conditions and manage chronic diseases for elderlies.

C **Smart Home and Robotics** include the use of home sensors (e.g. fall sensors, inactivity sensors), smart IoT appliances and care robots at the homes of elderlies, with the main objective of enhancing safety. Smart Home also improves convenience and independence of elderlies.

D **Digital Social Interaction solutions** include online communities and digital platforms, as well as lifestyle apps and cognitive games. Using these digital tools can promote socio-economic contribution, healthy lifestyle and improve quality of life for elderlies.

Each of the four solutions are further detailed in the next section. Market trends, current situation, and opportunities are examined and discussed.

Telehealth
allows healthcare providers to deliver healthcare services to patients remotely using ICT technology.

Key challenges

1. High health expenditure
2. Rising chronic disease prevalence
3. Poor availability and access to healthcare services
4. Living alone + risky living environments
5. Fall in elderly support ratio
6. Financial dependency on children and state

Solutions

A National Health Info. System

B Telehealth

C Smart Home and Robotics

D Digital Social Interaction Solutions

National Healthcare Information System will improve quality of care

Chronic diseases and complex medical conditions are becoming more common with aging society. For effective diagnosis and treatment of these diseases, full medical information and historic records on the patients are essential. If this information is stored separately by each hospital, when a patient goes to a hospital for the first time, doctors do not have access to his medical history from all previous providers. Time and efforts are lost in contacting providers to obtain medical information piece-by-piece. Often, patients still have to recall medical history to doctors verbally. This is subject to errors and misjudgments. National Health Information System (NHIS) addresses these issues by creating national, shared platform for storing patient records. The availability of data benefits both the patients and the providers, as well as the government in policy design and resource planning.

OVERVIEW

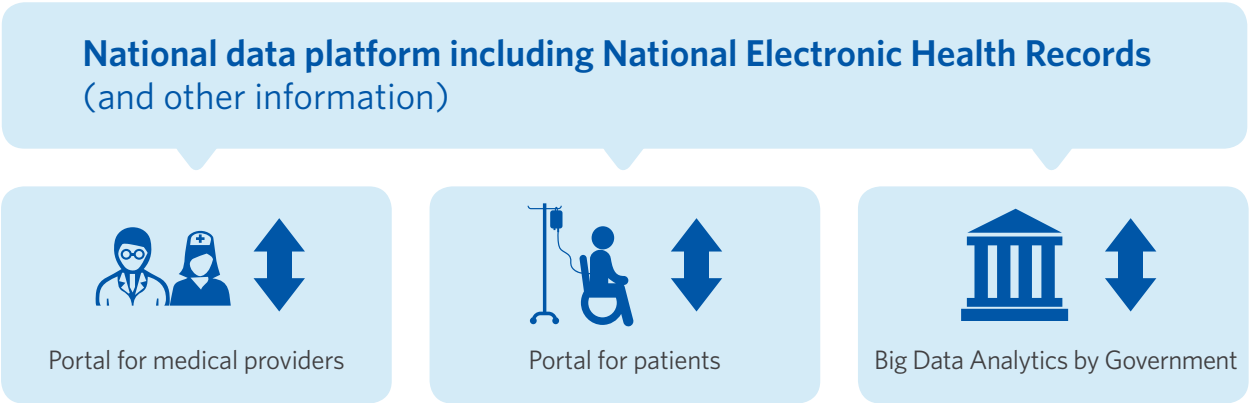
The NHIS involves collecting, storing, sharing, and using real-time data. It is centered around a national data platform, which is a shared central platform for storing information. It covers the life-long health records of individual patients. The electronic health record contains information such as personal demographic information, insurance information, allergies, diagnostics, treatment, medication, hospitalization, and results of lab tests. Other information may also be stored on the national platform, alongside patients' records such as database of doctors and hospitals.

Two types of Portals can serve two main sets of stakeholders, medical professionals and patients. Portal for medical providers is an interface to access the national data platform. It allows medical personnel to access patients' records stored on the national data platform. Doctors can view the information and make well-informed decisions on diagnostics and treatment plan. Emergency personnel can view patients' insurance and drug allergy information. Through the Portal, medical providers can also update patients' records in the national platform. All updates are done through a common program using consistent templates and standardized terminologies. The information is updated in real-time on the shared national platform and becomes readily accessible by the patients and other providers.

In addition, the Portal permits healthcare providers to interact with each other. For example, General Practitioners (GPs) can use the Portal to refer patients to suitable specialists. Doctors may also be able to send lab requests and order prescriptions through the Portal.

The Patient Portal is an interface for patients to access the national data platform. Patients can view medical records stored in national platform anywhere at anytime. They can also make updates to parts of their personal health records (e.g., insurance information, emergency contact details, self medication). Patients may update their personal records with own medical readings and lifestyle parameters such as daily blood pressure and calories intake. Through the Portal, patients can also search for information on hospitals and doctors. In some countries, the Patient Portal allows patients to make and manage appointments with healthcare providers. Health tips and latest information on diseases may also be provided to patients via the Patient Portal. Government can use the data on the national platform for policy design. Health records of individuals are anonymized and aggregated to form macro-view of health conditions and healthcare services provision. Big Data Analytics is leveraged to study diseases, lifestyle, treatment and medication, in order to design disease prevention strategy and plan medical resources efficiently.

Figure 12 : Key features of the National Health Information System



Source : Roland Berger

Case study : One Patient, One Record – Singapore's secret to better quality healthcare

Singapore is one of the few countries in Asia to have National Electronic Health Record (NEHR). With nearly 20% of people aged 60 or above in 2015 compared to 12% globally, Singapore is facing high prevalence of chronic disease, which requires continuity of care. The system has comprehensive, real-time information about patients, accessible by providers across the care spectrum – GP clinics, hospitals, nursing homes. For example, nursing homes can update health information of the elderly patients in the NEHR, and doctors can immediately access the updated information and make any adjustments to medication accordingly.

In 2016, Singapore also launched Health Hub, a patient portal, with the objective to see Singaporeans be more pro-active in managing own health, and reduce chronic diseases. Selected features are shown below:

View records

Download health apps

Search for providers

The public response has been very positive

90%

Report better quality of care after NEHR

87%

Willing to share personal data via the Portal

The priority now is to leverage Big Data Analytics to enhance predictive capabilities. This will permit early intervention among high risk population, thereby improving overall health and reducing healthcare bills.

Source : Singapore's Ministry of Health, National University of Singapore, Health Hub's website, Channel News Asia, Accenture

BENEFITS

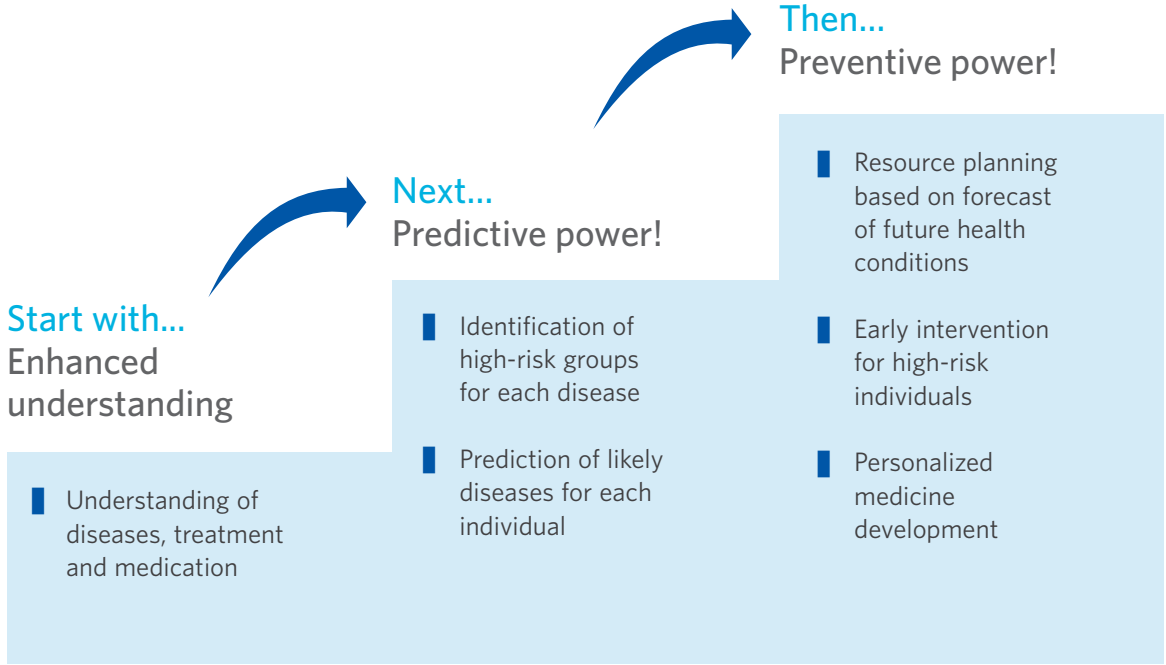
The National Health Information System (NHIS) benefits both the government, the patients (general population) as well as healthcare providers.

Government and medical researchers can leverage Big Data Analytics to enhance understanding of diseases, treatment and medication. The national data covers the entire population and includes more variation than smaller samples. This allows unknown patterns to be revealed including correlations between diseases, and correlations between diseases and lifestyle. Better understanding is gained on characteristics associated with each disease. In addition, Big Data permits more thorough analysis of effectiveness and side effects of different medication and treatment.

Better understanding of diseases enhances predictive capabilities of government. The government can identify demographic groups and individuals most at risk from each disease "more accurately" by looking at who possess the characteristics associated with a particular disease. Future health conditions and healthcare demand can also be more accurately forecasted.

Early intervention can be provided to these high-risk groups, which can reduce occurrence and severity of illnesses. If combined with genetic data, National Health Information System can also help predict health conditions of each individual and allow development of personalized medicine.

Figure 13 : Overview of benefits of Big Data Analytics



Source : Roland Berger

Patients, including elderlies, benefit from the NHIS. Firstly, the NHIS helps provide continuity of care for patients. The same health records are accessible by all providers nationwide regardless of location and types of hospitals. This enhances safety in emergency situation and permits smaller local hospitals to conduct effective follow-ups after treatment is received at bigger city hospitals. It reduces needs to travel to hospitals in the cities and helps alleviate accessibility issues for rural population. The NHIS provides continuity of care for patients across time. Lifelong records on each patient are stored in the national platform. Access to full medical history is necessary for effective monitoring and management of long-term chronic conditions, which are common among elderlies.

The NHIS can also help encourage population to be more pro-active in managing own health conditions. Patient Portal makes it easier for the population to view own health conditions and arrange healthcare services directly. Data in the NHIS facilitates growth of health startups and supports development of new innovative health applications. These applications encourage people to have healthier lifestyle conditions. Better health conditions help reduce healthcare bills for individuals.

Healthcare providers also benefit from the NHIS. Firstly, the NHIS can reduce time and cost of unnecessary administrative paperwork. The NHIS improves work efficiency. It also provides access to quality information for fully-informed clinical decisions. This is especially critical for chronic conditions requiring data points on patients across a period of time for effective diagnostic and treatments. In addition, the NHIS enhances effectiveness of collaboration between specialist doctors from different disciplines. The NHIS facilitates information sharing as providers nationwide have access to the same updated health records. It also makes referral of patients to other specialists easier. With a national doctor database, doctors can also easily search for suitable specialists to refer the patients to, even if the specialists work in different hospitals.

"Elderly patients usually have complex symptoms that require collaboration and data-sharing between doctors of different disciplines"

Geriatrician from a leading hospital

Case study: Estonia – A pioneer of NHIS and a success case for high adoption

Estonia launched the NHIS in 2008 to improve quality of care and reduce cost. The project was a part of the e-Government program. Patient records are stored on shared national platform and are accessible by providers nationwide.

90% of discharge letters

In digital format within 5 years

90% of population

Covered within 5 years

Key success factors of high adoption are:

1. Emphasis on safety and confidentiality to enhance trust in the system – patients can view who accessed their data and can restrict access of sensitive information such as mental and sexual health

2. Usage of existing infrastructure, which is trusted by the patients in terms of security e.g. the secured data exchange platform, called X-Road, the ID card system

3. Connection with providers' systems via interfaces to minimize integration costs

Source : European Commissions, Software Technology & Application Competence Center, E-Tervis

Case study : Denmark – Improving doctors' work with digital health records

Denmark launched National Health Information System to facilitate sharing of information and reduce administrative expenses for providers. Successful take-up by doctors is a result of continuous engagement. Medical personnel was actively involved in the development of the NHIS from the design stage. This promotes buy-in by ensuring the information and features included in the system genuinely help clinicians at work.

98% of GPs

Used the system after 4 years of launch

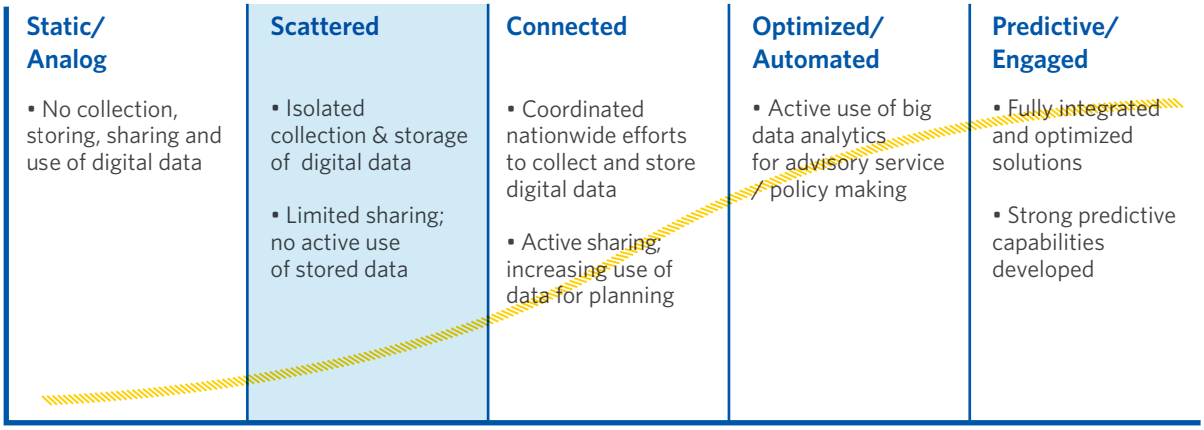
30 hours per week

Used the system after 4 years of administrative work saved per GPs

Source : Gartner, IBM Danish Department of Health

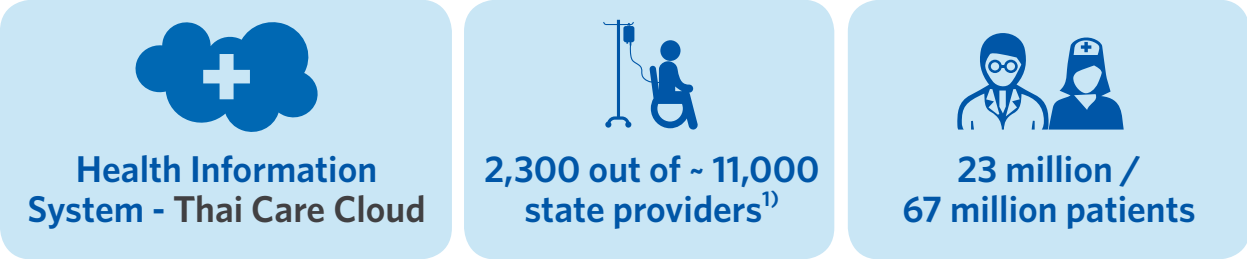
WHERE DOES THAILAND STAND?

Figure 14 : Digital maturity phases of national health information system



Source : Roland Berger

Status of government pilot (as of February 2017)



1) Hospitals under MOPH

Currently, in Thailand, the Digital Maturity level of NHIS is at "scattered stage". There is some isolated collection and storage of digital data by both the private and public sector. However, the efforts are largely uncoordinated with limited sharing and integration of databases. Stored data is not actively used by stakeholders for decision-making.

The Thai government is conducting a trial of NHIS. The government plans to link databases of different state hospitals, in order to create national database of patient records. A program, called the Personal Health Records, is initiated by the NECTEC, SIPA and the MOPH. The first pilot was launched in Nakorn Nayoke province, just East of Bangkok. Basic information about 2,500 participating patients is stored in provincial data center. The information is accessible via web browser by the patients directly and by all 60 healthcare providers under the MOPH. In mid-2016, the pilot was extended to 4 more provinces: Phuket, Kanchanaburi, Petchabun and Roi-Et.

Furthermore, MOPH and Khon Kaen University have signed a MoU to establish a National Health Information System, which later was established under the name "Thai Care Cloud" – a web application that is free of charge for public use. This system utilizes a bot that is able to extract data from the same data set that the hospitals normally send to the MOPH's National Health Security Office (NHSO). This system works regardless of the HIS that the hospital is using. This allows the data from the hospital own information system in the internal network to be transferred to the shared platform, the Thai Care Cloud, in real time. There are no requirements for the hospitals to open any ports to their internal information system; hence confidentiality will still be kept. The data provider still have full ownership of the data being transferred, and only if the permission is granted from the data provider, the data will be shared with site members, specify member, and the public. Data analysis can be done with just a click to get results per standard reporting templates. The data can be exported and downloaded for further analysis or research pur-

poses. In addition, users can create data collection form at any time to collect any data they need. Each form is linked with the citizen's national identification number. Membership is absolutely voluntary and HIS internal network's connection to Thai Care Cloud can be terminated and re-initiated at any time. Currently, over 2,300 organizations are members of Thai Care Cloud, and data is currently collected from over 1,900 sub-district health promotion hospitals, covering 23,000,000 people of Thai population.

Nevertheless, there are many challenges going forward. A common obstacle is the digital readiness of medical personnel. Some hospitals report that many of their personnel are still not comfortable with using computers. Besides, many medical personnel see digital tools as being difficult to use and adding extra layer of work. Another major obstacle facing some private hospitals is the shortage of computer hardware. With insufficient devices to efficiently collect digital patient records, records are not yet fully digitalized. Moreover, IT-personnel, doctors, and management team have often cited that low interoperability of systems limit the development of integrated information systems within hospital chains. High IT integration cost often delays efforts to combine patient records into one single database. In addition, doctors report that there are concerns among patients regarding data privacy and confidentiality. Patients are generally supportive of having digital records stored electronically in each hospital's private database. However, the idea of sharing patient data between hospitals and putting patient records on shared database often raise concerns that personal information will be leaked and used inappropriately. If the National Health Information System is to be further developed in Thailand, these concerns must be addressed to gain buy-in and participation from both the healthcare providers and patients. In addition, the system has not been adequately promoted, resulting in low awareness of the system and its benefit among general population and even among many doctors. This includes the fact that the existing system can avoid and get around interoperability issues.

The future goal is to have a single central data server for integrating provincial databases. Patient information will be made more comprehensive and will be accessible via smart devices, with links to personal wearables in the future. Public sector is also working with private sector software companies to develop innovative healthcare applications, leveraging data in the Personal Health Records. The goal is to use these applications to encourage the population to be aware of their own health and be pro-active with health management.

" Some of our doctors are the most senior and experienced in the discipline. Many are not too comfortable with computers and find the current interface difficult to use"

Doctor from a leading hospital

" Doctors say it is faster to write. Some fields such as ophthalmology require drawings"

Doctor from a leading hospital

" Different hospitals in our chain use different systems. It will be costly and time-consuming to integrate data"

Doctor from a leading hospital

" Health records contain private information about individuals. Patients are concerned that by putting the records in a platform shared by many hospitals, there is an increased risk of data being leaked to unintended audience and used inappropriately. Therefore, the use of secured servers, strong law and regulation to protect data privacy, and full transparency on data use by patients are all necessary"

Doctor from a leading hospital

HOW TO DRIVE THAILAND FORWARD?

The NHIS is useful in mitigating many challenges faced by Thailand. Aging society will continue to put pressure on the already high state healthcare spending, while access to high-quality healthcare services remains an issue, especially for poor and rural population. The promotion and capitalization on the existing NHIS in Thailand, beginning with the National Electronic Health Records (NEHR), could improve quality of healthcare services and reduce long-run costs for both healthcare providers and the government.

In the next five years, Thailand should improve its National Health Information System with more coordinated nationwide efforts to collect and store digital patient data on the single national platform. Providers and patients should also be encouraged to share and actively use the data. National Health Information can support medical research and enable data-driven policy design and resource planning. Open data policy will facilitate sharing of national statistics and analytics with the public and with businesses. This will also support the development of innovative healthcare products by the private sector and foster the healthcare startup ecosystems. The proposed priorities for Thailand regarding National Health Information System include:

1 Develop National Electronic Health Records (NEHR) accessible by medical personnel and analyze data for resource planning and disease prevention

- Involve healthcare providers in the design and roll-out of NEHR system
- Ensure level of quality and security of the cloud-based platform adhere to international standards
- Standardize and integrate existing data already collected
- Set national standards in the collection and storing of patient data to standardize practices for providers nationwide
- Use both regulation and incentives to encourage healthcare providers to participate in NEHR and contribute patient data
- Support provision of training to medical personnel on digital capabilities
- Define legal and regulatory framework to protect patient data privacy but at the same time allow for data-sharing via anonymization
- Promote awareness of system to healthcare providers and the public
- Link NEHR data with data from other relevant Ministries
- Use Big Data analytics software to anonymize, organize and analyze data, and use insights from analytics to formulate policy design, focusing on risk group identification and early intervention

Recommended KPI

% of providers contributing data to the NEHR

% of patients covered by the NEHR

2 Develop National Patient Portal for population to access the NEHR and provide open data to startups to develop innovative health applications

- Collaborate with private sector partner to develop National Patient Portal
- Continuously include new features in Patient Portal e.g. ePrescription
- Foster ecosystem of healthcare startups, which develop new applications leveraging data from the NEHR
- Evaluate and decide on business model for sharing data and analytics to businesses and public

# of active users of the National Patient Portal

# of healthcare apps developed from NEHR data

" It is important to encourage collection of more data, by encouraging more providers to collect and share data. However, standardizing and integrating existing data already collected is also critical"

Government official

" Collection of data is not the end in itself; it is only the beginning. (Anonymized) data should be analyzed and shared with providers, businesses and public "

Academic from leading university

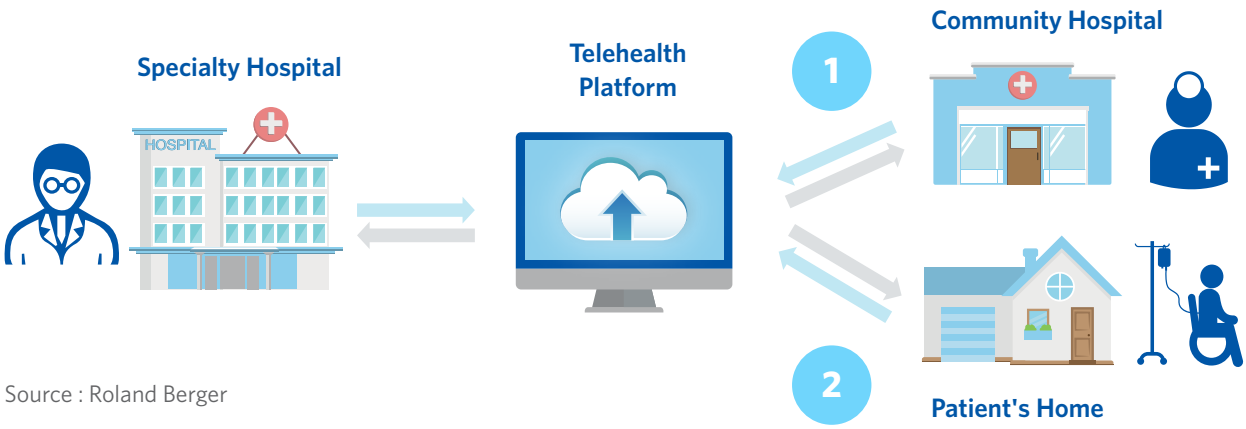
Telehealth provides more efficient and cost-effective solution of providing healthcare for elderlies in rural areas

Healthcare providers are usually at the forefront of innovation and are continuously trying to improve the reach, quality and efficiency of their services. Majority of rural population in developing countries, especially elderlies, still have physical and finance barriers in accessing healthcare services. With the advancement in ICT infrastructure and telehealth technology, healthcare providers are now able to provide value added services and bridge the service gaps. Telehealth offers benefits to healthcare provides, patients and governments. It greatly improves access to quality healthcare for elderlies, with particularly high impact on those living in rural area. It also has the potential to reduce healthcare expenditure for all parties.

OVERVIEW

Telehealth solution employs ICT to deliver health services remotely. It can be used between healthcare providers (provider-to-provider), or between healthcare providers and patients (provider-to-patient) as shown in Figure 15.

Figure 15 : Overview of telehealth concept



Source : Roland Berger

For **provider-to-provider,** telehealth builds collaborative environment and enables better interaction between healthcare providers. For instance, GPs could consult with specialists remotely via live HD video conference. Collaboration between doctors of different disciplines is especially common for complex condition usually faced by elderlies. While, for **provider-to-patient,** telehealth empowers healthcare providers to continuously monitor the health condition of elderly patient at home. This is especially useful for elderly patient with chronic health condition such as heart diseases. The two cases altogether cover over 30 service lines including, but not limited to tele-radiology, tele-stroke, tele-dermatology, chronic disease management and tele-education. There are many methods in which telehealth technology can be deployed. It can be tailored to the specific needs of doctor and patient including **Asynchronous, Synchronous and Remote Monitoring.**

Asynchronous (Store-and-Forward) approach utilizes telehealth software for transfer of information such as pre-recorded video, digital images like x-rays, and clinical results for reviewed by a specialist at a later stage. For example, smaller hospitals may not always have a radiologist on site so GPs can use telehealth platform to send patient's x-rays film and records securely to a qualified radiologist at another location, and to get a quick consultation on patient's condition. **Synchronous** approach employs real-time, two-way communication between healthcare providers (or between providers and patients) for live-consultations, health examination, and health education and training. **Remote Monitoring** involves the collection of health data, such as vital signs and blood pressure from chronically ill patients at home, and the transmission of that data to provider's telehealth platform in a separate location. This method is used mainly in the management of chronic conditions like diabetes, cancer, hypertension, and heart diseases. According to the Center for Disease Control (CDC), over 80% of healthcare spending in the USA was for people with one or more chronic medical conditions.

Case Study: Apollo – Achieve quality and accessible healthcare for everyone[1)]

Currently, more than 700 million people in India have no direct access to quality care. Leveraging ICT infrastructure advancement in India, Apollo decided to employ telemedicine to connect its consulting centers in rural areas to its specialty hub hospitals. This enables remote consultation to patients that have difficulty accessing quality care due to cost and distance. Audio files, text data, images and video can be transmitted using Broadband, ISDN lines or VSATs via in-house developed web based software "Medintegra". Now, Apollo has over 135 telemedicine consulting centers and is the largest multi-specialty telemedicine network in South Asia.

To-date over 80,000 tele-consultation services in 25 clinical specialties are completed

1) Apollo Hospitals Group – one of the largest private hospital in Asia
Source : Apollo Hospitals Group

Illustrative: How provider-to-provider telehealth reduces need to travel to hospitals for Parit

Elderlies visit community hospital nearby

- One day, Parit wakes up with a skin anomaly but he can't travel to specialty hospital because of his mobility issues and because his daughter is away
- Instead, Parit can opt for a visit to community hospital staffed with GPs

GPs perform basic examinations

- GPs can take basic medical readings and photo of the skin area with anomaly
- Preliminary results and photos are forwarded to dermatology specialist in tertiary hospitals asynchronously for remote diagnosis

Remote consultation with specialists

- Specialists can recommend treatment plan and provide guidance to GPs through the telehealth platform
- If needed, specialist can use tele-consultation, via HD video conference, for further live examination

Illustrative: How provider-to-patient telehealth helps Prim to manage her chronic health condition

Medical data taken at home regularly

- Prim is suffering from diabetes and she uses peripheral medical devices to measure her vital and sugar level
- Initially, Prim enters the readings into the telehealth station manually; now, her devices can automatically collect and transfer reading into the system

Alerts to medical personnel if problems arise

- Healthcare providers can analyze the data and get alert if the sugar levels and vital readings exceed normal threshold
- Doctor can adjust medication based on the current reads

Early intervention for prevention and treatment

- Homecare team can visit Prim to provide treatment at home or ask her to go to the hospital if needed
- This enhances preventive measures which reduce occurrence and severity of Prim's chronic conditions

BENEFITS

Telehealth brings efficiency to the healthcare industry. It offers various benefits to patients, healthcare providers and the government.

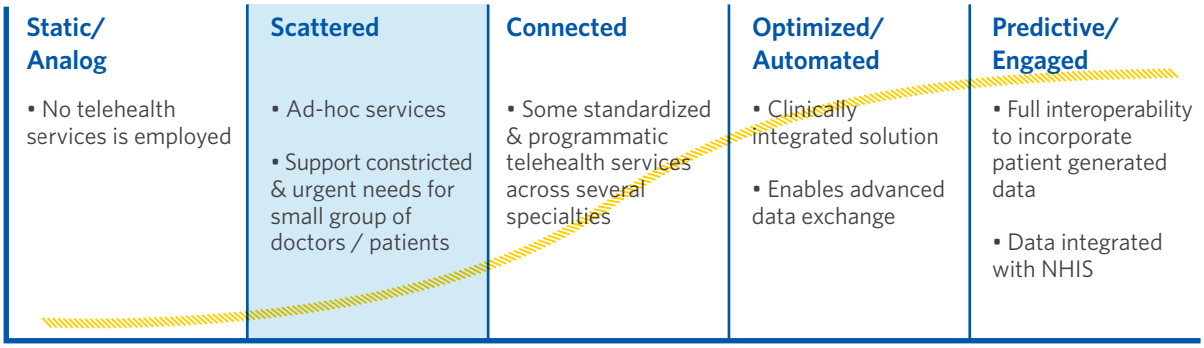
Healthcare providers can employ telehealth to extend their services to rural area without building traditional brick and mortar infrastructure. It allows GPs in rural area to consult and collaborate virtually with specialists at larger hospital. Telehealth also provides a channel for multiple providers to communicate within a single session as well as exchange large amount of data (e.g. x-ray films), ideal for elderly cases which usually require cross-discipline collaboration. This can improve healthcare service quality.

Elderlies can get better access to healthcare via telehealth. It allows elderlies to receive healthcare services from specialist in larger hospitals, simply by visiting the local health center. This reduces associated cost and burden from traveling long distance to specialty hospital. Furthermore, one of the key feature of telehealth, remote patient monitoring, allows healthcare provider to continuously monitor elderlies' health chronic conditions. This enables healthcare providers to address the problems before they become acute, improving preventive measures. This leads to reduction in occurrence and severity of chronic conditions as well as associated hospitalization and ER visits. According to remote patient monitoring pilot studies in the USA, hospital visits and emergency department utilization can be reduced by approximately 40% and 70% respectively, according to studies from Leading Age CAST.

Government can leverage telehealth to potentially reduce its healthcare expenditure. Telehealth lessens the need for costly nursing home and assisted care facilities. Government can employ telehealth to address the problem of healthcare personnel shortage, in which specialist in large hospital can provide tele-consultation services to local hospital or to area that lacks healthcare personnel. As mentioned, telehealth promotes greater patient engagement and more efficient care. It allows healthcare providers to remotely monitor and provide healthcare services for elderlies living at home or rural area. This facilitates more effective community based care approach, allows for better use of hospital beds, and empowers elderlies to "age at home". In addition, Telehealth can be used to develop medical specialist, especially in family medicine, via tele-education between resident and specialists in medical education center under MOPH

WHERE DOES THAILAND STAND?

Figure 16 : Digital maturity phases of telehealth



Source : Roland Berger

Public sector has initiative to develop telehealth system

to link and modernize over **116** general hospital and regional hospitals

Mostly ad-hoc services

for special needs via readily available tools and software

Currently, in Thailand, the digital maturity level of telehealth is at "scattered" stage. There are very limited standardized and programmatic telehealth services offered by both the public and private sectors. Telehealth is only used to support constricted needs for small groups of doctors and patients. Majority of telehealth services are still being employed as ad-hoc solutions. Doctors usually consult with each other for second opinion or provide advice to friends and family by using readily available devices and system such as smartphones and communication apps, but not through proper telehealth platform. However, increasing development and utilization of telehealth by both the public and private sectors expected in the coming years.

Public sector has conducted many pilots. For example, MOPH initiated to connect some sub-district health promotion hospitals (SDHPH) to hospitals with higher capability via telehealth, extending health services to rural area. Larger scale collaborative telemedicine project "Sukka Sala" under the direction set by HRH Princess Mahar Chakri Sirindhorn was also launched with the aim to increase access to healthcare services by people in border provinces. In addition, medical education center such as Siriraj hospital use telehealth to provide video conference services which are mainly used for tele-education and training.

Furthermore, MDES has collaborated with MOPH and EGA to develop telehealth system, as well as network infrastructure, IT system and application, to link and modernize over 116 general/ regional hospitals. They intend to utilize Government Infrastructure Network (GIN) for transferring visual and sound data in the target areas between general/ regional hospitals and community hospitals, improving the quality of treatment.

For private sector, there are scattered and silo-ed efforts to roll-out telehealth services. Standardized and programmatic telehealth services are usually found only in large private hospital chains. For example, Bangkok Dusit Medical Services (BDMS) group has set up telemedicine center which mainly provides tele-radiology and tele-conference services. BDMS also employs robodoctor system, which enables specialists in Hub Hospital to provide treatment to patient in Spoke Hospitals via robot. The robot is equipped with camera and microphone that allows specialists to see patient's condition live, to recommend treatment plan, and to provide guidance to GPs in Spoke hospital. Initial pilot was launched to help patients with brain and nervous system related symptom in 4 hospitals with no neurology specialists. While, Phyathai 1 Hospital has introduced Mobile CT and Stroke Treatment Unit, a special ambulance equipped with CT scan, laboratory and telemedicine system. Patients suffering from Stroke can be treated more quickly and effectively than conventional ambulances. Moreover, leading private hospitals such as Bumrungrad International Hospital has developed partnerships with 10 other hospitals nationwide to share and exchange knowledge through telehealth system.

"Telehealth usage is already widespread among doctors but mostly as an ad-hoc tools; while programmatic telehealth services offered by public & private hospitals are limited"

Doctor at a public hospital

Case study : Sukka Sala – Bringing doctors close to home: From 12 hours to just one-click away

Communities in remote boarder regions face difficulties in accessing healthcare services. For many, the journey can take up to 12 hours even to the nearest SDHPH. "Sukka Sala" project is a collaboration scheme between 6 organizations. Beginning in 2006, 18 small medical centers were set up at the Border Patrol Police's school campuses and staffed with local nurses. In 2008, telehealth systems were gradually added to these medical centers. GPs or specialists can use the system to talk to patients and see the patients via the camera, allowing diagnosis and treatment recommendations to be provided to the local nurses. Future plan includes installing more monitoring and diagnosis equipment at medical centers to permit tele-consultation to cover more complex diseases. Extension of broadband service to more areas will also help enhance the quality of the image.

Over 18,000 sessions across 7 provinces in 2016

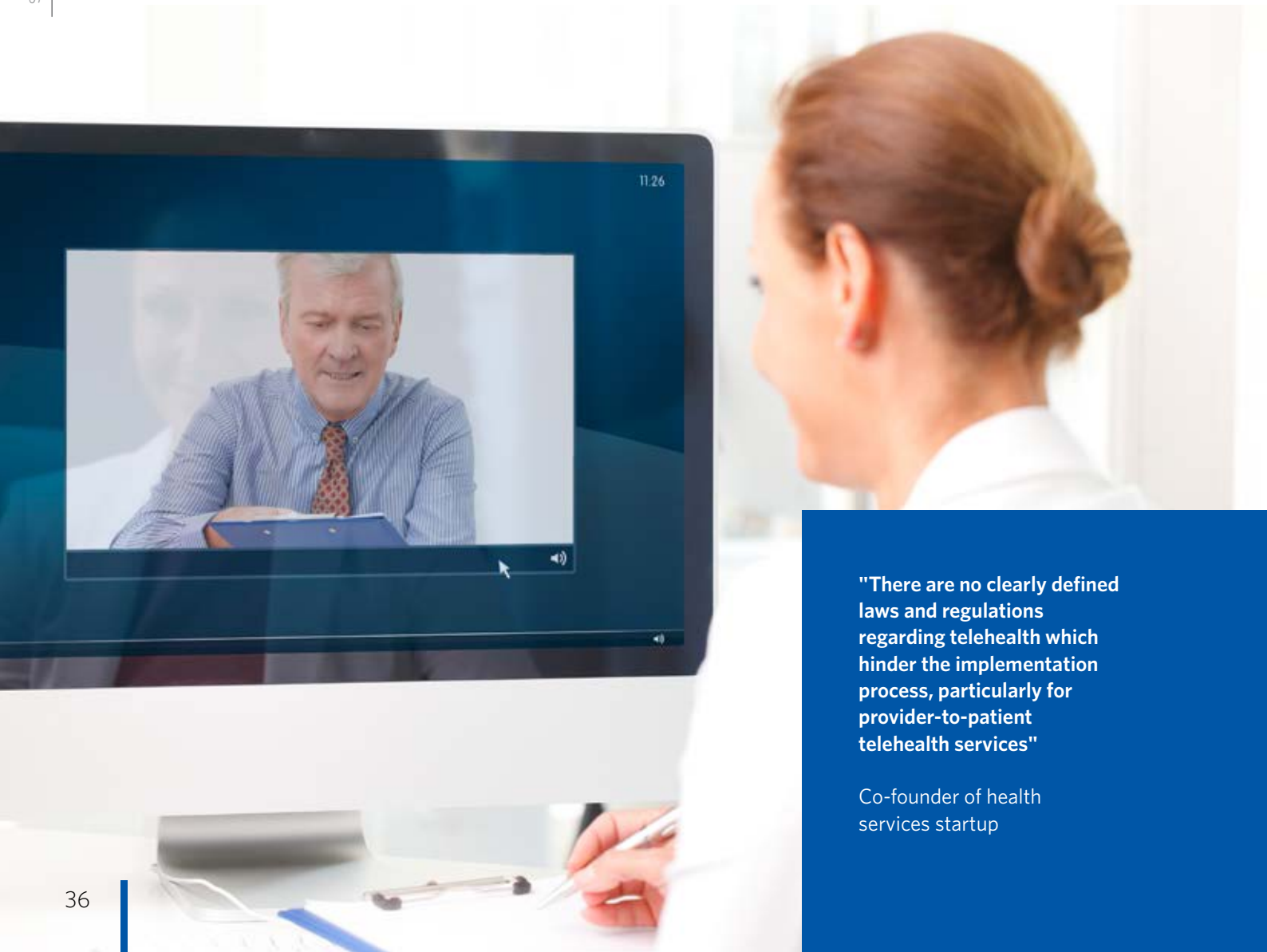
Source : MOPH, TOT, RYT9

In addition, many hospitals, both public and private, have plans to develop and launch provider-to-patient telehealth services, more specifically remote patient monitoring, to manage chronic disease among patients; while, companies and startups are on the process of developing standardized and programmatic platform for telehealth services.

To sum up, adoption of telehealth in Thailand is limited due to a number of reasons. Firstly, general population and many healthcare providers are still not aware of telehealth technology and its benefits. Secondly, telehealth is not yet being regulated in Thailand, making it unconducive for roll-out. Thirdly, the ICT infrastructure in rural areas is not ready, both in terms of speed and coverage parameters.

"General population are not aware of how telehealth could help improve their quality of life and reduce health expenditure. These technologies allow better management of chronic health conditions and reduce the need for unnecessary commuting to hospitals"

Doctor at a leading private hospital



"There are no clearly defined laws and regulations regarding telehealth which hinder the implementation process, particularly for provider-to-patient telehealth services"

Co-founder of health services startup

HOW TO DRIVE THAILAND FORWARD?

Telehealth technology can mitigate many of the on-going problems associated with healthcare for elderlies in Thailand including, but not limited to rising healthcare expenditure, shortage of healthcare providers, and increasing prevalence of chronic health conditions. Development of provider-to-provider telehealth network could significantly improve accessibility to quality healthcare for elderlies and address the healthcare provider shortage in rural area. Furthermore, introduction of provider-to-patient telehealth (i.e. remote patient monitoring) can assist elderlies to better manage their chronic health condition, reducing occurrence and severity.

In the next 5 years, Thailand should focus on the development of provider-to-provider telehealth service to connect general/ regional hospitals and community hospitals. Remote patient monitoring service should also be introduced and used more widely to better management chronic conditions. Public authorities need to collaborate to ensure infrastructure readiness. They also need to promote awareness and understanding of telehealth solutions. The key priority initiatives for healthcare providers are detailed below.

3 Develop nationwide network of provider-to-provider telehealth to improve access to health services for elderlies in rural area

- Define priorities and scope for provider-to-provider telehealth, focusing on the roll-out of services between general/ regional hospitals and community hospitals
- Ensure infrastructure and personnel readiness and support to improve access to health services for elderlies in rural area
- Amend and enact laws and regulations to support the launch of telehealth
- Promote awareness and understanding of provider-to-provider telehealth to both healthcare providers, elderlies and their family

Recommended KPI

% of Hospital with telehealth system

# of patients treated using telehealth

4 Initiate the use of provider-to-patient telehealth, particularly RPM, for chronic disease management

- Emphasize on the launch of RPM for chronic disease management
- Develop the infrastructure and personnel to support provider-to-patient telehealth service both at home and at the hospitals
- Promote and support private startups to develop wearable devices for elderlies
- Develop campaign to promote awareness and understanding of provider-to-patient telehealth to both healthcare providers, elderlies and their family

# of providers offering RPM program

% of elderlies enrolled in RPM program

Using smart home solution to enhance safety and convenience of elderlies at home

Ensuring safety of elderlies is one of the top priorities for both the families and the government. If an elderly gets into accident, it is critical to be alerted instantaneously. Few minutes delay can make a difference between life and death, being paralyzed or not. Smart Home is a set of digital solutions which help enhance safety of elderlies and reduce severity of accidents by allowing help to be dispatched quickly, should an accident occurs.

"Many elderlies suffering from stroke or severe falls end up worse than they could have been if they had arrived at the hospital earlier. Smart Home solution that allows immediate detection of accidents and permits prompt responses are thus critical for elderlies' safety"

ER doctor at a private hospital

OVERVIEW

The technologies involved in Smart Home can range from home sensors to more complex Smart IoT appliances, and care robots.

Home sensors for elderlies are unobtrusive items equipped with IoT technology placed around the house of elderlies to monitor the home environment. Sensors learn what is "routine" (e.g., typical movement of the particular elderly, usual room temperature) and detect when movement or temperature deviate from the routine. Once these irregularities are detected, automatic alerts are sent, permitting early intervention. Alerts may be sent to smartphones of elderlies or relatives, as well as directly to emergency services, depending on the types of sensors. Figure 17 below shows some types of sensors that can be used to enhance elderlies' safety and convenience. These sensors are the most simple and easy-to-use smart home solution, and can really help enhance elderlies' safety.

Figure 17 : Overview of some types of home sensors that can be used for elderlies

	Monitor	Detect	Alert
Inactivity sensors	General movements in and around the house	Unusually long periods of no movements around house	To relatives/ service providers for intervention
Fall sensors	On stairs and in bathrooms (common places for falls)	Unusual movements (speed, direction)	To relatives/service providers for intervention
Occupancy sensors	Absence/presence on beds at night (common time of falls)	Unusually long periods of absence from the bed	To relatives/service providers for intervention
Wandering sensors	Movement at doors of elderlies with dementia	Opening of doors in unexpected time	To relatives/service providers for intervention
Cupboard sensors (reed switches)	Opening of medicine cabinets and/or boxes	No openings of cabinets at a time when there is usually opening	To elderlies with reminders to take medicine

Source : Roland Berger

Case study : Life Link sensors – Helping Australian elderlies live fulfilling life at homes

With 20% of Australia's population being 60+ and shortage of nursing homes, Smart Home technology is seen as a major tool that allow elderlies to remain in their homes by enhancing safety and convenience of being alone. However, many elderlies perceive smart home solutions as expensive and difficult to use.

Feros Care's Life Link is changing this common perception by offering wide range of affordable smart home packages. The solution mostly focuses on sensors, which are simple and affordable. They are easy to use and can perform their functions without requiring lots of actions from the users. If movement associated with potential falls is detected, alerts are sent to the 24/7 call center. The staff tries to contact the elderlies first to verify if there is false alarm. If there is no response from the elderlies, emergency services are dispatched.

Life Link does not sell sensors off-the-shelf as products, but sensors are sold in packages as complete solutions for specific needs of the elderlies. Advices on the most suitable packages, installation services and connectivity features to 24/7 assistance center are provided in the packages.

Life Link is also very affordable with one-time installation cost of USD 75 - 150 and monthly cost of USD 25–50. The affordability of the solution enabled adoption. The solution is available nationwide.

Cost of using Life Link for 1 year is up to

1% **of average annual income of elderlies**

Life Link is well received by its users

90% of users **report better quality of living after using the solution**

Source: Life Link website,
Feros Care website, Huffington Post

Smart IoT Appliances allow communication with smart devices, as well as with other appliances. The objective is to enhance convenience of users in daily living. There are two main categories of Smart Appliances.

The first is the type of IoT appliances that can communicate with users' smartphones. Appliances can send alerts and reminders to smartphones when anomalous activities are detected. For example, alerts may be sent to users to switch off appliances. They also allow users to remotely control appliances from smart phone devices. For instance, smart light switches are controllable via smartphones to reduce need to walk around the room. The second is the type of IoT appliances that can also communicate with each other. These appliances can coordinate with each other to respond automatically to people's activities or surrounding environment. For example, a bed detects when a person gets up and automatically "signals the light to switch on". This prevents accidents as elderlies no longer needs to walk in the dark.

Some examples of Smart IoT Appliances are listed below:

Examples of IoT Appliances

Smart Air Con by Kuhl
Control temperature when not at home

Smart Lighting by Philips
Switch on/off and control brightness from phones

Smart Washing Machine by Samsung
Receive alerts on status of laundry

Smart Lock by Lockitron
Lock/unlock door remotely and be alert of changes

Smart Switch – MeterPlug
Detect electricity level usage and prices; adjust to minimize usage and bills

Care robots can also help elderlies with daily routines at home. They have the ability to sense external environment, and automatically respond to assist elderlies. One of the most common forms of robots is walking assistants. These come in the form of a walking cart of a wearable to put on elderlies' legs. Robots can sense external environments (e.g., slope, stairs) and can also learn individual's walking patterns. Robot speed is then automatically adjusted to mimic the users and assist with walking.

Case Study: Robots – the next generation caregivers for Japanese elderlies

Japan has the highest proportion of elderlies globally (33% of people aged 60+) and faces severe shortage of caregivers. Robots are increasingly being developed and adopted to manage these challenges. Examples of these robots are:

Walking assistant by Honda
Wearable that helps adjust the length of a person's stride with the use of a motor

Lifting assistant wearable by Smart
Wearable with rubber brands that assist caretakers in lifting elderlies

Toilet care machine by NWIC
Automatic toilet care machine to ensure patients can comfortably relieve themselves in bed

With rapid development of new products and increasing adoption, the Japanese elderly care robots market is expected to grow at 17% p.a. in the next 20 years from USD 0.16 bn in 2015.

USD 3.7 bn market size for elderly care robots in Japan by 2035

Source : PC world, Tech in Asia, OECD, Network world, Financial times

BENEFITS

Elderlies and relatives will see better quality of life with Smart Home solution. Firstly, Smart Home enhances security with reduced chance of severe accidents. Sensors can send alerts to relatives and emergency services when potential accidents are detected. This allows help to be dispatched timely, reducing severity of accidents. In addition, smart home reduces dependency on others for daily routine and overcomes issues of caregivers' shortage. Elderlies can perform more daily routine without depending on the help of family members or professional caregivers. For instance, cupboard sensors remind elderlies to take medication, while walking assistant robots help elderlies move around, improving mobility. Enhanced safety and independence at home permits elderlies to remain in own homes longer through enhanced safety and improved independence. In addition, smart home creates peace of mind for family members. Family members can be away and yet be alerted of potential dangers and accidents.

" Not only will physical safety and convenience be enhanced, elderlies will feel more confident in being alone and have more self-esteem from being less dependent on other people for daily living"

Geriatrician from leading hospital

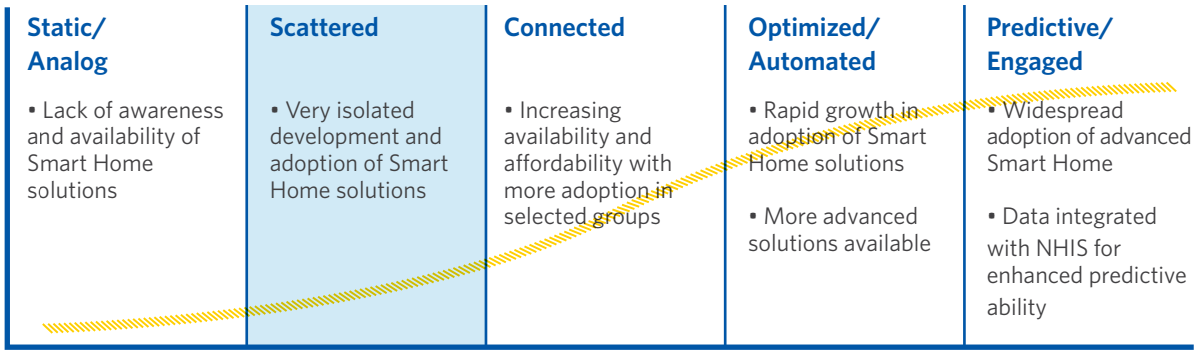
Government can also benefit from Smart Home and Robotics with reduced resource constraints and healthcare costs. It helps overcome issue of professional caregivers shortages. Moreover, there is reduced need for government-funded nursing homes. More elderlies can stay safely in their own homes reducing burden on the government to provide more nursing homes. Smart Home reduces severity of accidents, which can minimize hospitalization and help save healthcare costs.

" Enhancing safety at home can reduce occurrence of paralysis. These are long-term conditions which are not only tragic but can be very costly for the families and government"

Geriatrician from leading hospital

WHERE DOES THAILAND STAND?

Figure 18 : Digital maturity phases of smart home



Source: Roland Berger

Availability

Limited smart home solutions available for sale – Dinsow Mini launched in 2016

Affordability

Retail Price of Dinsow Mini robot is 70% of Thai elderly income compared to only 9% of Japanese elderly income

Currently, in Thailand, the Digital Maturity level of Smart Home is at "scattered" stage. There are isolated R&D of Smart Home solutions by both private and public sector. Very few products have been commercialized and adoption is also still very limited.

There are many reasons for current low adoption of Smart Home solutions in Thailand. There is generally low awareness and understanding of the Smart Home solution among the Thai population. People often associate "smart home" only with complex and difficult-to-use technologies. This misunderstanding leads to lack of perceived benefits of smart home solution to their daily lives. People do not see smart home solution as relevant for them.

" The challenge is not with the technology, but it is with developing a commercially viable business. The private sector and public sector should work together to raise awareness and understanding of smart home solution"

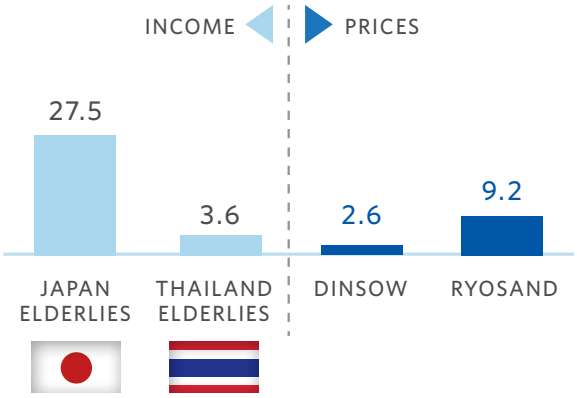
Startup considering developing home sensors

" It is important to raise understanding that the concept of smart home also includes simple technologies such as sensors that are easy to use and have so many benefits. Now, people still perceive smart home solution as expensive, cool toys, rather than something they can potentially adapt to help in daily lives"

Researcher at a leading university

In addition, there are limited number of providers of Smart Home solution in Thailand. Many universities, research institutes, and private sector are conducting research on Smart Home solutions. However, they face challenges in commercializing the solution due to limited demand. Dinsow Mini was the first elderly care robot to be developed by Thai technology company. It offers very comprehensive features to take care of elderlies and is sold in both Thailand and Japan. However, as seen in Figure 19, the retail price of THB 85,000 (USD 2,600), represents more than 70% of an average annual income of Thai elderlies. In contrast, the retail price of Dinsow Mini represents less than 10% of average annual income of Japanese elderlies. Affordability is another key driver of adoption of Smart Home solutions.

Figure 19 : Average annual income of elderlies vs. Price of robots [USD K]



Source : Euromonitor, Providers' website, Roland Berger

Case Study: Dinsow Mini – First Thai elderly care robot

Dinsow Mini is an elderly care robot, produced by CT Asia Robotics. It can be placed on the table and is equipped with fall and inactivity sensors. The robot can also warn elderlies to take their medications and be connected to monitoring devices via wireless technology, allowing readings to be recorded and stored. Video calls and entertainment are also available via the robot. After successful trial in Japan and in Kluaynamthai Hospital in Thailand, the company has already received 500 orders in 2016, mostly from Japan. The company expects to sell at least 1,000 robots in 2017 with more Thai customers.

Source : NIA, Bangkok Post, the Nation

HOW TO DRIVE THAILAND FORWARD?

Smart Home solution helps to mitigate many challenges faced by Thailand in the context of aging society. With changing socio-economic environment, more and more elderlies in Thailand are living alone as children may move to work in different provinces. In some cases, children and parents still live together, but parents are left alone while the children are at work. Caregivers are also not commonly used as they are difficult to find and most caregivers employed today are untrained. Adoption of Smart Home solutions, starting with simple home sensors, can greatly improve quality of life for the elderlies and their families.

In the next five years, Thailand should focus on increasing adoption of Smart Home by elderlies. This involves collaboration between the government, academics and the private sector in developing and commercializing of Smart Home solutions. The solutions should be designed to accommodate needs and challenges of elderlies. They must be user-friendly. In addition, all sectors can work together to promote awareness of the solution among elderlies and relatives, and support adoption of the solution. Proposed priorities for Thailand regarding Smart Home include:

5 Establish public-private partnership to develop commercially viable home sensors, and support adoption by elderlies

- Form partnership between public sector, private sector and academics in the development of home sensors – continuously improve design
- Design and establish business model for home sensor business that is commercially viable
- Promote awareness and understanding of simple home sensors for elderlies, family members and caregivers
- Consider offering means-tested financial support to elderlies to promote adoption of simple home sensors
- Develop infrastructure and services that support home sensors for elderlies (e.g., cloud-based platforms, emergency call center)

Recommended KPI

# of adopters
of simple home sensors

# of startups
offering simple home sensor products

6 Support private sector, including startups, in developing advanced Smart Home solutions and robots tailored for elderlies

- Design clear scope and strategy for government to support the private sector in development of smart appliances and robotic solution e.g. criteria of businesses to receive support, type of support to be provided
- Support the growth of Thai startups developing Smart Home solutions e.g., streamlined process for business set-up, provision of useful data
- Foster collaboration between researchers and private sector
- Cater design of the solution to the challenges of elderlies, by creating platform for businesses to work with people with understanding of elderlies' challenges
- Raise awareness and highlight the benefits of smart appliances and robotic solution to the public

# of adopters
of smart appliances and robotics

# of startups
offering smart appliances and robotics products

" Researchers have done extensive work on the home sensors business. We would like to work with private sector partner to help develop commercial business model and promote the solution "

Researcher at a leading university

" We have done lots of research on smart home for elderlies. However, the demand is still small and government incentives can help increase adoption "

Corporate player entering smart home solution

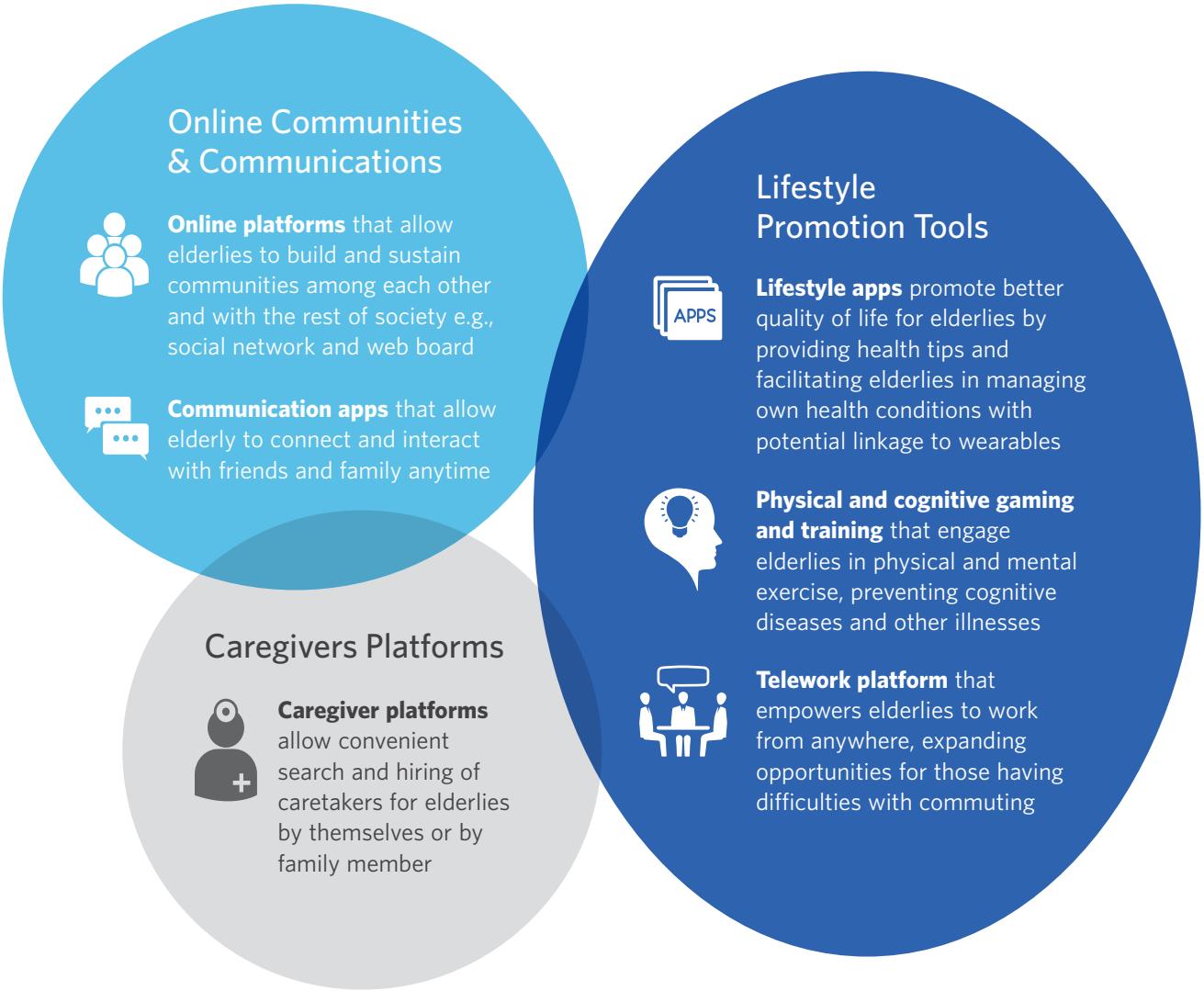
The key to better quality of life for elderlies is only a click away

Preparing for aging population is a major challenge on a national scale. As people grow older, they experience an increasing number of major life changing events – retirement, lower social interaction, living alone, and declining physical and cognitive health. Many of these challenges could lead to deteriorating quality of life.

For instance, elderlies who experience social isolation tend to suffer higher rates of illnesses. The advancement of digital technology allows individuals to adjust their lifestyle and activity as they age, and to increase health awareness - "Health Literacy". Furthermore, this will enable elderlies to remain active and associated more with social life – "Active aging".

OVERVIEW

Digital Social Interaction Solutions can empower elderlies to achieve active aging lifestyle. They improve awareness of what they can do to keep fit and healthy. Also, digital solutions can also help elderlies to maintain their cognitive and physical conditions, and to stay integrated with the society. Digital social interaction solutions can be categorized into three main groups: online communities and communications, lifestyle promotion tools, and caregiver platforms.



BENEFITS

Digital social interaction solutions benefit not only elderlies but also relatives and the government.

Elderlies can employed digital tools to support active lifestyle that should characterize their life-course. Many elderlies suffer from cognitive impairments and decreased mobility, making it difficult for them to go out and socialize. Online communities and communication apps enable elderlies to remain connected with their family and society, promoting social participation and preventing health risks such as depression. Lifestyle promotion tools, such as health tips apps, can enhance elderlies' awareness of different diseases and encourage pro-active management of own health. Besides, brain game apps or video games system controlled by motion, can also be used to help elderlies maintain their physical and cognitive ability, and at the same time allow elderlies to have more fun. Furthermore, caregiver platforms can facilitate elderlies to find high-quality caregivers, help elderlies to age at home and improve their quality of life.

"Online communities & communications are great tools to promote social participation especially for urban areas where local offline communities are not as strong as in rural areas"

Public official from MOPH

Families and relatives can use social network and communication apps to continuously keep up with elderlies' wellbeing and physical condition, providing peace of mind. They can also leverage digital tools such as health tips and medical adherence apps to provide care for elderlies, improving convenience and quality of homecare.

Government can benefit from digital social interaction solutions. Telework platform empowers elderlies to engage with work even if they suffer from reduced mobility. It also facilitates elderlies to be economically active for a longer period or time and make more economic contribution. Active lifestyle can also reduce health risks, leading to reduction in public healthcare expenditure. In addition, improved homecare quality can reduce preventable hospital visits and reduce the need for the government to build nursing homes.

"Brain game apps have the potential to help maintain cognitive health – particularly in preventing diseases such as dementia"

Doctor at public hospital

"Quality caregiver can support elderlies to age in place and reduce the need for government to build costly nursing home "

Founder of startup providing caregiver platform

Case Study: Lumosity – digital technology has revolutionized cognitive trainings for elderlies

Aging has long been associated with a decline in cognitive abilities. Some researches have shown that cognitive exercise can be critical for maintaining brain health and execution function, as well as for preventing diseases such as dementia. Lumosity has created a brain game training program aiming to improve core cognitive skills such as memory, attention, processing speed, mental flexibility, spatial orientation, logical reasoning and problem solving. Scientists worked with game designers to transform neuropsychological and cognitive research into cognitive games. Lumosity currently has over 70 million registered users globally and has already been recommended by leading geriatric doctors in Thailand.

Source : Cogstate, Frontiers journal, Elsevier, NCBI

WHERE DOES THAILAND STAND?

Figure 20 : Digital maturity phases of digital social interaction solutions

Static/ Analog	Scattered	Connected	Optimized/ Automated	Predictive/ Engaged
• Elderlies do not leverage any digital tools	• Low internet adoption among elderlies • Digital tools are launched and used sporadically by elderlies	• Rapid growth in digital tools utilization by elderlies	• High internet adoption among elderlies • Some digital tools locally developed	• Wide spread of local developed digital tools • Integrated into elderlies daily life

Source : Roland Berger

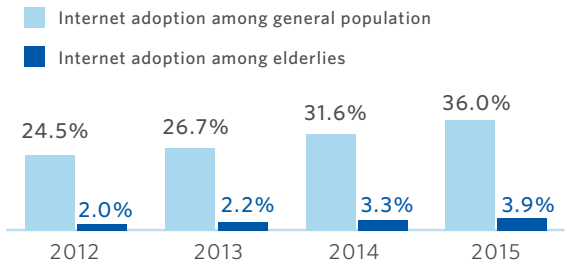
Only **3.9%** of elderlies have adopted internet in 2016

Elderlies adopted internet use it **extensively**

Limited digital solutions developed locally

Currently, in Thailand, the digital maturity level of digital social interaction solutions is at "scattered" stage. ICT adoption in Thailand among elderlies is extremely low, only 3.9% of elderly populations are actively using Internet compared to approximately 58% of elderlies in the USA. Majority of Thai elderlies still lack internet access, ICT literacy, and awareness of the benefits that digital social interaction solutions could offer.

Figure 21 : Internet Adoption



Source : Thailand National Statistics Office

"Elderlies usually can afford and can learn to use digital tools, but many do not see any benefits of doing so. It is important to simultaneously promote existing digital tools to elderlies and support development of more elderlies-oriented tools"

Academic at a university

"Elderlies want to learn how to use these tools, but they have no one to guide them. They are overwhelmed by the variety of tools available. Younger family members should play a role in teaching them how to use and guiding elderlies to the most relevant tools"

Academic at a university

However, those Thai elderlies who are internet adopter use the web extensively. According to Thailand National Statistic Office, they spend on average 4.5 hours per day on the internet with 78% using smartphone to access the internet. In addition, 53% of this group of elderly use digital tools on a daily basis to keep in touch with their children. Furthermore, Thai elderlies are very active on social media, just like other age group – 89.9% of elderlies who are internet adopter use social media on a regular basis. Therefore, it is crucial for the government and private sector alike to drive internet adoption among elderlies.

In addition, there are very limited digital social interaction solutions developed by Thai developers to accommodate the specific needs of Thai elderlies. Most social network sites, online communication apps, and lifestyle apps are provided by international providers. Only a few caregiver organized as online marketplaces are locally developed and operated. Nonetheless, there are some Thai tech startups that have realized the potential of digital technologies, and have started using these technologies to streamline their process and improve their services. Therefore, it is crucial for the government and private sector alike to drive development of digital social interaction solutions.

Case Study: Thai tech startups have emerged to make "aging at home" more convenient than ever

Source:
Health At Home,
www.chiiwii.com

Heath at Home aims to promote "aging in place" by sending quality caregivers to provide care services at elderly's premise and to provide consultation to the families on the required home medical devices. Health at home intends to set a standard for caregivers in Thailand and to resolve issues regarding homecare in 3 aspects. The company wants to 1) create a platform in which elderlies can conveniently search for trusted caregivers, 2) create a channel to provide health insurance that can be used for homecare, and 3) develop real-time analytics to enable family to monitor elderlies' well-being at all time.

Aiming to bridge the gap and to improve access to healthcare, a group of doctors decided to set up an online community called **"Chiiwii"** which provides health tips and free medical consultation. They are currently developing telehealth platform to provide add-on doctor-to-patient services via smartphone or laptop, focusing on patients who require services such as post-op, dermatology, follow up, and chronic disease management. Chiiwii also plans to collaborate with caregiver providers, insurance company and private hospitals to provide an integrated high-quality service to Thai customers.

HOW TO DRIVE THAILAND FORWARD?

Digital social interaction solutions can support Thailand to prepare for the population aging, particularly with issues of declining elderly support ratio and increasing financial dependency of elderlies on children and state. The solutions will also allow Thailand to better pursue community-based care approach, which can alleviate the rising public healthcare expenditure.

In the next 5 years, Thailand needs to first build ICT and health literacy, and create a platform to support socio-economic and health inclusion of elderlies before it can reap the full benefits from these digital solutions. The roll-out of these digital tools should be emphasized in urban areas, where community support is not as strong compared to rural area. The digital tools will help elderlies to maintain quality of life and age in place even without care support from family or relatives. Government should also support Thai startups to develop digital solutions which address the need of Thai elderlies. The two key initiatives to help Thailand reap the full benefits from digital social interaction solutions are detailed below.

7 Develop public platforms to support socio-economic inclusion, and support the adoption of ICT among elderlies

- Promote awareness and attractiveness of digital technology and health literacy to both elderlies and relatives
- Enhance skills of elderlies to be able to use digital tools
- Equip elderlies with the technology required to use digital social interaction solutions
- Government should consider collaborating with private sector to develop digital platform to facilitate elderlies in work condition

Recommended KPI

% of elderlies actively using the internet

Economic contribution from elderlies

8 Support the development of new digital tools that promote social interaction and quality of life for elderlies

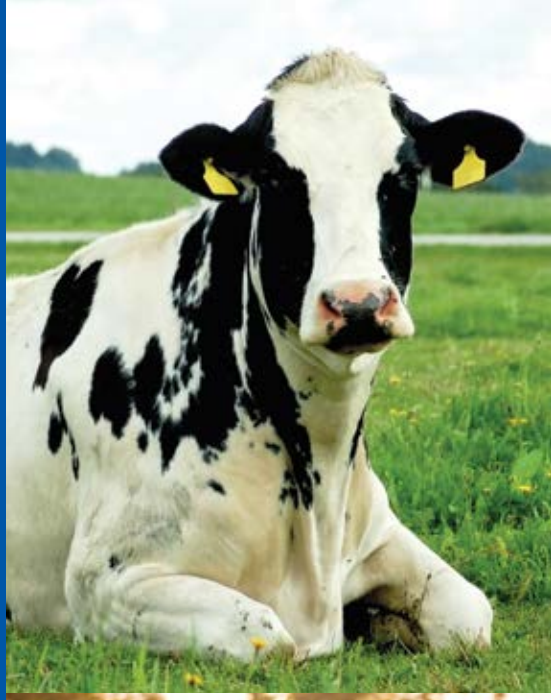
- Provide infrastructure and services to support private sector developers to develop applications
- Equip private sector developers with data and insights
- Support and promote private sector to develop online community, caregivers' platform and lifestyle and cognitive apps
- Design incentive scheme that support the growth of startups developing digital solutions

# of elderlies employing caregivers

# of digital solutions locally developed

CHAPTER 4

Digitalization of Agriculture



Thailand's agriculture industry is highly fragmented with room to improve productivity

The world is experiencing a rise in food demand across continents. Population growth and change in food consumption pattern are the two key drivers. There is more than 1% annual rise in global population (or net addition of approx. 80 million people every year). In parallel, there is also a significant shift in eating habit. People consume more meat and dairy products. With overall carbs consumption also rising, hunger problem is still prominent in certain parts of the globe. Thus, it is imperative to ensure sustainable food production and supply to adequately serve the global needs.

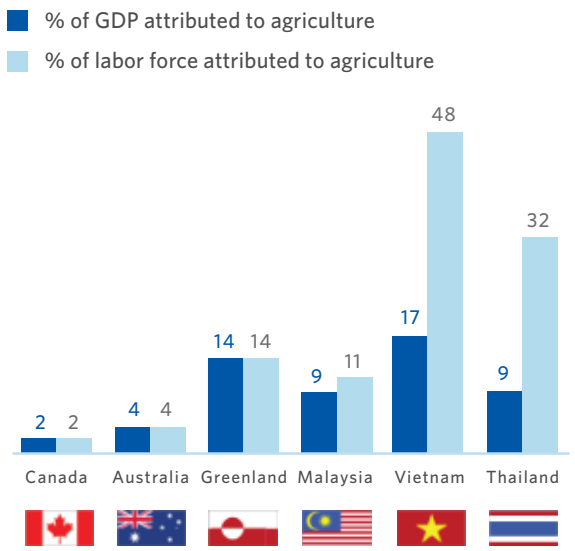
Unfortunately, global agricultural production has experienced yield plateau in the past 10 years. Farmers, especially those in developed countries, are facing stagnant growth. Soil quality is worsening due to the acceleration of crops production, while urbanization is limiting the land available for agriculture. In addition, overall employment in the agricultural sector is declining with a global average rate of 1.8% per annum. The sharpest decline is experienced in developed countries (2.9% per annum).

Considering these challenges, countries around the world are looking for technological solutions to optimize agriculture processes, improve efficiency, and boost productivity.

Thailand is facing similar challenges. Agricultural sector is one of the most important sectors in Thai economy and society. Thailand utilizes more than one-third of the nation's labor force in agriculture. However, the sector only contributes 9% to the country's gross domestic product (GDP). Thailand is lagging behind regional peers in terms of agricultural labor efficiency. For example, Malaysia utilizes 11% of its workforce to generate 9% agricultural GDP (See Figure 22)

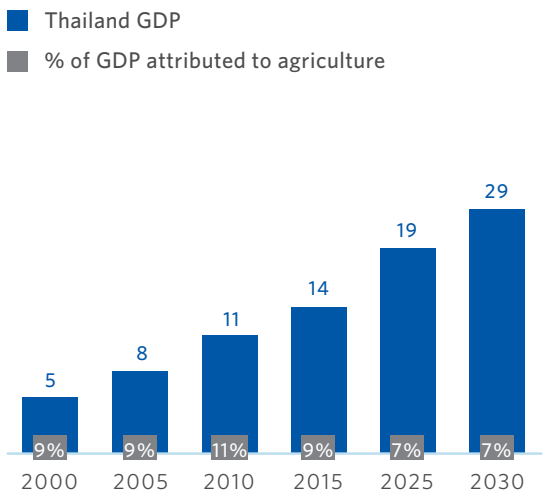
In the next fifteen years, Thailand's GDP is forecasted to grow at 3% per year (CAGR). However, agricultural GDP is projected to increase at lower rate of 2%. As a result, Thailand will experience a declining contribution of agricultural sector to total GDP – shrinking to 7% of total GDP in 2030. (See Figure 23)

Figure 22 : Agriculture's contribution to GDP and labor force [%]



Source : IHS Global Insight

Figure 23 : Thailand GDP and % of GDP attributed to agriculture [THB trillion, 2000-2030]



Source : Central Intelligence Agency (CIA)

Production of key crops has experienced declining or stagnant growth. In 2015, Thailand had below-average yield per Rai rice production (456 kg/Rai vs. ASEAN average of 698 kg/Rai) despite being ranked 3rd in total volume produced. Yield per Rai of maize was also below average in the same year (644 kg/Rai vs. ASEAN average of 684 kg/Rai) (See Figure 24-25). Thailand is also lagging behind many countries in value added of agricultural products. In 2015, total value-added generated from agricultural products per worker was lower compared to developed countries. At 2,157 USD per worker, Thailand created less value-added for agricultural products compared to regional peers including Singapore (92,629 USD/worker), Malaysia (19,818 USD/worker), and Indonesia (2,629 USD/worker). Root causes included inefficient farm practices, limited know-how, low modern technology adoption to improve productivity, and poor marketing strategy for end product.

Figure 24 : Benchmark of rice production and productivity in ASEAN countries

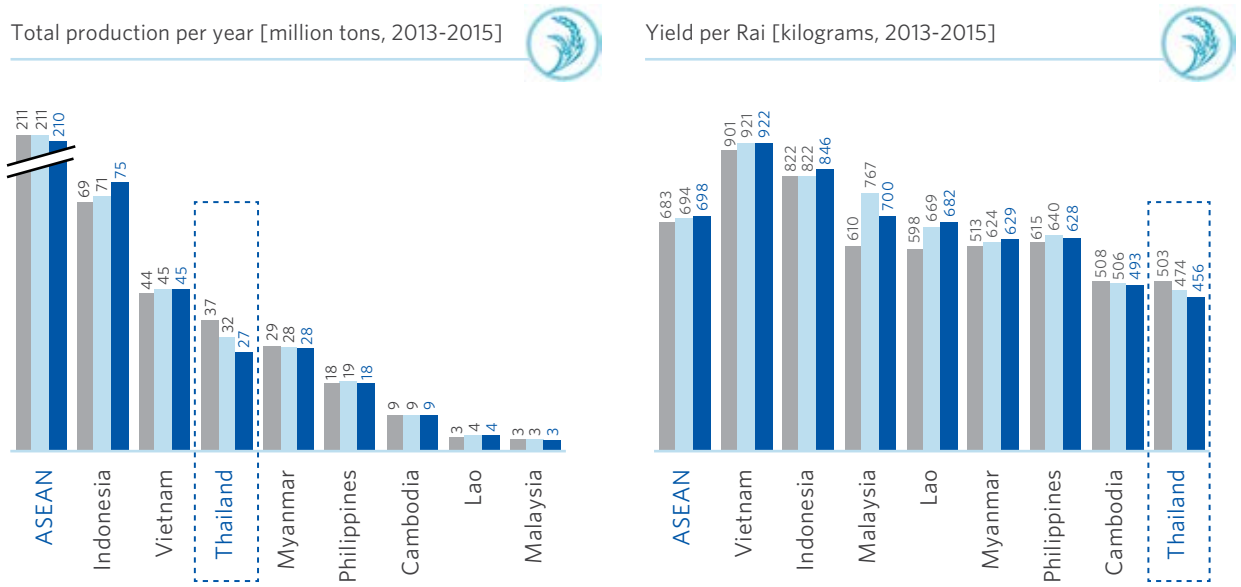
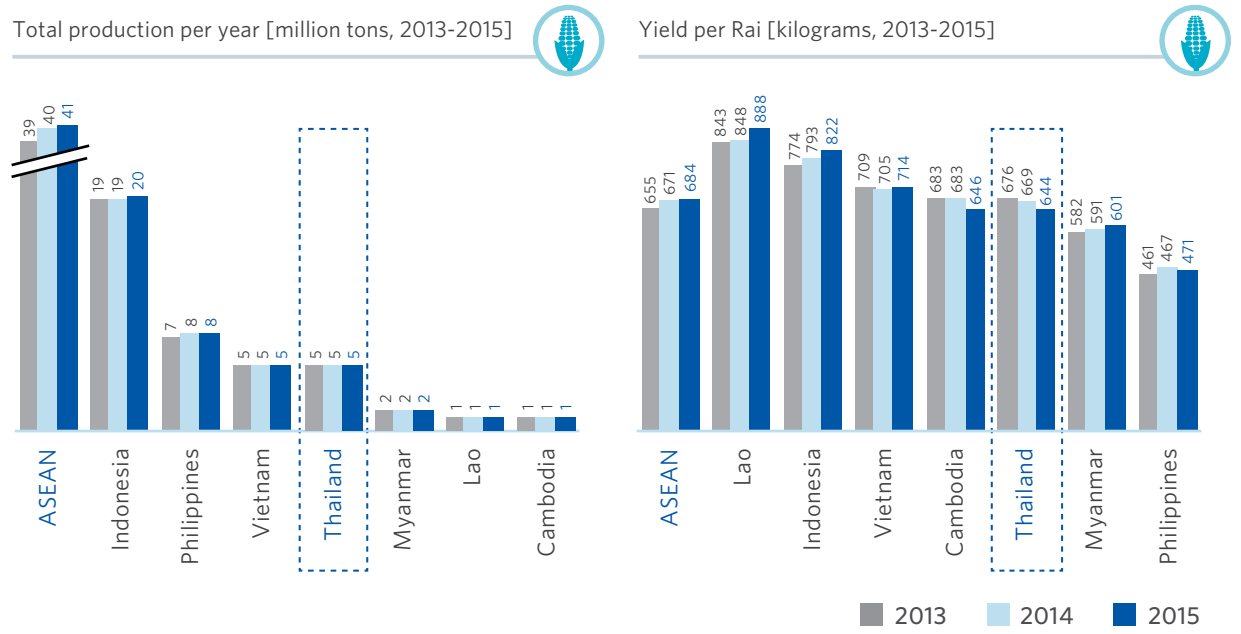


Figure 25 : Benchmark of maize production and productivity in ASEAN countries



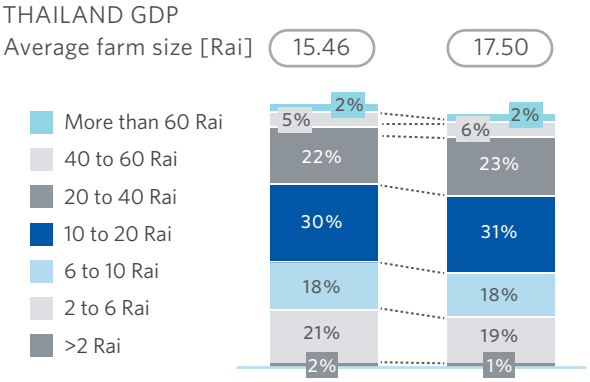
Source: Office of Agricultural Economics

In line with global trend, agricultural product demand in Thailand has increased in the past 10 years and is expected to grow further (1.8% CAGR during 2015-2025). The two main drivers are increasing population and higher food consumption. Thus, it is important to understand key challenges faced by Thailand agricultural sector in order to identify solutions to address these six issues effectively.

1. Highly fragmented market with limited access to information

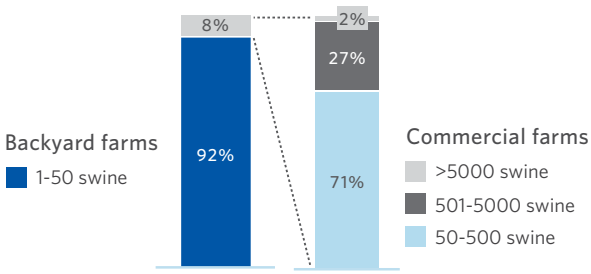
The Thai agricultural market is fragmented with majority of farmers owning small land. More than 38% of total rice farms are smaller than 10 Rai (1.6 hectare) and more than 92% of total swine farms nationwide are backyard farms (less than 50 swine) (See Figure 26 and 27). Local farmers usually lack information, data, and knowledge to improve their agricultural operations. As a result, farmers often do not select the most appropriate crop to plant or do not deploy the most sustainable farming practices. Networking and information sharing among fellow farmers or public officials can also be a challenging due to absence of effective communication channel apart from face-to-face meeting.

Figure 26 : Thailand rice farm size distribution [%, 2009-2014]



Source : Office of Agricultural Economics

Figure 27 : Thailand swine farm size distribution [%, 2014]



Source : National Statistical Office of Thailand

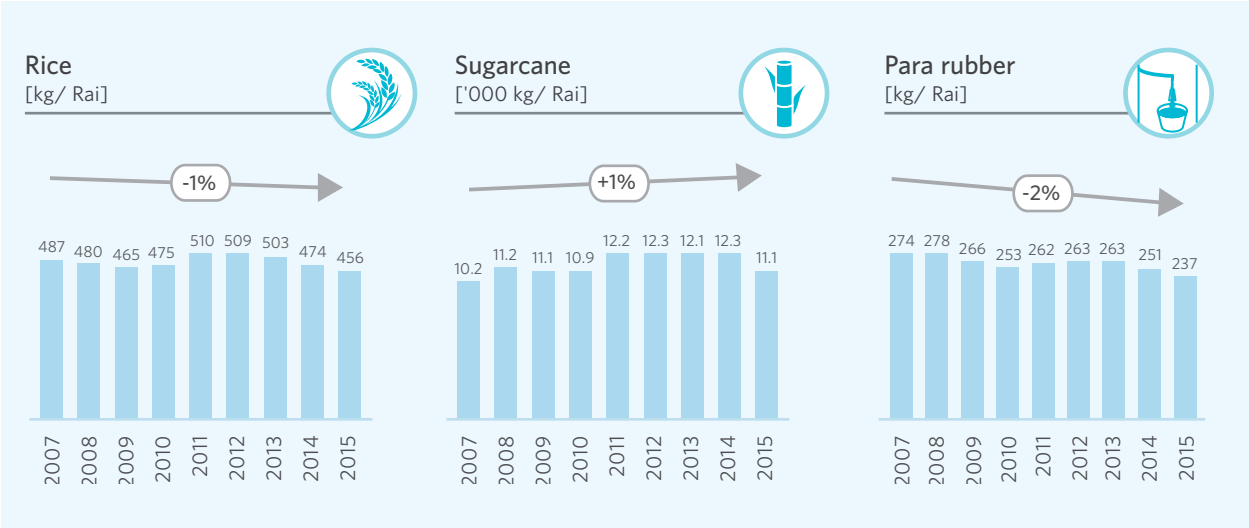
Local farmers usually lack information, data, and knowledge to improve their agricultural operations.

2. Production yield challenge

Thailand is also experiencing stagnant production yield for crops. In the past 8 years, production yields of key crops in Thailand has been flat or declining (See Figure 28). Since 2013, rice and para-rubber are experiencing continuous decrease in yield.

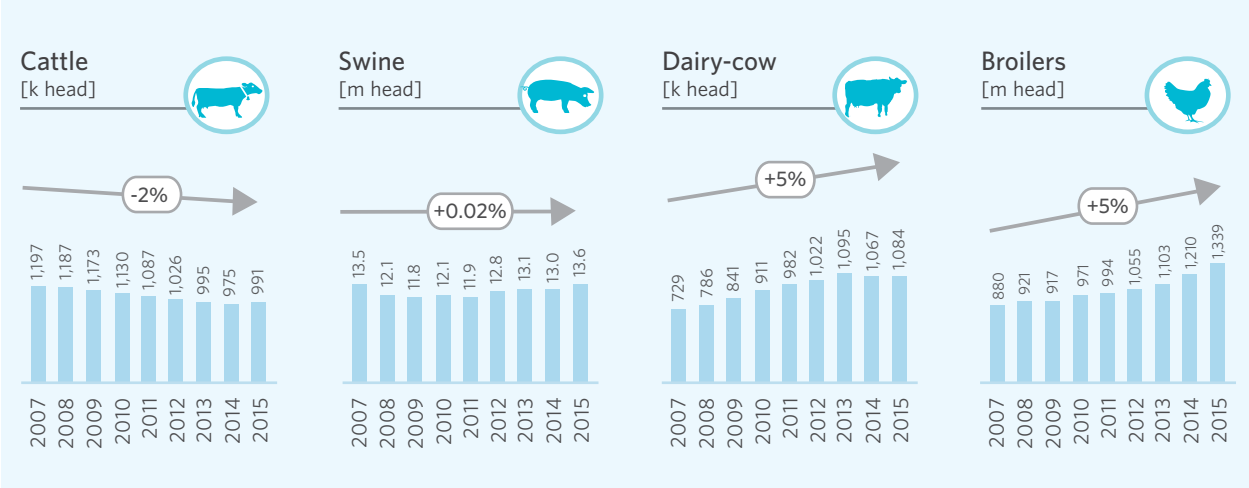
On the other hand, production of certain livestocks has improved including dairy cow and broiler. However, stagnant or decreasing production have been observed for shrimp, cattle, and swine (see Figure 29).

Figure 28 : Production efficiency (yield) of Thailand key crops [%CAGR, 2007–2015]



Source : Office of Agricultural Economics

Figure 29 : Production of Thailand key livestocks [%CAGR, 2007–2015]

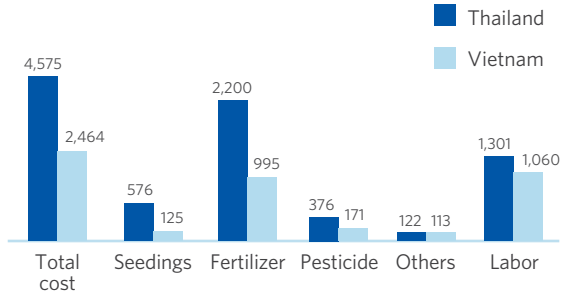


Source : Office of Agricultural Economics

3. Room to optimize the use of inputs

Production cost in Thailand is also rising for all major cost items including fertilizer, labor, seeding, and pesticide. In 2015, it was more expensive to operate a farm in Thailand compared to a neighboring country (see Figure 30 for comparison between Thailand and Vietnam). The key cost differentiator is fertilizer, which account for almost 50% of the total production cost. In fact, the use of fertilizer in Thailand has been continuously rising since 2008. Rising costs put significant pressure on farmer's margin. Significant efficiency improvement is required

Figure 30 : Production cost benchmark per Rai Thailand vs. Vietnam [THB, 2015]

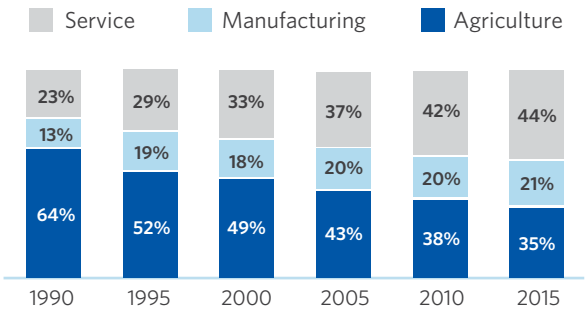


Source : Kasetsart University

4. Agricultural labor force and efficiency

Agricultural sector is one of the most labor intensive sectors in Thailand, utilizing one-third of the workforce in the country. However, the significant human resource investment does not correlate with high economic output, contributing to only 9% of Thailand's GDP 2015. With decreasing agricultural labor force, Thailand is at risk of experiencing lower agricultural GDP contribution in the future. The employment in agricultural sector is declining due to aging population and shift of labor interest towards manufacturing and service sectors (see Figure 31). Thailand currently lacks new generation farmers to help improve the sector. It is important to bring young generations back to the farm and improve efficiency as the workforce is declining

Figure 31 : Employment by sector in Thailand [%, 1990 –2015]



Source : National Statistical Office of Thailand

5. Lack of market channels and efficient trade platforms

Most local farmers and producers are not self-reliant and have limited marketing knowledge. They usually work with middlemen to distribute their products. Complex value chain hinders farmers' ability to obtain reasonable profits, lengthens distribution cycle, and contributes to high end-user prices. Several online trading platforms or marketplaces are at development stage providing more tools for local farmers to cut middlemen and reach end-customers directly. However, adoption is limited as neither the systems are efficient nor farmers have trust in the new e-commerce solutions.

6. Limited quality control and supply chain management

Thailand has increased food quality regulations to address new global standards. Stringent quality control is now required from trusted agricultural product suppliers. However, e-traceability technology has been implemented only by big private players. Most small to mid-sized producers still lack understanding about the importance and opportunity to improve stock and warehouse management, and integrate smart supply chain management solutions.

Digital technology can pay a pivotal role in facing these six key challenges. Several digital technologies have been identified and grouped into four solutions to address different issues as shown below.

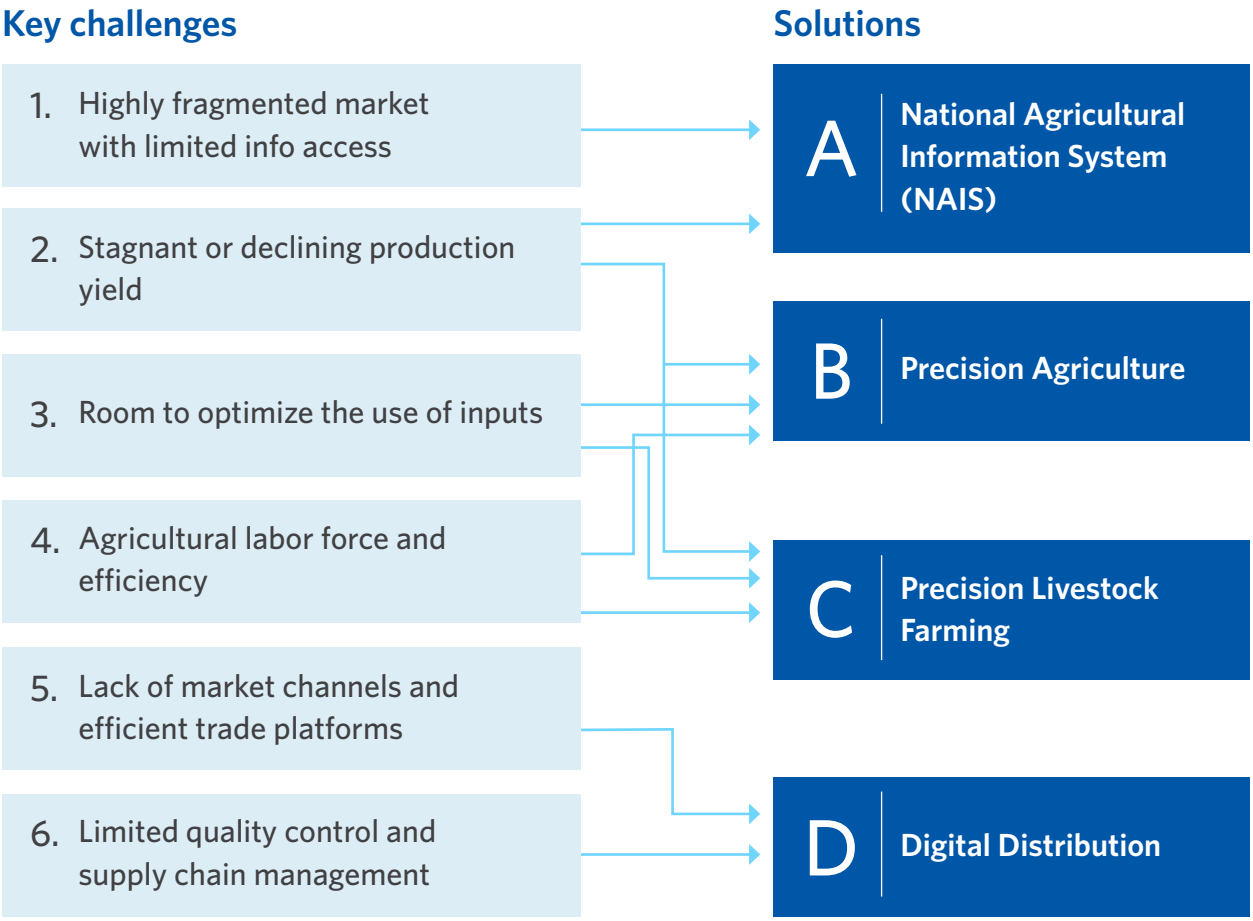
A **National Agricultural Information System (NAIS)** is a centralized digital platform, serving as a national agricultural data and knowledge depository. NAIS provides a better access to a comprehensive range of agricultural information to key stakeholders including government, agribusiness, NGOs, and general public.

B **Precision Agiculture (PA)** entails the use of digital technologies to optimize plant farming operation and boost production yield. PA technologies combine sensors and imagery, connectivity, farm management software, and robotics and automated machineries. The solution helps the producers to optimize their operations, save costs, and utilize workforce more efficiently.

C **Precision Livestock Farming (PLF)** is the use of digital technologies to improve productivity and enhance livestock welfare. PLF uses multiple digital technologies led by tracking instrument, sensors, connectivity, management software, and robotics and automated machineries. As a result, producers can control breeding process, save feed cost, and increase overall production.

D **Digital Distribution** includes a set of digital tools to help producers and entrepreneurs bring products to market in smarter ways. In essence, it allows farmers and producers to track and trace the products, control quality, efficiently manage the stocks, and trade products easier. The solution helps farmers connect directly with end-customers. It enables agribusiness to prepare for increasingly stringent agricultural product quality standards.

In the next section, each of the four solutions are further detailed. Global trends, international best practices, and Thailand position are examined



Empowering Thai farmers and policymakers with a centralized agricultural information system

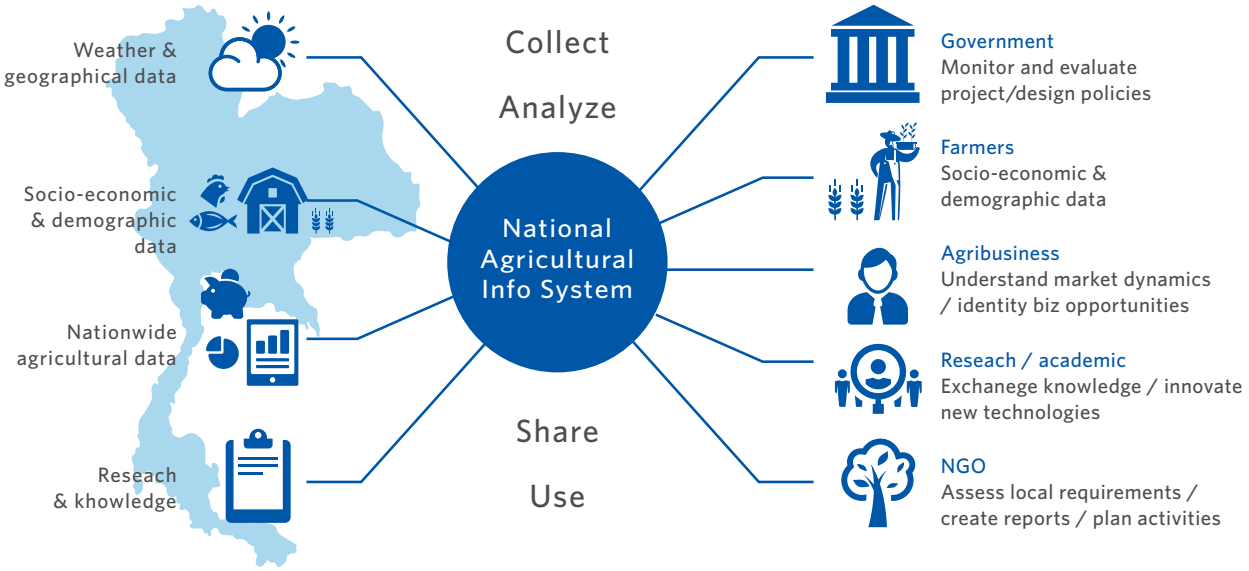
Synthesized and accurate agriculture data for the sector. Farmers search for weather information or market trends before making decisions. Government also utilizes regional plantation data to plan new development projects. These are only few examples of infinite possibilities information can help empower the whole agricultural sector.

The set up of central online platform, which gathers and organizes agricultural information, will be extremely useful for the country by making them accessible to farmers, public agencies, and other beneficiaries in the sector.

OVERVIEW

The National Agricultural Information System (NAIS) links all stakeholders in agricultural industry to create, share, and utilize agriculture data. The platform includes comprehensive digital repositories, cloud storage, real-time data synchronization, and user-friendly interfaces. Essential datasets such as farmer demographics, soil quality, land elevation, plantation area, weather forecast, historic rainfalls, market prices and trends, agricultural best practices and R&D are materials made available on the platform. Big Data is used to provide additional insights to relevant stakeholders, giving perspectives on the dynamics and trends of the entire agricultural sector.

Figure 32 : Simplified schematic diagram of NAIS



Source : Roland Berger

BENEFITS

Main beneficiaries of NAIS are the government, farmers, private sector, researchers and academics, and NGOs.

Government and public agencies can obtain visibility on current agricultural facts and figures in order to formulate effective strategic development directions and policies (e.g., selection of strategic crop plantation for a specific region based on historical weather information). Agricultural data stored in an information system can also be used to create value added services. For example, the government can provide reliable data services and offer on subscription fee to agribusiness for private use (Data as a Service).

Farmers and producers can receive essential agricultural information and exchange know-how or best practices. For example, data such as temperature, moisture, rainfall and soil quality can help make a correct production and harvest plan. For **agribusiness**, NAIS can provide understanding of current market situation, help to develop new products or identify new opportunities. For instance, a private agricultural software developer can use public geographical data to develop new products.

Researchers and academics can strengthen agricultural R&D through the access of historical and new agricultural knowledge. NAIS also foster knowledge exchange environment. Teachers at agricultural institution can also make use of available data on NAIS to create better educational tools.

NGOs can assess local farmers' requirements and monitor progress of their activities by using information on NAIS. With such data, they can also plan their next initiatives and create reports for management and external users.

Different approach toward agriculture information system used around the world. The setup varies across countries. In the United States, the National Agricultural Statistics Service (NASS) stores all related agricultural statistical information in one single platform (e.g., demographics, economics and prices, research and technology, charts and maps). The entire platform is free for everyone. More than 6 million datasets tracking back as far as 1866 available for free download. There are more than 130,000 NASS website visitors per month. In Asia, South Korea has a centralized agricultural information system for farmers called "Rural Development Administration (RDA)". It integrates all agricultural institutes into a network to share information on technology evolution and best practices.

The RDA offers email, SMS consultation services (with more than 35,000 farmers and 8,000 researchers registered), and Internet-based training courses (with more than 1,000 farmers or extension workers taking a course annually). RDA website has more than 50,000 monthly visitors.

Agricultural information systems at national level have also been established in developing countries. In Jordan, there is a national open-access online platform to exchange agricultural knowledge and information. Meanwhile, India has established a national repository of agricultural knowledge from agricultural universities and institutions around the country.

Case Study: Jordan open agricultural research information for innovation purposes

Jordan's NAIS is an integrated institutions-based web platform for info/knowledge sharing and exchange of agricultural R&D under the Ministry of Agriculture (MOA).

NAIS has been created through multiple stages and launched in 2012, currently offering information in 17 structurally-linked modules via bilingual mode (Arabic/ English) including documents/ publications, institutions, experts, projects, news, meetings and events, good practices, successful stories, country reports, laws and regulations, treaties and agreements, rural women knowledge base, media center, desert locust, work opportunities, collaborative partners, and e-library.

Source: CIARD Jordan

Success factors:
1. Knowledge sharing culture
2. Continuous financial support
3. Stakeholders' buy-ins
4. Ready infrastructure
5. Quality content and info

Case Study: KrishiKosh – National digital open access platform improves agriculture knowledge base

Indian National Agricultural Research and Education System (NARES) is one of the biggest academic agricultural systems in the world. KrishiKosh was developed as an institutional repository portal which captures, preserves, archives, and provides access to intellectual outputs of NARES.

Built and configured in 2012, KrishiKosh is currently housing more than 50,000 records available for search and download including articles, books, institutional publications, journals, conference proceedings, reports and thesis. Open access architecture has been in the forefront in providing latest information in time to the agriculture user communities nationwide including researchers, scholars, teachers, producers, public officials, and general public.

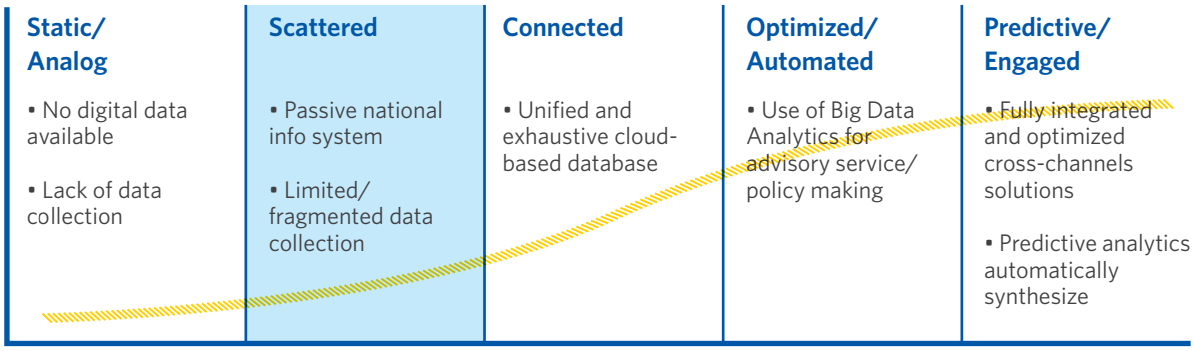
Source : e-GRANTH

The system costed INR 86 mn (USD 1.3 mn)

It provides open access to >16 million digitized pages with approx. 50,000 digital items

WHERE DOES THAILAND STAND?

Figure 33 : Developmental maturity phases of Thailand's NAIS



Source : Roland Berger

Fragmented data

Statistics, economics, market information, weather data are stored scatteredly across public agency websites

Limited knowledge sharing

Lack of strong public network to share knowledge and R&D know-hows

In Thailand, the existing agricultural data is at scattered stage. Several information systems and databases developed. Lack of centralized approach hinders potential potential use of available data to improve agricultural practices. (See Figure 33)

Currently, various agencies are responsible for different databases in Thailand, creating complexity for data management and data integration. Economics, production statistics, and market information are available at the MOAC and its departmental websites (i.e., OAE[1] DOAE[2], and DLD[3]). Local weather information including forecast is key to agriculture and available at the TMD[4] website. Agricultural research, science and technology knowledge are fragmentally available at agricultural universities and MOAC departmental websites. Local farming best practices are stored at Thai National AGRIS centre (maintained by Kasetsart University) and MOAC departmental websites. Not all of these departmental databases and information systems are well-maintained and organized. Some of them provide similar datasets with discrepancies. Certain links are not working nor data is not up to date. There is also lack of awareness on availability of the information systems. Overall agricultural data and information collection is fragmented. There is plenty of room for improvement in terms of data management and public awareness.

In fact, Thai government is aware of the situation and has taken measures to improve on agricultural information management. There is an ongoing initiative, called "Farmer One", aiming to centralize agricultural data providing accurate farmer information. Another project is called, Thailand Agriculture Mobile Information System (TAMIS), which aims to offer mobile farmer registration service to local farmers. However, this application is still under testing period and not ready for nationwide implementation.

"I am not aware of any public agricultural information system in the country"

Agricultural SME owner

"The agricultural databases have never been updated since forever"

Public university researcher

"There are a number of initiative of the Ministry trying to combine agricultural data in one place. It is challenging but we are trying hard beginning with the farmer information"

Public official

1) Office of Agricultural Economics,
2) Department of Agricultural Extension,
3) Department of Livestock Development,
4) Thai Meteorological Department,
5) Department of Fisheries

Case Study: Farmer One aiming for a single farmer registration system

MOAC (by OAE) has an ongoing project, called "Farmer One", to integrate farmer registration across three departments including DOF[5], DOAE, an DLD. In the past, farmers registration could be done at these departments independently. A problem occurred when the same farmer registered in all three departments to receive triple government financial supports. Farmer One pilot was initiated to eliminate such glitches in the system and to establish a single trustworthy farmer database.

With support from NECTEC and EGA, the national farmer data is now being cleansed and transferred to the governmental cloud storage for use to design future agricultural plans and policies. Should Farmer One be proven successful in the first stage, OAE is planning to incorporate household agricultural data into the system. OAE is now also working with its collaborators to develop artificial intelligent function as an add on to the current Farmer One information system.

Geographical and map data including soil quality and area elevation are also important and currently collected by different departments under MOAC and MOST (i.e., GISTDA[1]). These data overlap and are not integrated into a single map. The recent development of Agri-Map by MOAC in collaboration with NECTEC combines data from all relevant units to generate an interactive online national agri map. Despite ensuing further improvement, Agri-Map has set a good example for a collaborative effort to build a comprehensive information system at national level. A comparable interactive map information system for agriculture was developed by GISTDA under the name, "GIS Agro". Consolidation of Agri-Map and GIS Agro would provide a comprehensive interactive map information system, containing single datasets.

1) Geo-Informatics and Space Technology Development Agency

The projects discussed (i.e., Farmer One, Agri-Map) provide the first steps to build a central agricultural information system for Thailand. In order to improve Thailand agricultural information system from "scattered" to "connected" stage, a centralized national information system which unifies all existing agricultural information must be established through collaborations among relevant stakeholders led by public agencies. NAIS has a potential to become a powerful single platform, in which users can retrieve any available agricultural data for different purposes.

Case Study: Agri-Map to help Thai farmers manage their farms smarter

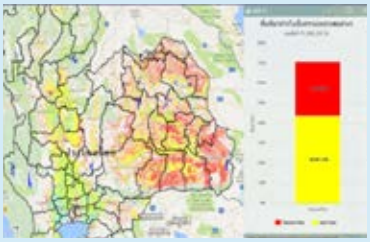
Agri-Map provides farmers with information to help them understand more about what to grow in the area, where should they buy land to expand their business, and where are the nearest marketplaces and cooperatives. Developing from What2Grow project[2], MOAC themes Agri-Map as an "Agricultural Map for Adaptive Management". The interactive website was developed by combining raw data collected from all departments under MOAC.

A parallel initiative to develop such interactive agricultural map is called, "GIS Agro". It has quite similar functionalities as what Agri-Map offers. The major difference is that GIS Agro starts to incorporate farmer registration data into the system, showing name, farm size, and production capacity.

As the current version still lacks full set of historical data (up to 10 years) and needs improvement on data accuracy, Agri-Map is under further development to incorporate additional historical datasets with assistance from relevant data owners. Annual data update is also essential and considered to be the next milestone. Agri-Map should also seeks for an opportunity to merge with GIS Agro to form the best quality interactive agricultural map information system for Thailand.

Agri-Map project presentation to the Prime Minister [2016, April]

Agri-Map in action – showing suitable area to grow rice in the Northeastern region of Thailand



Comparison with GIS Agro, another initiative by the GISTDA – showing rice field in Sing Buri area

2) What2Grow is a basic agricultural information system providing agricultural data integration and zoning optimization modeling

Source : Agri-Map

HOW TO DRIVE THAILAND FORWARD?

It is essential to develop Thailand's NAIS as a single platform to consolidate existing and new agricultural data. The Big Data Analytics is used to create value-added services, which will benefit all relevant stakeholders. In parallel, farmers will need to be educated to become smart farmers and know how to leverage agricultural data on NAIS to improve their farming methods.

Four initiatives are identified and recommended as guidelines for the next 5 years to close the gap of Thailand's current organization of agricultural information and improve management of existing and new datasets. First, NAIS will need to be established with cooperation from data owners of relevant existing agricultural databases and information systems. With all agricultural data in one place, new government-led business solutions offering data as a services can be developed. Subsequently, startups which use public agricultural data can be fostered. Last but not least, local smart farmers need to be developed through information sharing and educational programs.

		Recommended KPI
9	**Establish Thailand's NAIS** • Integrate existing agriculture-related datasets and identify data/information gaps • Develop a centralized online platform to unify Thailand agricultural info/data across all relevant databases and infosys • Collaborate with relevant stakeholders to obtain information necessary to include in the NAIS • Promote NAIS to target users and general public	**Establishment of NAIS** **#** of the NAIS **visitors**
10	**Develop new government-led business solutions (G2B)** • Assign a working team to define scope and formulate strategic plan • Develop and prepare resources necessary to commence the program including pilot projects • Promote the program and consider to provide tax incentives to gain attention from private players	**# of the new G2B business** initiatives
11	**Foster agricultural startup leveraging national Open Data** • Study international best practices of agricultural startups using agricultural data provided by public sector • Ensure readiness of the datasets potentially used by startups • Establish partnerships with relevant public and private organizations to seek for and foster Thai agricultural startups matching the objective • Continuously support and promote agricultural startups under this initiative	**# of datasets open in API-ready format**
12	**Develop local smart farmers through information sharing and educational programs** • Establish local working team by involving local administrations to focus on disseminating knowledge and educate local farmers • Set up training programs for the local working team to be prepared to provide proper education to local farmers • Launch smart farmer education program locally and ensure effective communication channels to fully engage the locals • Ensure continuous implementation by local farmers	**# of the local administrations** having smart farmer education program launched

Transforming conventional farming into smart farming using PA

The role of digitalization in agriculture has significantly shifted from driver of marginal effect to enable full transformation. Precision Agriculture (PA) is a practice of using ICT to improve agricultural productivity and to empower farmers to take informed and quality decisions. It deploys a wide range of hardware and digital solutions from basic sensors to hi-tech field surveillance drone. This broad range of digital PA technologies offers new tools for farmers to optimize field practices, make better decisions, optimize input costs, and improve workforce efficiency (See Figure 34).

OVERVIEW

PA can be applied in different farming phases, from choosing the right inputs, optimizing the production, to planning the harvest. Key elements of PA include imagery and sensors, connectivity, farm management software, robotics and automated machineries.

Imagery/ Sensors technologies enable collection of geospatial data and in-field information including humidity, temperature and soil condition.

Connectivity is enabled though the use of IoT technology. Different devices are connected in the agricultural operation allowing farmers to collect all essential data and leverage big amounts of agricultural data; ICT technology is the key enabler to allow data transfer, communication, and connection among different technologies.

Farm management system aggregates all collected data and uses Big Data Analytics to provide information and insights to support farmers on monitoring and management of the farm (e.g. recommendation on area-specific requirement on seeding, fertilizer or pesticide amount).

Robotics and automations are used to assist in operation, leveraging auto-guidance, telemetry, and unmanned aerial vehicle to improve operational efficiency and standardize task.

BENEFITS

PA potentially provides significant benefits to the users in various farming stages. It helps farmers to optimize input application by providing precise amount of fertilizer required for different areas of the field. Such information can be derived from the analyses of in-field data and collected geospatial information. This helps them save cost and avoid unnecessary soil degradation from overuse of fertilizer and other chemicals. PA also assists farmers to proceed with the right seed selection, the right input and nutrient choices, and the right harvest timing. The farm management system helps farmers to make the right decisions to improve work efficiency and thus productivity and yield. Auto-guiding machineries (e.g., GPS-guided tractor) mitigates intensive workload, improves minimizes operating risks, and helps to preserve soil quality. Moreover, farmers can reduce unplanned maintenance expense with automatic preventive maintenance capability (e.g., farming vehicle's tire condition monitoring).

Figure 34 : PA in action

PA typically saves **10-20%** of the input usage,
reduced **20-30%** of the workforce,
and obtained **10-30%** improved maize yield through adoption of PA

Right seed selection with biotechnology and area information

A farmer can use images taken from drone and soil quality determined by sensors to help him understand more about the area to be able to select the right seed to grow

Optimized farm operation with sensors/software

A farmer can also save water and fertilizer usage by variable rate control, using "in-field" sensors with farm management software's advisory function

Less labor intensive operations with automation

The operation is more efficient at a farm with GPS-guided tractors; a farmer can also use drones to monitor crop conditions

Better harvesting plans with accurate weather forecast

A farmer can check the weather condition with the sensor station and makes better decisions when to harvest

Source: Roland Berger

PA technologies have been successfully implemented globally. PA is more advanced in the developed countries led by USA, Netherlands, and Australia. In those countries, farmers generally own large farms (10-1,000 hectares or more) and the agricultural processes are already mechanized. PA has been widely implemented among arable farmers to drive production efficiency and productivity. PA has demonstrated benefits to farmers in developing countries where government support plays an important role in the implementation.

In China, there have been several government-driven PA projects which started as R&D pilots and roll-out as large-scale practices purpose initially before becoming a part of actual practice later. One successful example is a large-scale implementation of PA in Heilongjiang province, which is one of the most important grain and soybean production regions in the country. At regional SEA level, Malaysian government launched Rice Paddy Precision Farming program, aiming to increase rice production efficiency through the use of PA by local farmers.

Case Study: Agricultural transformation in Heilongjiang using PA

Heilongjiang province is an important grain and soybean production area – accounting for 10% of the national farmland. The province provides the opportunity to develop scalable PA due to its flat and wide open agricultural area, with low historic yield. Government driven PA project started in 2009 and continued expanding through 2016. Different technologies were deployed in the project including: equipment telemetry (e.g. automatic guidance, variable rate technology), and Agronomy data (e.g. imagery/satellite, remote sensing). All input data is consolidated in a cloud based information management system. Across Heilongjiang, more than 1 million hectares farmland is now managed according to PA practices.

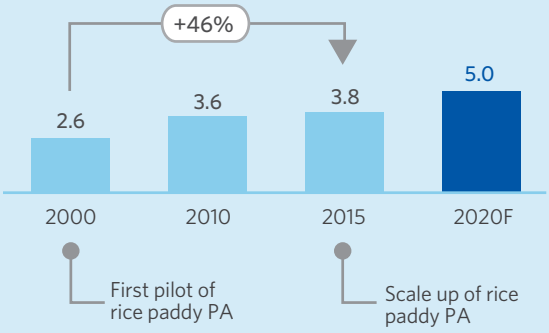
25% of farmland in Heilongjiang leveraging on PA tech. by 2015

Source : ISPA Report, Shandong University of Science and Technology

Case Study: Malaysia is on a road to self-sufficient rice production

Rice paddy precision farming program was carried out in Sawah Sempadan, one of the rice granaries in Malaysia. The program focused on nutrient management and monitoring for paddy field using GIS and satellite imagery /remote sensing through the collaboration of various government agencies. First pilot project in 2011 started on 2,300 hectares of land and 86 individual farmers. Online cloud based GIS with user friendly interfaces was introduced to farmers – providing access to online database (e.g. pest & disease information), interactive mapping and fertilizer recommendation. The program is a part of an ongoing government initiatives to achieve self-sufficient rice production of 5 ton/ha by 2020.

AVERAGE PADDY YIELD IN MALAYSIA (TONS/HA)



Source : Universiti Putra Malaysia (UPM), Dept. of Statistics, Malaysia

WHERE DOES THAILAND STAND?

Figure 35 : Developmental maturity phases of Thailand's Precision Agriculture

Static/ Analog	Scattered	Connected	Optimized/ Automated	Predictive/ Engaged
• Lack of PA initiatives • Basic machinery	• Scattered PA pilots/demo projects • Limited to basic sensors & automation equipment	• Increasing real in-field implementation of PA • Adopting automation solutions	• Expanding number of PA • Integration of PA technologies	• PA integrated across majority of farms

Source : Roland Berger

Public-developed PA still at pilot stage

Implementation by local farmers needed to be supported and encouraged

PA is implemented by big players

Low level of implementation by small to medium-sized farms

In Thailand, PA is at "scattered" stage with only few initiatives and pilot projects carried out by public agencies, universities, and agribusiness conglomerates. The entire concept about PA is still new to the local farmers, who are the majority of potential adopters but lack knowledge and financial capability to adopt the solution. (See Figure 35)

There are several examples of public and private-led projects and initiatives on PA in Thailand. NECTEC has developed a number of affordable PA technologies. The first example is the weather station, using basic sensors developed by TMEC[1)] to collect in-field data and provide information to farmers via mobile phone application. Another example is the irrigation control box, developed to enable flexible and remote control watering program using Bluetooth connection. The Rice Department under MOAC has also worked with NECTEC, AIT[2)], and private partners to introduce PA to the selected rice farming areas in the central region. Public and private universities have also rolled out PA research programs. For example, Research University Network Thailand (RUN project) is a collaborative research network of Thailand leading universities to innovate and implement PA technologies. Recently, the "Thai Smart Farmer" project has been launched under Pracharat initiative. The main objective is to improve agricultural productivity and product quality in the entire value chain through the use of technologies and introduction of modern farm. Key private players in this PA initiative include Thai Chamber of Commerce, ThaiBev, Mitr Phol, CP, Betagro, etc. Most of these private companies are the first adopters and have ongoing PA practices either in-house or with local partners (See Mitr Phol case study on the next page).

In order to further shift PA in Thailand from "scattered" to "connected" stage, it is vital to transform PA from being only research projects or demo experiments to actual in-field implementation by local farmers. It is challenging for PA adoption due to the fragmented agricultural industry, the lack of knowledge and financial capability. Thus, financial support measures for SMEs and some consolidation of smaller farms is an important prerequisites before these players can embrace PA. National communication strategy (gaining buy-ins from local leaders/local administrations) need to be deployed in order to ensure successful large-scale PA implementation

"Users and developers are different people – most PA are done at research centers as pilot but not being implemented by farmers"

NGO representative

"Most conventional farmers are not aware of what kind of technologies available out there and how to use it"

Owner of an agricultural business

"Farmers are still doing agriculture based on what they are used to. Unsuitable crop selection for the area and wrong timing of agriculture are factors that lead to low yield and high cost of production"

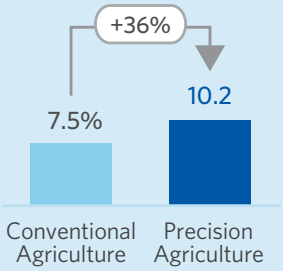
NECTEC representatives

Case Study: Mitr Phol Modern Farm System

Mitr Phol, a leading sugarcane producer in Thailand, has introduced various PA technologies in its operation to improve the issues of low yield productivity. Mitr Phol introduced "Mitr Kalasin Driving Productivity (MDP)" program in sugarcane field in Kalasin Province. Different PA technologies were introduced including GPS for field data collection, and GIS for data analytics. The collected and analyzed data is connected to smart devices and used by Mitr Phol area officer, enabling real-time and flexible monitoring of field operation. This information enables area officers to monitor and plan each individual plot of sugarcane (e.g. yield issue, disease monitoring). This project has resulted in overall yield improvement from 7.5 ton/Rai to 10.2 ton/Rai, while 5% increase in gross margin due to reduction in cost.

Source : Mitr Phol

Production Yield [ton/Rai]



Potential increase in margin

Case Study: "Smart Farm Model" First pilot of PA project by Thai government

Rice PA is introduced to the local farmers and implemented in 3,000 Rai of paddy field with 86 farmers in Saraburi Province in 2013. The project is done through the collaboration among government agencies, private companies and local farmers. Unmanned aerial vehicle (UAV) was used to collect imagery data on paddy field. Field mapping was produced using data collected from UAV and weather station. This project results in real in-field implementation of PA by the local farmers using basic technologies.

Source : NECTEC

Collaboration among different stakeholders in the project

Unmanned aerial vehicle (UAV) was used to collect imagery data on paddy field.

HOW TO DRIVE THAILAND FORWARD?

In order to ensure successful implementation of PA in Thailand, support from both public and private sectors are needed. Public- driven initiatives are essential to increase the adoption among local and small farmers by considering the fragmented nature of the industry and level of readiness of local farmers. Adoption of PA by private sector will also be important to drive the overall agricultural production of Thailand, given the scale and high capability readiness level. Detailed initiatives are designed to drive PA adoption for Thailand.

13 Roll out PA program for small local farmers nationwide

- Launch series of pilot PA project for key crop in strategic areas
- Assign project champions and key stakeholders involved at local level to ensure successful implementation
- Support PA implementation by providing small farmers with basic affordable sensors and centralized data analytics at local administrations

Recommended KPI

# of roll-out PA projects

% of farmland utilizing PA technology

14 Adopt large-scale PA projects in the private sector

- Increase adoption of PA by big private sector by providing PA seminars, training programs and advisory to small and medium players
- Promote and support small to mid-sized players to implement PA through knowledge sharing, financial support, advisory services by government and big private players

# of new private players adopting PA

% of farmland utilizing PA technology

Delivering higher livestock production and quality through PLF

Animal-centric approach is becoming a focal point in livestock farming industry. The aim of PLF is to help farmers control and monitor animal behavior and environment to support animal growth, detect disease at the early stage, and maximize production of livestock. PLF is a practice of livestock production management by using different technologies to enable better monitoring and control of individual livestock and overall farming operations. PLF allows farmers to make better decision from optimizing feed input, to monitoring environment for livestock growth, and to address the needs of individual animals (See Figure 36).

OVERVIEW

PLF focuses on using digital technology to monitor critical parameters of livestock farming and provide information essential to make the right decisions to improve animal welfare and maximize production.

Livestock sensors/ RFID are used to collect in-farm data and individual animals' condition such as location, animal's weight, farm humidity and temperature.

Connectivity is the technology that enables collection of critical data of livestock production system that indicate the efficiency of resource used and production through the communication & connection of various devices.

Farm management system is used for interpreting the information captured through the use of Big Data analytics to support farmers with decision making process.

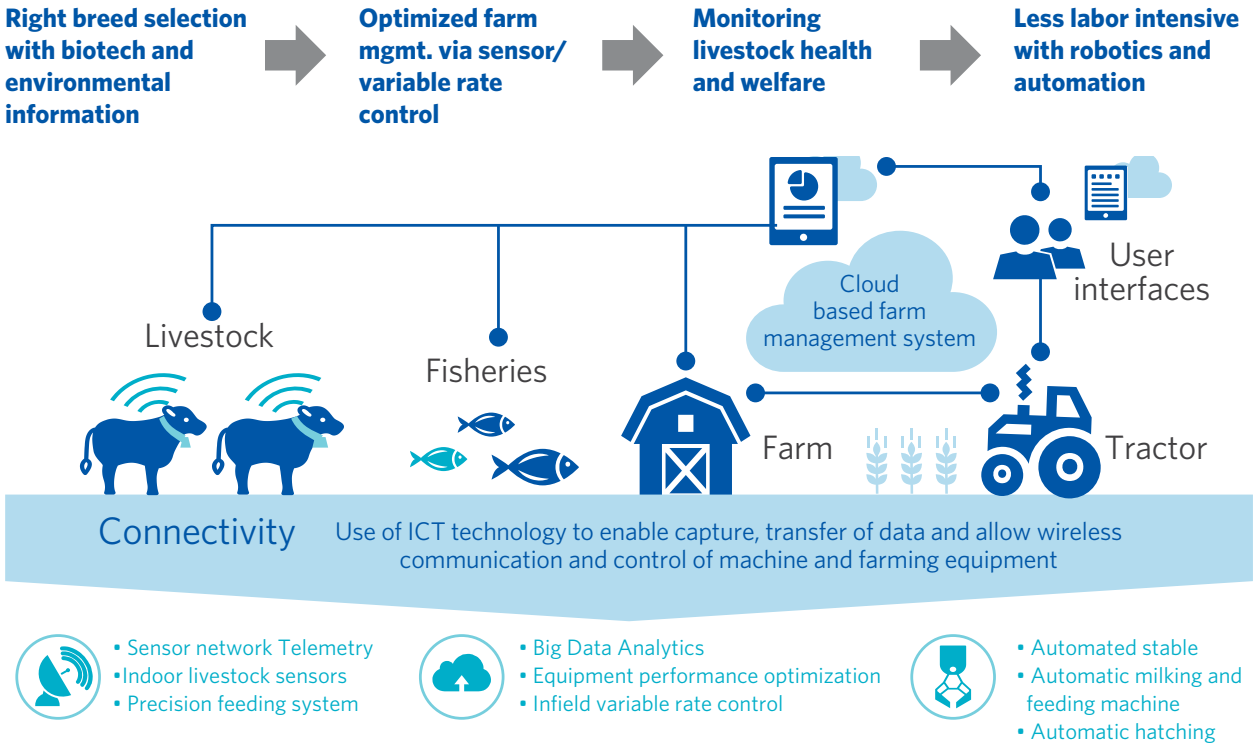
Robotics and automation are used to support farming operation and improve standardization (e.g. automatic temperature control, automatic milking and feeding machine).

BENEFITS

Farmers can realize several benefits of PLF. First, it helps increase productivity due to better farming condition and improved animal welfare. For example, farmers can optimize feeding amount and temperature of the farm according to what they learn from the measurements of livestock sensors. As a result, higher cow milk production or increasing broiler growth rate can be observed. At the same time, signs of infection or potential disease in animals can also be detected at early stage so that farmers can take proactive steps before further development.

PLF can support farmers to work efficiently. They can spend less time on routine tasks in the farm as automated system (e.g., variable controlled feeding) takes care of the business. As the feed inputs are controlled and optimized, the associated cost is minimized. For a large-scale livestock farming, animal tracking instrument and farm management software helps farmers to operate the farm remotely in a more systematic and standardized way.

Figure 36 : PLF in action



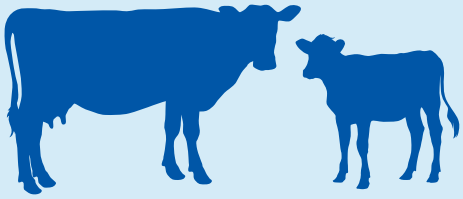
Various international successful implementations of PLF practices have demonstrated tangible benefits for livestock farming industry. PLF is more advanced in developed countries such as USA, Europe, Australia, and New Zealand. For example, Smart Dairy Farming (SDF) project in Netherlands discussed below was a collaboration between local farmers and various organizations to implement PLF in dairy cow farms.

In Asia, PLF has been implemented by a number of private players.

Another case study below discusses eFishery, an Indonesian based startup, which leverages PLF technologies to help farmers optimize feed input for fishery farming.

Case Study: Precision Livestock allows Dutch farmers to monitor individual cows

Smart Dairy Farming (SDF) brings the knowledge from different Dutch organizations, including cooperation, SMEs, research institutes, and farmers to accelerate the development of dairy cow precision farming. The project aims to support dairy farmers to increase monitoring quality of individual animals. Two key technologies were used in SDF: sensor system and PLF software. Sensor system was introduced to enable the collection of individual cow's data (e.g. weight, movement, and temperature). Data from sensor systems and various database are aggregated and analyzed into one single platform. This platform allows farmers to obtain insights of their own farm and individual cows. The platform also allows Dutch institutes (e.g. research institutes and cooperation) to access macro overview of the total dairy farms, leveraging on Big Data analytics.



"Smart Dairy Farming supports farmers with information and technology to further improve the health and longevity of cows"

Smart Dairy Farming representatives

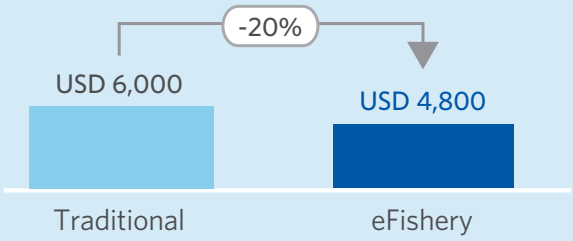
Source : Smart Dairy Farming

Case Study: Smart fish feeder help farmers decide the right amount of feed

eFishery is a startup company in Indonesia using PLF technologies to eliminate the issue of overfeeding. The system was introduced to help farmers optimize feed input by using programmed feeding technology. The product combines time based feeding with sensors to judge the fish's appetite by measuring the rate of feed depletion and fish movement. The system is connected to a centralized software, enabling remote control and real time report via smartphones and laptops. The data collected from smart feeders will be connected to eFishery software for monitoring and analysis of fish feeding activities. eFishery business model includes monthly subscription fee for participants to use eFishery application. eFishery demonstrates proven benefit that it can help farmers cut monthly feed costs up to 20%. The company has attracted various local and international investors.

Source : eFishery, FAO

Feed cost reduction
(avg. feed cost/ month per average farm)



WHERE DOES THAILAND STAND?

Figure 37 : Developmental maturity phases of Thailand's PLF

Static/ Analog	Scattered	Connected	Optimized/ Automated	Predictive/ Engaged
• Lack of digitalization initiatives • Basic machinery	• Scattered PLF pilots/ demo • Limited to basic sensors & automation equipment	• Growling number of precision farms • Increase adoption of automation solutions	• Expanding number of precision farms • Integration of PLF technologies	• Precision farming integrated across majority of farms

Source : Roland Berger

Scattered pilot PLF project, mostly implemented by big private players under contract farming business model

Sensors and automation equipment are mostly introduced at research stage by public sector/universities

PLF in Thailand is at "scattered" stage as PLF adoption is mostly limited to big private players. Small backyard farms usually do not have capability to afford PLF technology adoption. Some PLF demonstrations projects driven by public sector have been executed. (See Figure 37)

Commercial farms account for majority of livestock production in Thailand. Commonly, large private players engage smaller commercial farms in contract farming business model, especially for poultry farming industry. Through this model, small farmers are introduced to closed system farm management techniques and methods to help improve production and quality of livestock. Key private players for livestock production in Thailand include Thai Foods Group, CP, GFPT Group, and Betagro. These companies are equipped with advanced farm management knowledge and already implemented some level of PLF in their operations. Independent small farms typically do not use any PLF due to either lack of awareness on how PLF can help improve livestock farming production or have low financial capability to purchase costly PLF instrument.

"Small scale farmers cannot afford to invest in Technologies"

Management at a leading poultry business in Thailand

"Existing technologies are not being utilized due to low knowledge and understanding of the technologies"

Owner at a livestock technology company

Case Study: CP closed farming system helps local poultry farmers improve poultry production

Rice PA is introduced to the local farmers and implemented in 3,000 Rai of paddy field with 86 farmers in Saraburi Province in 2013. The project is done through the collaboration among government agencies, private companies and local farmers. Unmanned aerial vehicle (UAV) was used to collect imagery data on paddy field. Field mapping was produced using data collected from UAV and weather station. This project results in real in-field implementation of PA by the local farmers using basic technologies

10-15 days reduction of broiler lifetime

+1 additional production cycle/ year

Source : CPF

"Big farms are well equipped but they account for a very small number of total farmers in Thailand"

Professor at a pubic university

In term of fishery farming, Fishery technology in Thailand mostly focuses on the capture methods rather than the farming methods. Over the past decades, Thailand has been facing with declining catch-rate due to over-fishing and depletion of natural resources. In order to rebound Thai fishery industry, PLF can play a vital role to support robust fishery farming. Through the use of PLF technology, Thailand can be more focused on sustainable fishery farming. Currently, some research projects have been carried out by both public and private efforts, yet most of them were at small scale. Thai Smart Shrimp farm is an example of research project under National Research Council of Thailand, targeting to help farmers manage their shrimp farms more efficiently.

In order to improve PLF in Thailand for both livestock and fisheries from "scattered" to "connected" stage, it is crucial to make the technology available, accessible and affordable for farmers. Consolidation of smaller farms will also be an option to consider in order to enhance knowledge and improve financial capability. It is also imperative for the public sector to work with the big companies on collaborative effort to disseminate the knowledge and tools to local farmers. PLF, if deployed effectively, will greatly help Thailand to become a sustainable livestock producer for the World.

Case Study: Thai Smart Shrimp Farm

Smart Shrimp Farm is one of 600 research projects under National Research Council of Thailand's initiative called, "R&D for Stability, Prosperity, and Sustainability of Thailand". It was conducted by a research team at Nakhon Pathom Rajabhat University with the main objective to help farmers manage water quality in shrimp farms better by using wireless sensor network (WSN). Critical parameters including oxygen level, pH and temperature were measured by system of sensors. The readings were then sent to farmer with recommended actions via mobile application. The pilot test was done in Nakhon Pathom in 2016 and successfully helped famers reduce operating cost of 12.6% per life cycle of shrimp production by improved water quality with this PLF technology.

Cost reduction of 12.6% per life cycle of shrimp production

Source: Nakhon Pathom Rajabhat University

HOW TO DRIVE THAILAND FORWARD?

To increase PLF adoption in Thailand, government-led initiative to support local farmers on both knowledge and financial sides will be key. Adoption of PLF by big private players will be another area to look into. With increasing concerns on livestock product quality, it is necessary to raise awareness of PLF and its importance among SMEs. Two initiatives are identified to help improve on adopting PLF and potentially prepare Thailand to be more ready to become leading livestock producer at international level.

15 Roll out PLF program for small local farmers nationwide

- Launch series of pilot PLF project for key livestock in strategic areas
- Assign project champions and key stakeholders involved at local level to ensure successful implementation
- Support PLF implementation by small farmers with basic RFID technology and centralized data analytics at local administrations

Recommended KPI

# of roll-out PLF projects

% of farmland utilizing PLF technology

16 Adopt large-scale PLF projects in the private sector

- Increase adoption of PLF by big private sector by providing PLF seminars, training programs
- Promote and support small to mid-sized players to implement PLF through knowledge sharing, financial support, advisory services by government and big private players

# of new private players adopting PLF

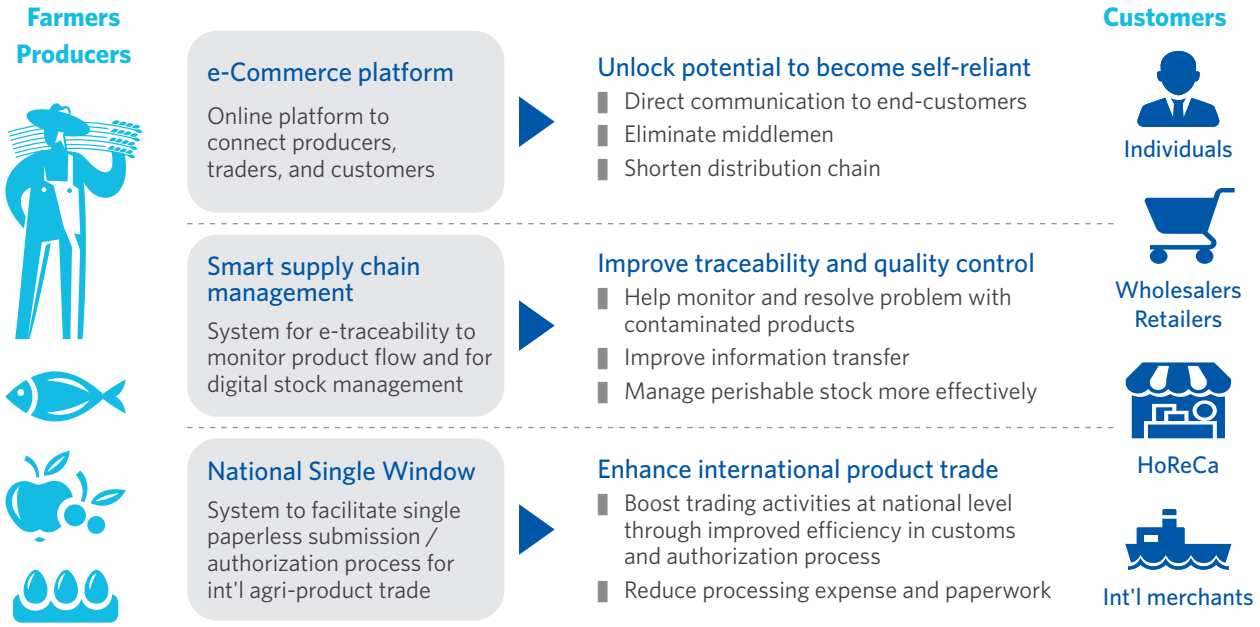
Digital solutions can support famers expand market reach and improve margins

Farmers are facing several problems when it comes to bringing products from farm to the market. Most farmers still rely on middlemen. It hinders them from maximizing profitability and connecting with customers directly. Apart from farmers, Thai agribusinesses are also in need to enhance their capabilities in response to stricter food standards and regulations and changing consumer behavior. Besides, agricultural product trade at international level can be improved as the current documentation and authorization process are still not effective. Digital technologies have potential to help small and mid farmers and agribusinesses to address above challenges. This solution can potentially help close these gaps, focusing on three main topics: e-commerce platform, smart supply chain management, and National Single Window system.

OVERVIEW

Farmers are facing several problems when it comes to bringing products from farm to the market. Most farmers still rely on middlemen. It hinders them from maximizing profitability and connecting with customers directly. Apart from farmers, Thai agribusinesses are also in need to enhance their capabilities in response to stricter food standards and regulations and changing consumer behavior. Besides, agricultural product trade at international level can be improved as the current documentation and authorization process are still not effective. Digital technologies have potential to help small and mid farmers and agribusinesses to address above challenges. This solution can potentially help close these gaps, focusing on three main topics: e-commerce platform, smart supply chain management, and National Single Window system.

Figure 38 : Three key digital solutions to help farmers/producers bring products from farm to market



Source : Roland Berger

Case Study: WeChat opening new markets for small and medium farm entrepreneurs

A messaging application links producers to customers in a more targeted and cost-efficient manner, serving big producers, and empowering small and medium players. The application provides insights using Big Data Analytics. It also offers effective tailored digital marketing campaign. WeChat empowers many farmers and entrepreneurs in China, no matter how small they are. For example, a group of six students in Shandong has built a business selling fruits to their classmates at school through WeChat, generating monthly income for each member approx. of USD 500 in 2014 (approx. 70% of average Shandong personal income).

Source : Statista, Bentham Open, J. Chem. Pharm. Res

Case Study: Esoko helping commercial farming in Africa with the introduction of real-time market prices for farmers

Founded in Ghana, Esoko empowers farmers by reducing the information gap, and providing farmers with update market information and direct access to the market, which could help to generate higher income. Esoko provides trading platform, price information, news and knowledge sharing, locations of shops and markets by using its website and text messages. Information are obtained via Esoko's own collection efforts as well as from user submissions. Primary users include individual farmers, traders, farmers' association, agribusinesses and public agricultural organizations. Esoko typically helps increase customers' income by 30-40%. There are currently more than 7 international partnership projects spanning 15 countries.

Source : Statista, Bentham Open, J. Chem. Pharm. Res

Secondly, digital technology also enables smart supply chain management, improving quality control and stock management. Due to more stringent food standards and regulations, the producers are now facing new challenges. Traceability plays an important role to fulfill the requirements, giving the producers an option to track & trace their products and the customers to access information about their purchases. RFID and QR code are the two key technologies enabling e-traceability. RFID technology helps the producer understand specific product flow from farm to factory to market. QR code improves information transfer from the typical barcode as it directly links a user to the website providing product information. e-Traceability system provides essential information when a problem rises (such as product contamination). Important data including product origin and batch number can be retrieved digitally, enabling producer to understand and resolve problems timely. The system also gives the producer information necessary to manage stock efficiently. For example, by knowing stock level at retailers, the producer can optimize manufacturing cycles and inventory

Case Study: Nortura enabling food traceability and smart supply chain management via RFID technology

An Oslo-based food supplier is among the first companies to lead the Norwegian e-traceability initiative. Partnering with an IT company, Nortura designed and built RFID infrastructure that enables manufacturers and grocery retailers to obtain a complete history of their products. As a result, the customers would be able to track any products and refer to specific batches timely if there is a problem about contamination. Nortura also use the this track and trace capability to drive process improvement in the areas like replenishment, logistics, and strategic market planning.

Source : IBM, RFID journal, Nortura, ICT works

Thirdly, National Single window (NSW) for more efficient international agricultural product trade can be developed using digital technologies. Import and export activities usually involve lengthy process with significant documentation work. Fortunately, NSW can help to facilitate single paperless submission and authorization process for international product trade covering agricultural products. The system boosts trading activities through improved efficiency in customary and authorization process. It also reduces paper work, dwell time and expense incurred along the process.

NSW System has been established in various countries around the world including ASEAN peer. Implementation of NSW comes with challenges, which are related to technical aspects. The implementation would require the policymakers and persons in charge of the project to have advanced managerial competencies in trade policies, business process analysis, change management, electronic business and information technology, legal matters and single window architectures.

Case Study: Singapore's NSW setting the bar for other ASEAN countries for agricultural trade

Singapore was among the first countries to establish its NSW in ASEAN, calling its project "TradeNet". The system reduces the cost and time to prepare, submit and process trade documents as well as expediting the clearance of cargo. Since TradeNet's implementation in 1989, it currently handles more than 30,000 declarations per day with over 8,000 users. 100% of the collections are made electronically through inter-bank deductions. 90% of permits are now processed under 10 minutes. As Singapore imports approx. 90% of its food supply, TradeNet is a key tool facilitate international agricultural trade.

Source : TradeNet

WHERE DOES THAILAND STAND?

Figure 39 : Developmental maturity phases of Thailand's digital distribution

Static/ Analog	Scattered	Connected	Optimized/ Automated	Predictive/ Engaged
• No established platform • Manual traceability • No established NSW	• e-Platform available but not widely used • Some e-traceability adoption • Partly-used NSW	• e-Platform used as one of the market channels • Widely adopted e-traceability • Functional NSW	• Established centralized e-platform • Established network of e-traceability • Connected and optimized NSW	• Advanced centralized e-platform • Predictive function for e-traceability network • Fully connected with NSW

Source : Roland Berger

Public-developed e-platforms are not widely used just yet

SMEs still lack knowledge and financial capability to adopt smart supply chain management

NSW in place since 2011, **still requires full connectivity**

When evaluating technology adoption and maturity of the three topics discussed, Thailand is at "scattered" stage. Platforms and technology are being developed and made available to potential users. However, most are adopted fragmentally, led by agribusiness conglomerates but not SME players.

"The first priority is to help smaller players to become self-reliant – digital technology will play an important role on that"

Public official

"Most farmers are old but they use smart phones"

Professor at an agricultural university

e-Commerce platform

Thailand has platforms developed exclusively for agricultural product trading. Agrimart (only directory, payment not available) and Ortorkor.com (online payment available) were created by departments under MOAC while Co-opclick (online payment available) was developed by the Agricultural Co-operative Federation of Thailand. However, they are still at early stages and have not been widely adopted by the local producers yet. More than 90% of the farmers in the rural area still use middlemen to distribute their products. On the private side, mobile applications for agricultural product trade such as FolkRice and GetKaset are gaining certain popularity. Younger entrepreneurs equipped with strong marketing knowledge have managed to engage more local producers and get them to make the best use of the platform. FolkRice has been featured significantly in various forms of media while GetKaset received more than 7,000 website visitors monthly.

Case Study: Agrimart" and "Ortorkor": tandem online agricultural product trade platforms

The Marketing Organization for Farmers (under MOAC) has developed two e-platforms for agricultural product trade: Agrimart.in.th and Ortorkor.com. The former one offers pricing information, agricultural knowledge, and online directory which links a user to merchant's website. The latter is an online marketplace where selected products (partly from Agrimart) are listed for purchase on the platform.

Launch earlier in 2016, both e-platforms are still in pilot phase, offering only few kinds of agricultural products with minimal number of merchants. These are first attempts by public sector towards connecting local producers to potential customers across the nation digitally. However, further promotion and improvement are needed.

Agrimart.in.th **Ortorkor.com**

Source : Agrimart, Ortorkor

Case Study: Folkrice creating social and economic impact to Thailand's agriculture

Founded in 2014, Folkrice focuses on providing an online platform to connect local farmers to customers. Folkrice is active on both website and mobile application. More than 1,000 producers have applied and more than 100 producers have been selected and registered as merchants on the platform. The company takes 10% commission, compared to typical approx. 30% made by a middleman. This model helps improve farmers profitability and shorten distribution cycle.

Source : Folkrice

Smart supply chain management

The big agribusiness conglomerates in Thailand have adopted digital technologies to upgrade their supply chain management. Market leaders (e.g., CP and Betragro) have RFID e-traceability system in place. In the meantime, the National Bureau of Agricultural Commodity and Food Standards (ACFS) has promoted the importance of traceability for SMEs since 2015. However, most of them still lack of knowledge and financial capability to adopt such technologies. In order to increase the adoption rate, it is importance not to only raise the awareness but also provide financial support or tax incentive. This will equip SMEs with track and trace capability to comply with domestic and international standards. e-Traceability will also help them to communicate better with the customers as well as improving their production planning and stock management.

National Single Window System

For Thailand National Single window, the system has been in place since 2011, yet is still improving for trade of rice, sugar, livestock, and frozen seafood. Department of Agriculture, Department of Fisheries, and Department of Livestock Development have only connected with NSW partially and are targeting to completely link the data with the system to fully digitize agricultural product trade, which will lead to 54% dwell time saving and 70% processing expense reduction.

HOW TO DRIVE THAILAND FORWARD?

Digital technologies will help bridge the gap of Thailand's current agricultural product distribution settings. A robust e-commerce platform, affordable smart supply chain management and improved national single window system will effectively assist farmers and agribusinesses at any size to become more connected to end-customers and better equipped with capability to make better decisions. This will ultimately boost agricultural product commercialization at both domestic and international level.

Three recommended initiatives are proposed to reshape Thailand distribution of agricultural products. First, it is essential to create a reliable e-platform which will be well-embraced by the potential users nationwide. Secondly, supply chain management will need to be improved by using digital technology such as RFID to equip producers with e-traceability capability. Last but not least, NSW should be improved, especially in selection to connectivity of data with relevant public agricultural agencies to help facilitate international agricultural product trade.

		Recommended KPI
17	**Create advanced and trustworthy digital distribution platform for local producers to offer their products to end-consumers** • Consolidate existing public-developed e-commerce platforms to develop and promote a single online marketplace nationwide • Provide marketing and ICT education for local farmers/producers • Support startups development of alternative online marketplace business for agricultural products	**Establishment and # of visitors** of an MOAC-consolidated e-platform
18	**Enhance agricultural product supply chain by using digital technology to improvetraceability, quality control, and stock management** • Continue to raise awareness on traceability and quality control of agricultural products • Support agribusiness SMEs to comply with GS1 traceability standard • Create public-private partnerships with big agribusinesses to provide necessary technology for small producers to improve their supply chain management	**# of SMEs** having e-traceability system in place **# of campaign** to promote traceability and quality in food products
19	**Develop National Single Window system to boost international agricultural product trade** • Assign responsible unit to improve and develop fully-connected NSW system • Complete the connectivity and information exchange between related agricultural agencies and other relevant stakeholders to NSW • Encourage the use of NSW for agricultural product trade	**% reduction in processing time/expense** due to NSW

CHAPTER 5

Digitalization of Tourism

Thailand's tourism - the key engine propelling social and economic growth

With technological advancements, cheaper flights, and ever increasing curiosity towards other countries and cultures, the world has become a smaller place. Tourism industry is changing fast, attracting more travelers every year. In 2015, more than one billion people around the world traveled, generating income, supporting jobs creation, and boosting development globally.

Over the past decades, tourism industry has experienced continuous expansion and diversification to become one of the largest and fastest-growing sectors in the world. According to the World Travel and Tourism Council (WTTC), travel and tourism sector generated USD 7.2 trillion (9.8% of global GDP) in 2015 while supporting 284 million jobs, equivalent to one in eleven jobs in the global economy. In the next ten years, the world will welcome nearly 1.8 billion international visitors. Tourism GDP is expected to grow at 3.8% p.a., reaching USD 11.4 trillion by 2025, and the sector is expected to contribute 357 million jobs globally.

With the promising growth of the industry, many countries are striving to capture a share of the increasing demand. Destinations, which design comprehensive and visionary tourism strategies to capitalize on the changing environment will have higher chance of becoming the world's next tourism leader.

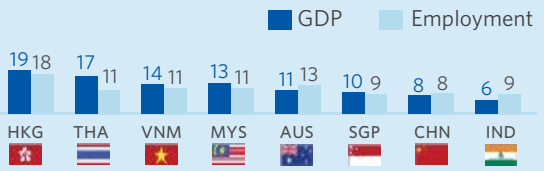
Thailand has been among the top choice of destinations for global travelers. The country is known for its world-renowned tourism assets – unique culture and heritage, flavorful cuisine, serene sea and sand, and welcoming hospitality.

In 2015, Thailand hosted nearly 30 million international visitors, bringing in more than USD 44.6 billion to the country, which placed it on the 6th highest tourism receipt destination in the world. Tourism is the key pillar of the country's economic and social development, contributing to 17% of national GDP and accounting for 11% of employment. Tourism is undoubtedly the integral part of Thailand's advancement over the past decade, and is expected to be the major driver in the future.

In light of intensifying competition among destinations and ever-changing tourist expectations, Thailand tourism needs to focus on strengthening its foundations to ensure industry resilience and sustainable growth. The sector should also enhance overall industry competitiveness in order to retain the leading position in this dynamic market.

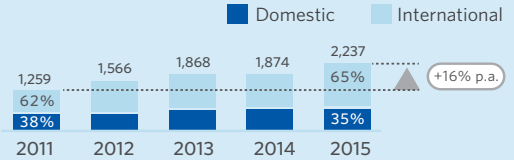
Thailand tourism is of great macroeconomic significance compared to the region – growth in tourism contribution to GDP is expected to surpass regional and global average over the next ten years.

Figure 40 : Economic and social importance of national tourism [% contribution, 2015]



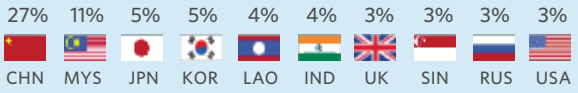
International tourism receipts have shown robust and resilient growth over the last five years despite a short-term drop in 2014 due to political turmoil.

Figure 41 : Evolution of Thailand's tourism receipts [THB billion, 2011-2015]



Majority of tourists are concentrated among top ten countries, five of which contributed to more than half of total arrivals – growth is especially high among tourists from East Asia and ASEAN.

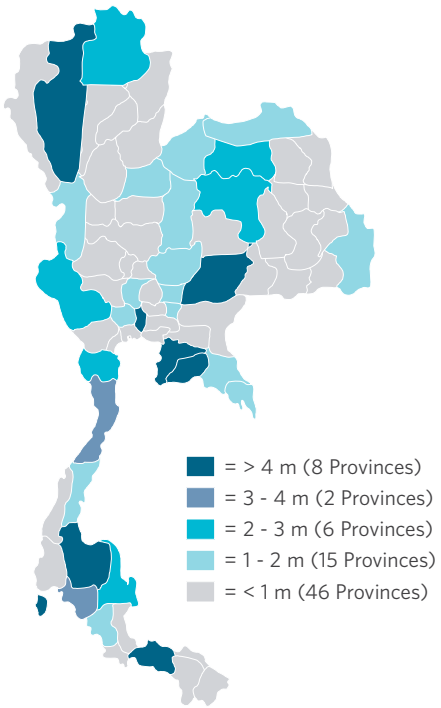
Figure 42 : Top ten nations of inbound tourists in Thailand [% total, 2015]



Source: UNWTO, Thailand's MOTS, Thailand's Department of Tourism

Thailand tourism industry is experiencing one of the fastest growth in the world. The number of visitors has tripled over the past decade, surging from 9.6 million in 2000 to nearly 30 million in 2015. Significant growth is also expected over the next few years – it is forecasted that international tourist arrivals in Thailand could reach 50 million by 2020[1]. The growing popularity brings new challenges for the country to manage. In order to maintain Thailand's position as a leading tourism destination, it is critical to proactively confront four main challenges.

Figure 43 : Distribution of tourist arrivals in Thailand by province [m visitors per year, no. of provinces out of 77, 2015]



Source : Thailand's Department of Tourism

1. Concentration of tourists in primary cities

Despite abundance of natural and cultural assets across the country, tourist arrivals are heavily concentrated in a number of main cities, such as Bangkok, Phuket, and Chiang Mai, as seen in Figure 43. This concentration creates several concerns, including capacity constraints in transport and accommodation, inadequate public infrastructure, and deteriorating environmental and cultural resources. Case in point is the indefinite closure of Tachai Island in Southern Thailand in 2016 due to the overcrowding and degradation of natural resources from tourism. The concentration also limits income distribution and improvement in quality of life for local communities nationwide.

Strategies to discover and market the lesser-known attractions are needed to unleash Thailand's full tourism potential and ensure sustainable development. One of the keys to attract and guide tourists to other parts of Thailand is the availability and quality of information on attractions nationwide. It is important for the country to establish comprehensive and robust tourism database which is easily accessible for tourists to search before or during the trip.

2. Slow adaptation to the shift in travelers' preferences online

Google's "Traveler's Road to Decision" report shows that 65% of prospective leisure travelers research and plan their trips online. In addition, eMarketer estimates that global digital travel sales[2] totals more than USD 500 billion in 2015, a 13% increase from the year before. Double-digit growth is expected to continue in the next five years, especially in Asia-Pacific. This illustrates how travelers are increasingly opting for online alternatives in planning their vacation.

Thailand is at subpar level both in terms of online tourism content and ICT adoption in local businesses. According to World Economic Forum's Travel & Tourism Competitiveness Index 2015, Thailand ranked #48 and #59 from 141 countries in ICT readiness for B2C and B2B transactions respectively. Leading airlines and hotel players are better equipped in offering online alternatives due to the dominance of multinational Online Travel Agents. However, local tourism businesses in retail, restaurants, entertainment, and tours still have low online presence. Existing online information on local businesses is fragmented or usually only available in Thai.

Slow adaptation to tourist's online preference poses serious limitations to meet tourists' demand during trip planning (See Figure 44 – Step 1). It is important for the country to develop a platform with sufficient quality information to promptly capture business opportunities and enhance industry competitiveness.

"I've always heard good stories about the North and wanted to visit – I know there are many nice places, but I'm not quite sure what it actually has to offer and how to get there. So I ended up staying in my resort down South and a few days in Bangkok"

Australian Tourist in Thailand, 2015

1) Pacific Asia Travel Association
2) Leisure and unmanaged business travel sales booked via any online or mobile device

3. Limited convenience and value-added at destination

Tourists are traveling more frequently, yet staying shorter in each destination. On one side, they need to plan carefully on which attraction to visit and how to get there within a tight schedule. On the other side, destination itself has shorter window of opportunity to create positive impression and memorable experience among visitors. This emphasizes the importance of convenience and flexibility in transportation planning. It also highlights the ability of attractions to create beyond-expectation values for visitors right at the moment of interaction. (See Figure 44 – Step 2 & 3).

In Thailand, transportation has long been the troubling issue for tourists. Public transport schedule and booking portals are operating in isolation and often with information only available in Thai. Bangkok has the most connected public transportation in the country, yet there is no centralized schedule information or multi-modal travel cards available. There is a single ticketing project ("Mang Moom") planned, covering BTS Skytrain, MRT Subway, Airport Rail Link, and Bus, but the exact launch is unspecified. Transport inconvenience and limited mobility make it difficult for tourists to explore and enjoy the various offerings across the nation.

Once at attractions, tourists are often greeted with static exhibitions such as information stands and leaflets, which are rather dull and inadequate for providing insights about the attraction. The setup can be further enhanced with provision of more engaging experience to better captivate the moment and create value for the visit.

"As we set off from Kao San Road to our hotel, we stopped at tourist information booth to ask about the best way to get there by public transport. The officer seemed to have no idea and there's no other way I can find how to get there"

British Tourist in Thailand, 2014

4. Poor safety and security for tourists

"Is it safe to travel to Thailand now?" This is one of the most common questions from foreign tourists over the past few years.

Since 2013, Thailand has been in political tension which resulted in several unrests and left a mark of insecurity among tourists. According to the World Economic Forum's Travel & Tourism Competitiveness Index 2015, Thailand ranked 132 out of 141 countries on Safety and Security, lowest among ASEAN countries. Road accident is one major causes. According to World Health Organization, in 2015, Thailand saw the highest number of road accident deaths per 100,000 populations in the region at 36.2 cases, among which 34 incidents are related to tourists. Terrorism is another rising concern, with history of bombings and terrorist attacks over the past few years. These incidents create negative impacts on tourism confidence and overall perception of Thailand.

Serious and comprehensive initiatives should be put in place to mitigate and reduce potential of harm for tourists and to reassure international travelers that Thailand remains a welcoming and secured destination.

"In the past, we did not deal with the root causes of the tourist safety problem proactively, rather reactively. From now on, we will tackle at the issue and address it seriously – it will be our number 1 priority."

Permanent Secretary, MOTS, 2015

Figure 44 : Assessment of tourist touch-points in Thailand

Source: Tourismthailand.org, Roland Berger

Thailand is facing challenges in ensuring sustainable tourism growth in order to maintain its leading position. Four key challenges hindering the competitiveness of Thailand tourism have been identified, including concentration of tourists, slow adaptation to tourists' online preferences, limited convenience and flexibility at the destination, and safety and security concerns.

It is critical for Thailand to proactively confront and address these challenges. Based on rigorous assessment and validation, four digital solutions capable of addressing and mitigating such challenges have been proposed:

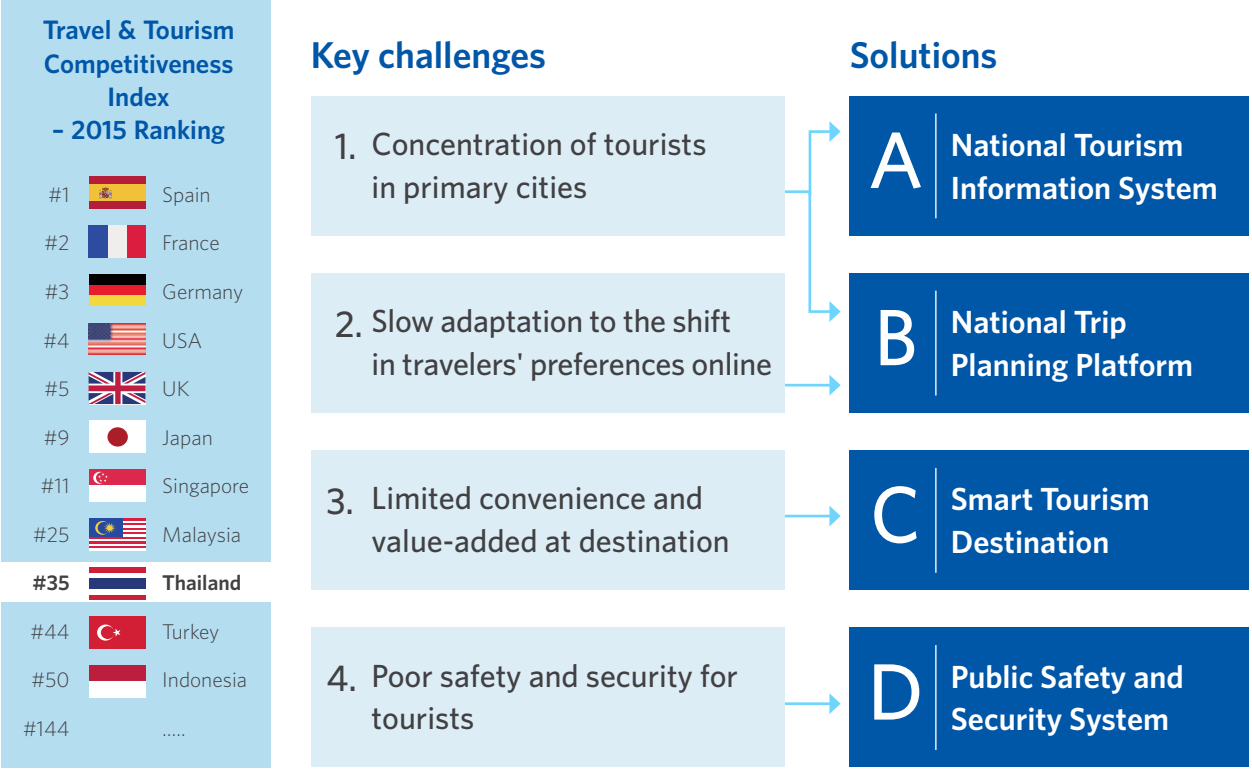
A **National Tourism Information System** is related to collecting and distributing all tourism-related information in the country in centralized database. Based on this comprehensive information available, key insights can be extracted with Big Data Analytics to allow effective policy planning in order to improve overall management of tourism industry. At the same time, opening these data to public ("Open Data") could foster the growth of local tourism startups and the overall tourism ecosystem

B **National Trip Planning Platform** is related to building a one-stop national information platform that consolidates online tourism content and provides relevant suggestions for tourists in their trip planning. It also covers the use of digital channels for tourism marketing to best anticipates and responds to the change in traveler demands

C **Smart Tourism Destination** is related to building the infrastructure that integrates digital technology to enhance attractions, transportation, and payment facilities. Tourists can enjoy enhanced convenience in transportation and have more immersive experience during their visits in Thailand. The concept aims to add value to the existing tourism offerings through integration of technology, in order to better facilitate and enrich tourists throughout touch-points

D **Public Safety and Security System** consists of four interrelated sub-systems, covering immigration and border security, surveillance system, convergent security command center, and emergency alert system. The solution aims to provide safe and secured environment for tourists and to reinforce Thailand as a safe destination

The four solutions will be detailed in the next section, showing overall concept, key benefits for stakeholders, international best practices, and implementation steps for Thailand.



National Tourism Information System is the single source of truth on Thailand's dynamic tourism sector

Travel is truly a fast-paced industry. Frequent travelers around the world are looking for a flight to book, a hotel to stay, an activity to join on a daily basis. This process creates enormous set of information which holds great insights about travelers and the industry. By the time you finish reading this paragraph there are already about 300 new travel itineraries made online worldwide![1)]

OVERVIEW

The hospitality, travel, and tourism sector is an inherent data generator, creating millions of records about tourists daily. These data sets create challenge for the country to efficiently collect and make use of the information available.

National Tourism Information System is related to collecting and distributing all tourism-related information in the country through a single centralized database. The system aims to link people and organizations to create, share, and utilize the collected and analyzed data for tourism development purposes.

Inputs on the supply and demand sides are generated, collected, and used. On the supply side, information on tourism offerings and destinations are critical for public references and industry management. On the demand side, data on tourist arrivals, expenditure, and consumption indicates industry performance and improvement opportunities.

The key design principles of the National Information System include comprehensive digital repositories, user-friendly portal and interface, and Big Data Analytics. Cloud storage and real-time data synchronization are the essential building blocks of the system.

The Information System is metaphorical to a human being – where vital components need to be functional and operate cohesively (See Figure 45).

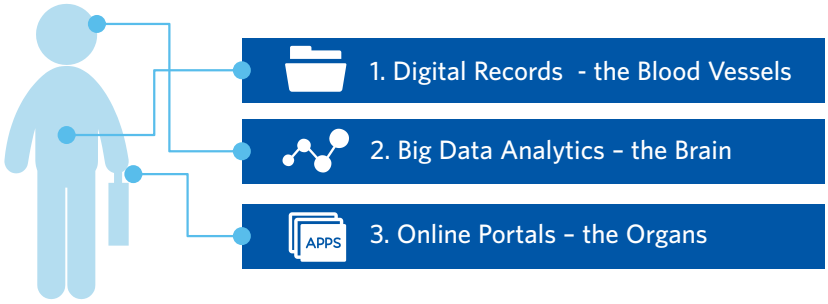
First, Data Records or Data Repositories represent the Blood Vessels that constitute and sustain the lifeline, where raw data is collected, arranged, and stored. Through every traveler, different traces are left behind and big amounts of data are generated, from general demographics of a tourist collected upon arrival through immigration form, to mobility patterns observed by his mobile-location. To collect a comprehensive set of data across different touch-points, appropriate tools are required.

Second, Big Data Analytics represents the Brain that conducts analyses to derive insights from the big amounts of information available. Analyzing these data offers the possibility to track, measure, and predict travelers' behavioral patterns and needs. From these insights, government can improve its policy planning while businesses can better tailor their products and services and improve operations. For example, mobility pattern of tourists between sightseeing spots allows local tourism authorities to set effective policies to alleviate concentration of tourists in a particular area.

Third, Information Portals represent the Organs that deliver different set of information to address different needs. Collected input is processed into a more meaningful form and transferred as output for relevant stakeholders to use through appropriate communication channels. Government can gain access to macro-level view on tourism trends and forecasts to formulate strategies. Businesses can get a detailed view on particular segments to analyze market opportunities or areas for operational improvement.

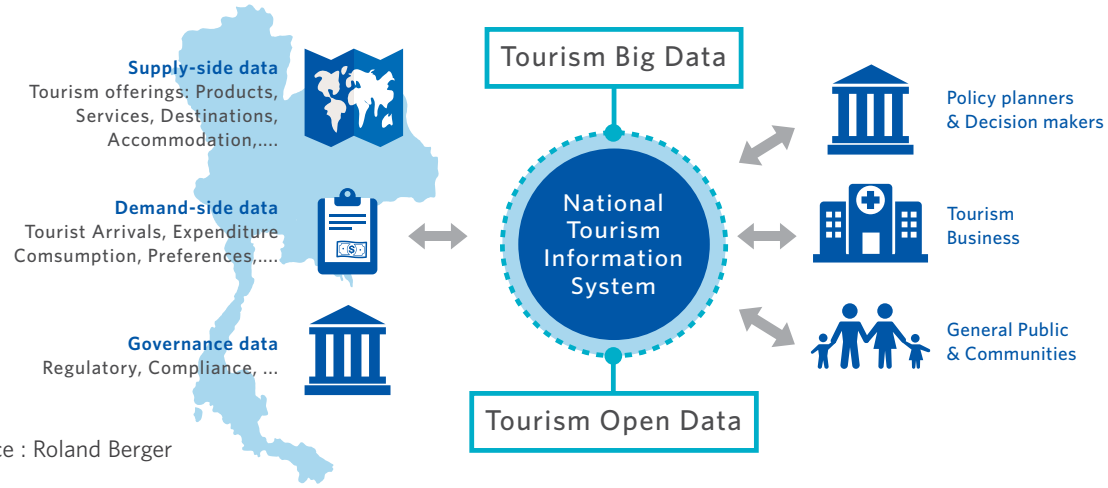
1) Number of travel bookings made on the internet per minute, according to eMarketer Survey in 2014 (148.3 million online bookings made each year)

Figure 45 : Key components of the information system



Source : Roland Berger

Figure 46 : Overview of concept for National Tourism Information System



Source : Roland Berger

Big Data Analytics and Open Data platform should be developed to leverage the collected information. Based on the comprehensive information available on National Tourism Information System, key insights can be extracted with Big Data Analytics to assist government with policy planning. At the same time, opening these data to public ("Open Data") can foster the growth of local tourism startups and the overall tourism ecosystem.

Big Data Analytics focuses on extracting valuable conclusions from hundreds of millions of data records, using complex algorithms and powerful processing. Big Data offers huge advantages especially in the context of travel and tourism, where spontaneity, mobility, risk, and expectation all weigh so heavily on the tourist journey. Through Big Data Analytics, the industry can learn much more about tourist behaviors and preferences. Tourism authorities can make more effective policies to create an environment friendly to tourists and residents. For example, Big Data Analytics can help identifying hotspots frequently visited by tourists but overlooked by the municipalities. Theses insights can guide the promotion of new attractions and potential tourism segment, such as medical tourism, based on trends in employment in particular region. Tourism businesses can improve marketing and products to offer better values for tourists. For example, Big Data Analytics can generate insights on travel patterns that helps local businesses launch tailored, more profitable bus routes, or to optimize content and language for products that are most popular for certain nationalities of tourists.

Case Study: Japan – Big Data helps local governments better promote tourism

To help develop new tourism spots and routes, the Japan Tourism Agency engaged in a massive data collection. Data collected includes mobile GPS coordinates and social media streams from 700,000 tourists in eight areas across the nation. The aim was to discover patterns in the way tourists travel the region, and find ways to maximize those patterns and potential revenues along the way. For example, many travelers were found to have headed for Mt. Fuji from Yokohama. Launching a tailored campaign on attractions along the Mt. Fuji-Yokohama route was shown to be effective to promote secondary destinations.

Source: Nikkei, datanami

Open Data concept focuses on publishing the collected and analyzed data to the general public. Open Data can help promote the "assets" destinations have to offer and help different players make better-informed decisions. Many individuals and organizations collect a broad range of data in order to perform their tasks. Governments, in particular, collect reliable and exhaustive information, from city information on point of interests and routes, to tourist demographics and industry performance. Hence, it is critical for these sets of information to be available and accessible to general use.

Open Data has great potential to increase innovations and destination management in tourism. Cities can better manage the challenges of tourism by empowering travel tech startups with resources and information, allowing them to create better, more relevant apps with smaller investment. This would promote industry competition, and tourists would benefit from a wider choice of digital services.

Nevertheless, embracing Big Data and Open Data needs to be treated with cautions. Given that travel and tourism concerns information at the individual level, there are associate socio-economic, ethical, legal, and privacy aspects that must be evaluated and taken into account.

Case Study: CitySDK Smart Tourism API – Helping cities open & unify tourism data, giving developers the needed tools

Europe has embarked on the ambitious task to collect and open information on city point of interests, events, and routes, and make it available to startups. The database provides startups with seamless access to tourism information on participating cities through a single, interoperable API (Application Programming Interface) endpoint. The API is now available in 5 cities. Several travel tech mobile applications have already been developed using this API functionality. For example, 'Crash & Play' connects travelling musician away from home with local musicians so they can rent instruments and play.

Source : CitySDK

BENEFITS

National Tourism Information System provides great benefits for key stakeholders. Leveraging on available and accessible information, government, businesses, and communities can better cope with the rapidly changing market dynamics and ever-demanding tourist expectations.

Government can leverage in-depth tourism intelligence to better macro-manage the industry. First, it can achieve data-driven policy making, management, and monitoring. For example, designing tourism zoning of coastal areas based on resources capacity and consumption, or setting measures to mitigate noise pollution in tourism areas. Second, the government can promote industry standards and quality control through exhaustive list of database on tourism offerings. This allows for better control and classification, from setting hotels stars rating and segmentation, to designing quality and capacity control for public toilets at attractions. Lastly, through open database and data provisions the country can improve overall transparency and governance.

Tourism businesses can enhance its capabilities and business opportunities through greater insights. First, businesses gain better accessibility and visibility on comprehensive and real-time tourism statistics and performance. Second, they gain the ability to personalize marketing and tailor products and services using analytics to match tourists preferences and cultural-specific requirements. Lastly, businesses can improve planning capabilities and business development opportunities such as the ability to adjust prices dynamically in real time in response to the predicted change in travel demand.

General public and communities also benefit from the integration of tourism database and better policy making. Better industry education on economic importance of tourism can generate awareness and encourage tourism development mindsets among individuals. This encourages better social inclusion and wealth distribution across the nation.

"Figures for Thailand tourism have been good. But the question lies in how to sustain this growth further. The key is for the government to make data-driven, rigorous policies. Huge information on the industry is already collected - We need to understand these numbers a little bit better in order to plan better."

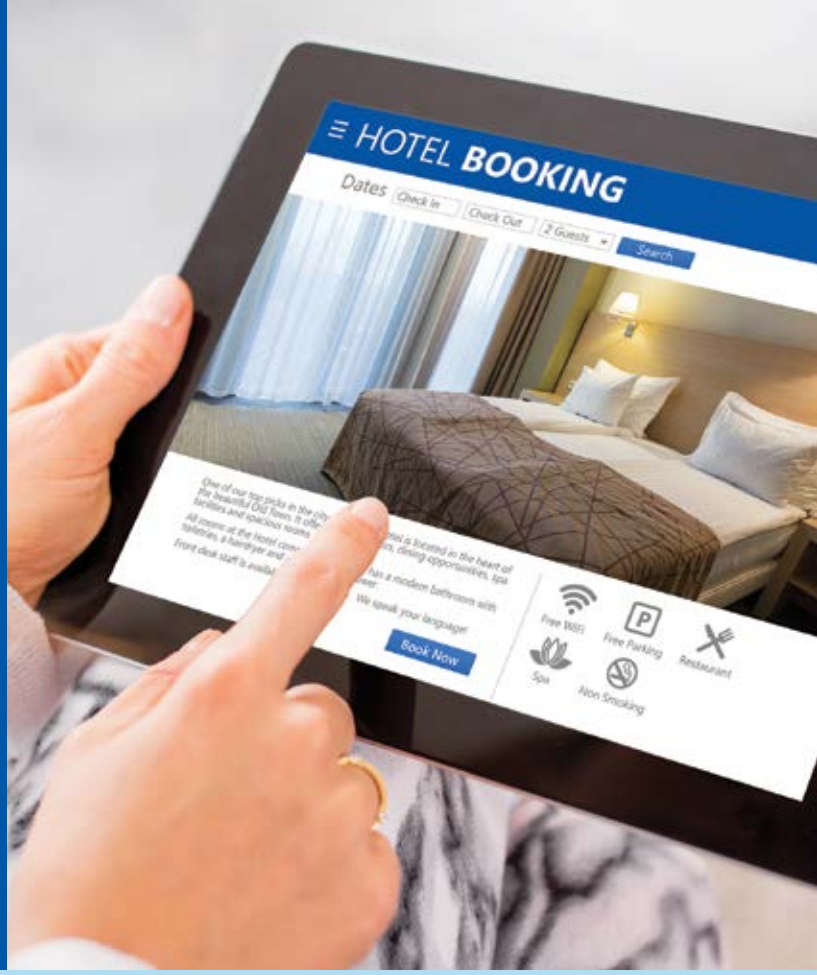
International expert on sustainable tourism development

"As one isolated village in the middle of nowhere, we can't really do much. Now once the database of our assets will be created and combined with other villages nearby, we can present ourselves as much more powerful tourism cluster."

Head of Village in one of the pilot projects on Community-Based Tourism

"The #1 problem local SMEs, like myself, faced everyday is the limited information accessibility. Finding comprehensive data/ stats on homestays in Thailand is extremely difficult – even if found, they are not consistent across official websites."

Owner of a Thai-based travel Start-up



Case Study: Australian Tourism Data Warehouse – the Single National Platform to improve competiveness of all tourism operators, large and small

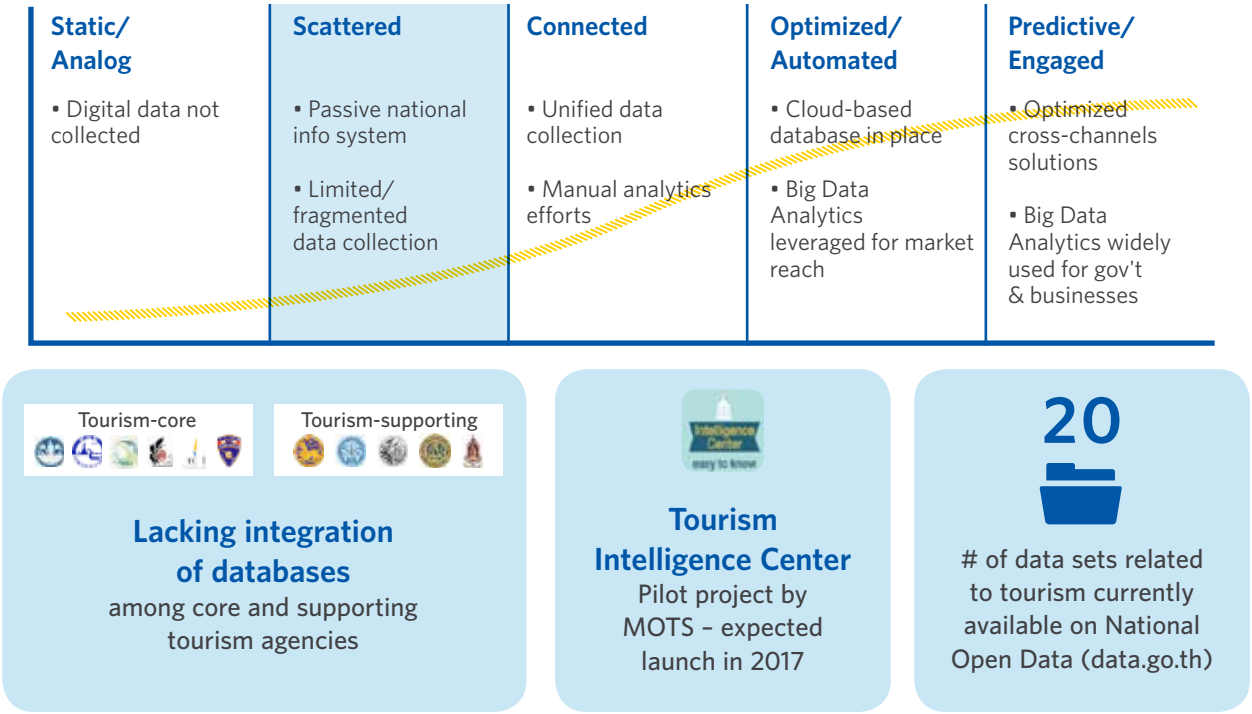
Tourism industry is of major importance for the local and national development for Australia. It directly employs over 500,000 people and generates nearly 10% of export earnings. The industry faces several challenges with the multitude of players involved and ever increasing competition.

Founded in 2001, the Australia Tourism Data Warehouse (ATDW) is the national platform for digital tourism information on Australia. The system acts as the only national central storage and distribution facility for tourism offerings and destination information. ATDW focuses on tourism suppliers and intermediaries, and less on providing access to the tourists directly. Suppliers gain broader exposure while intermediaries gain access to comprehensive and quality content. It offers visibility through real-time, location-based, and unified listings. It also provides booking functionality with inclusive online B2B booking exchange, promoting local tourism SMEs. The database currently covers 40,000+ listings across 11 categories, published by 150+ online distributors globally. The ATDW-online platform replaces eight different legacy systems previously used by local tourism bodies, offering cost optimization & management efficiencies for the country.

Source: Australian Tourism Data Warehouse

WHERE DOES THAILAND STAND?

Figure 47 : Developmental maturity phases of tourism digitalization



Source : Roland Berger

Currently, in Thailand, the Digital Maturity level of National Tourism Information System is at "connected" stage based on three main reasons. First, tourism -related information in Thailand is collected, digitized, and stored to a certain extent, yet integration across entities is lacking. Second, the efforts are largely uncoordinated with limited sharing and provision. Lastly, the collected data is not actively used by stakeholders for decision-making.

Integration of macro-level tourism databases across entities is lacking. Multitude of public, private, and community stakeholders are involved in the development and management of tourism databases. Key stats on tourist arrivals and receipts are publicly available on official MOTS and DoT[1)] websites, as well as TAT[1)] Intelligence Center. MOTS and DoT also publish related laws and regulations, standards, and database of destinations, while TAT publishes detailed statistics and survey findings. However, there are cases of data overlaps or inconsistencies, which poses limitations to industry management. Challenges also exist in inter-department collaboration on retrieving necessary information to distribute in integrated manner, such as data on tourists border crossings or tourism employment.

Current data repository is "Closed" and lacks intuitive functionality and interface. Existing dissemination of data sets is usually rigid and static, with variation in format and quality of data sets across time periods and entities. Available data files for public retrieve are usually in pdf or image format, posing limits for viewing capability, deeper understandings and further use of data.

Tourism analytics is not sufficiently leveraged in policy planning. Current application data is mostly used for operational and reporting purposes. Further digitalization and integration of data could provide powerful source of insights for tourism authorities to formulate strategies. The ultimate goal is to enhance industry competitiveness and sustainability, especially for supporting local tourism businesses which are highly fragmented and mostly dominated by foreign players.

In order to shift the development stage of Thailand tourism information system to "optimized" or "predictive" stage, collaborative efforts to integrate, analyze, and utilize the data are critical. The future goal is to have a single central database for all tourism-related information for public use. Some efforts have been made in this direction. MOTS has launched a project under 'Digital Tourism' plan to develop a centralized national tourism information system called "Tourism Intelligence Center", with expected launch in 2017. The aim is to leverage on synchronization of data to develop "Tourism Big Data" to aid tourism planning and improve efficiency.

1) DoT = Department of Tourism; TAT = Tourism Authority of Thailand

Case Study: Tourism IntelligenceCenter – the most comprehensive database on Thailand tourism industry up to date

Realizing the need for the centralization and consolidation of tourism data, MOTS developed "Tourism Intelligence Center" (TIC). The project promotes integration of tourism statistics and knowledge, aiming to improve tourism decision-making and monitoring. TIC entails three major building blocks: tourism performance (receipts, satisfaction, impacts), tourism industry components (demand, supply), and tourism library (research paper, policy paper, news). The development is currently in Phase 1 (2016-2017) on integration among core public agencies in tourism, full-fledge functionality is expected to be ready by 2018.

Source : MOTS

I.
Core tourism agencies
(MOTS, DoT, TAT)

II.
Related agencies
(AOT, Tourist Police, etc.)

III.
Across industry
(Public & Private)

HOW TO DRIVE THAILAND FORWARD?

Thailand should develop National Tourism Information System to address critical challenges faced by the industry. Without proper planning, concentration of tourists and limited distribution of wealth will persist with the continued growth of inbound tourism. The establishment of National Tourism Information System could also promote work integration down to the local level and improve efficiency among public entities. Key findings can be derived from Big Data Analytics to allow effective data-driven policy to support sustainable tourism development. At the same time opening these data to public (Open Data) can foster the growth of local tourism startups and the overall tourism ecosystem.

In the next five years, Thailand should enhance its National Tourism Information System with coordinated nationwide and sector-wide efforts to collect, store, and integrate tourism-related datasets, to derive meaningful insights for policy and decision making, and to open the data to general public. Private players should be encouraged to share or exchange the data to promote greater understandings of tourists behaviors. Technical and financial support should be made available to foster tourism startups.

The proposed priorities for Thailand in developing National Tourism Information System are outlined in two key initiatives:

20 Develop National Tourism Information System as the central online platform providing tourism information for institutions and public

- Integrate existing tourism-related datasets among public stakeholders
- Collaborate with private stakeholders to obtain necessary information to complete and complement tourism 'Big Data'
- Enhance the integrated national tourism datasets and platform
- Apply tourism intelligence in policy planning and management

Recommended KPI

# of visitors to platform

% policies leveraging tourism Big Data Analytics

21 Foster digital ecosystem for travel tech startups through national tourism Open Data and travel and tourism community

- Open specific tourism datasets to public, ensuring API-readiness
- Develop online portal for Tourism Open Data
- Provide technical and financial support for tourism startups
- Promote tourism public-private-community forums/ dialogues for learning, networking and exploring collaboration opportunities

# of travel & tourism tech solutions successfully developed using tourism API

Providing tourists with rich information on attractions and reaching them at the moment of interest

The digital revolution has liberalized the way consumers shop for travel products and services. Digital technology equips consumers with tools to search and compare thousands of flights and hotels in an instant. Finding the best-value deals is now only one click away. Consumers have more opportunities to share experiences and influence others, changing the way travel is planned, booked, and shared.

OVERVIEW

Travelers are now making trip planning and booking decisions predominantly online. They turn to the Internet to ask questions and expect immediate answers. In these online moments, decisions are made and preferences are shaped. Destinations with strong and systematic online presence to attract and facilitate tourists will reap the benefits.

In order to respond and capitalize on new online preferences, the government should support and facilitate private players to improve their online presence. More importantly, it should improve the country's official online trip planning platform with sufficient online content and dynamic functionalities. It should also leverage on advanced digital marketing tools to raise awareness and drive traffic.

Building the **one-stop national trip planning platform** for tourists is a critical first step. Prospective tourists face challenges in accessing relevant and quality information in real time to assist their travel planning.

At each decision-making moment, information must be provided effectively in real time. First, since travelers are most likely unfamiliar with the destination or simply just looking for inspirations, they usually look for content that best suits their needs and preferences. In order to grab their attention, the platform should provide information based on travelers interests and behavioral context, rather than demographic profiles. For example, trip suggestions for cat-lovers, honeymooners, or leisure photographers. Second, database of information on the destination, including attraction listings, tours and activities, or hotel options, must be comprehensive and visually-appealing. This database should also support searching functionality based on keywords that corresponds to travels' interests. Third, information on how they can navigate to and around the destination should be holistic and accurate, covering different modes (air, land, water) and different regions. The presentation of this end-to-end navigation and way-finding information should be intuitive and easy-to-understand, with the use of visual maps and clear symbols. Lastly, once decided, travelers are ready to firm up their purchases. At this point, seamless integration to redirect them to booking and payment sites is critical to secure the trip.

However, tourist portals should deliver more than just static information. Tourists are embracing the "new normal" across the travel journey, driven by technological adoption and demand for personalization. To meet the consumers' needs in that right moment, the portal should have four key characteristics.

Real time and convenient – Travelers can seamlessly navigate across the web portal or application with real-time updates on destination, such as opening hours, weather forecasts, festivals and events, or nearby facilities.

Simple and user-friendly – Design of the portal and interface should be easy and appealing with clear message. The content should be shown in a most convincing way, such as using diary-style narration to present trip itinerary as an experience rather than a product.

Predictive and personalized – The platform should provide language-optimized, culturally-tailored, relevant suggestions based on user location, search history, time of the day, or other context. For example, providing location-based push notification about the upcoming firework festivals nearby.

Device-compatible and mobile-optimized – The platform should be compatible across devices and operating systems. Dedicated mobile site or application should also be developed in order to cater to the on-the-go needs of travelers.

"I think it's very important for a country to have a robust official website for tourists. It's like the front gate into one's house – you need to get it right at the first time."

International Expert on Tourism

Case Study: Newzealand.com
"One site for all" National online travel planning platform

Tourism New Zealand recently revamped its official tourism website, which now receives over 2 million visits every month. The site offers various trip itineraries customizable by length of stay, preference, and areas of interest. It contains intuitive blog-style content, clear and visualized information on the routes, suggestions on mode of transport and travel time, and list of accommodations. The site is linked directly to qualified local hotels and tours booking sites.

Source : Newzealand.com

To popularize the national trip planning platform and ensure successful roll-out, it is critical to package and present the platform most effectively, using advanced digital marketing tools. Destination branding and marketing should be delivered to the right target group, in the right place, at the right time, using the right channel. Digital marketing puts the tourists in control and provides convenience across the online journey. It allows for real-time interactions with potential tourists, providing a concrete call-to-action.

The digital marketing channel mix should be developed to reach tourists at different stages of the acquisition funnel, as shown in Figure 48.

Awareness and Interest – Search Engine Optimization (SEO), Search Engine Marketing (SEM), OTT push marketing, or social media campaigns can provide cost-effective awareness.

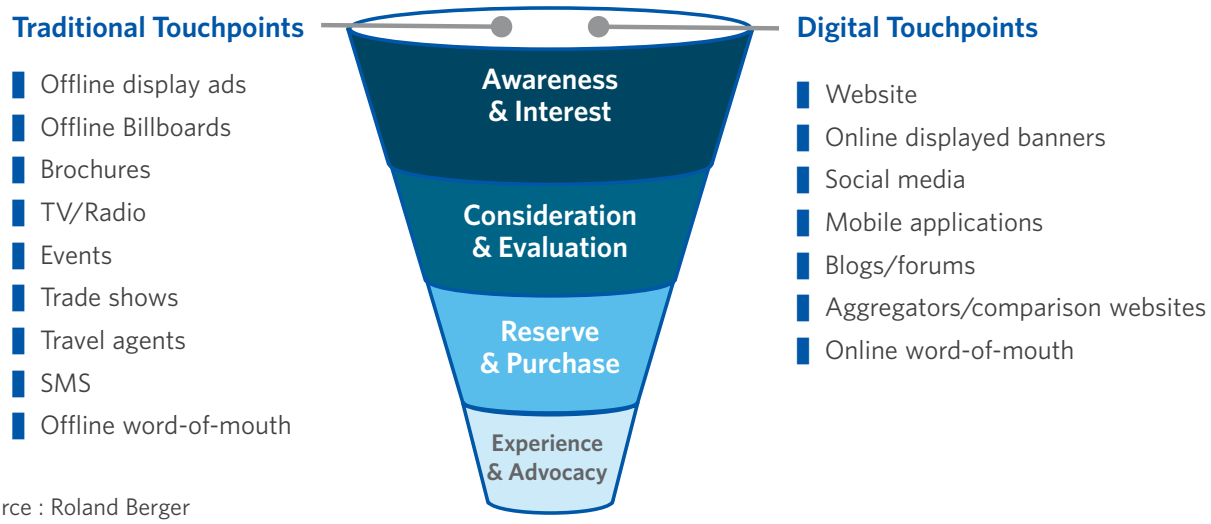
Consideration and Evaluation – Email marketing and newsletter, as well as retargeting campaigns can trigger already-interested customers to make final decision.

Reserve and Purchase – Partnership with leading global travel agencies can provide greater confidence and last-mile delivery of offers with robust booking and payment functionalities (e.g., Expedia, Kayak, Booking, etc.).

Experience and Advocacy – Mobile app push notifications, or online word-of-mouth campaigns on social media can play a significant role in effectively ensuring overall positive and memorable trip experience.

Through effective marketing and presentation of offerings on the country's valuable tourism assets across the journey, tourism destination can better attract and assist tourists, and further strengthen overall competitiveness of the industry.

Figure 48 : Overview of traditional and digital marketing touch-points in tourist acquisition funnel



Source : Roland Berger

Case Study: VisitBritain's 'GREAT China Welcome' tailored marketing to fit Chinese traveler needs

China is now the world's largest outbound tourism market. In Great Britain, visitors from China grew continuously, reaching 270,000 in 2015. 'GREAT China Welcome' is VisitBritain's initiative to make Britain the most welcoming destination in EU for Chinese visitors. It aims to encourage UK tourism businesses to sign up to a Charter which proves that their products and services are right for Chinese visitors. The GREAT China Welcome Charter mark makes Chinese visitors easily identify hotels, attractions, retailers, tour operators that are 'Chinese-friendly' by providing info. in Mandarin/ Cantonese and adapting products for the Chinese market and culture.

Dedicated web portal "Visitbritain.cn" was launched to cater to Chinese tourists, as well as targeted Search Engine Marketing on Baidu, WeChat, and Weibo campaigns. In 2015, famous UK attractions were put on Chinese social media inviting Chinese people to come up with Chinese name. The campaign attracted over 620,000 participants.

Source : VisitBritain

BENEFITS

Designing a one-stop national trip planning platform combined with effective digital marketing campaigns can strengthen overall tourism competitiveness. Tourists, enterprises, and authorities stand to greatly benefit by offering diverse online options and promoting to the right target group at the moment of interest.

Tourists can benefit from the overall enhanced pre-trip experience with readily customized, personalized suggestions for better searching and planning. They can also experience greater convenience and save time by browsing in single integrated point. Tourists are offered a holistic, end-to-end content directory. In addition, official tourism information and national standardization of offerings also helps ensure quality and reliability of experience for tourists.

Tourism businesses can improve their business exposure to potential tourists through targeted and effective channels. They can also be provided with better matching of tourists segments with their businesses offerings. For example, young couples can be suggested with honeymoon-oriented resorts. Also, with the robust and integrated information platform, covering inter-modal, multi-segment dimensions, businesses can gain more insights and holistic view into how to design products and services that would effectively anticipate tourist needs.

Government can enhance its holistic tourism management capability, through integrated oversight of transport-hospitality-retail views. It can also improve effectiveness of government-sponsored marketing campaigns by leveraging digital channels with concrete call-to-action. In addition, tourist online behavior on the national portal provides valuable insights. It helps generate comprehensive view on tourists' behavior.

Case Study: "Inspired by Iceland" – How social media rescued Icelandic tourism after the volcano explosion

When the Eyjafjallajokull volcano exploded in April 2010, Iceland's economy was already struggling in the wake of the 2008 financial crash. This event not only turned air travel upside down, but also caused longer-term damage to Iceland's image as a safe travel destination.

In light of the situation, the government and tourism stakeholders established "Inspired by Iceland" campaign, focused on rebranding the country to show the world that everything was OK in Iceland. The strategy encourages Icelanders to counter negative sentiment by getting them to post content on social media to show how beautiful the country was, how welcoming the people were, and how it was open for business. It also involves innovative online content targeting the youths, featuring bands, celebrities and distinctive minimalist design. The national tourism agency also worked with agencies from several countries who provided a 'visitor's viewpoint' of the campaign.

As a result, the country not only managed to beat the projected inbound tourist decline due to the disaster, but also successfully improved the perception of Iceland as tourism destination.

Source: Inspired by Iceland

Illustrative: How Stephanie is prompted for a trip to Thailand with effective digital marketing

Awareness & Interest

One cold night at train station, Stephanie was attracted into an interactive digital billboard of a trip to a tropical beach in Thailand. The 3D digital billboard even radiates heat which simulates the vivid experience of her trip to this sunny beach in Thailand.

Consideration & Evaluation

She searched on Facebook for more info. about the beach, and was prompted by this ads that redirects her to official Thailand tourism website. She quickly spotted the banner 'The perfect honeymoon on a private island' as she just got married and was researching for the perfect honeymoon destination.

Reserve & Purchase

Her planning was much easier with complete options of local hotels, attractions, and activities tailored for the honeymoon couple. Her complete reservations were immediately sent to her email and updated onto her Smart Trip Planner app by Tourism Authority of Thailand.

Experience & Advocacy

Throughout the trip, Stephanie received push notifications about nearby events or attractions which was tailored to her interests. All of the positive experience before/ during her trip encouraged her to write positive reviews on travel websites and happy to recommend Thailand trip to her peers.

WHERE DOES THAILAND STAND?

Figure 49 : Developmental maturity phases of tourism digitalization

Static/ Analog	Scattered	Connected	Optimized/ Automated	Predictive/ Engaged
• Offline marketing • Paper-based info. materials for tourists	• Limited online marketing • Digital channels not available for trip planning	• Online marketing used, limited tailoring/ mobile support • Fragmented online national trip planning tools	• Tailored, personalized contents for trip planning • Mobile/ online widely used for marketing	• Predictive ads/ real-time/ location push ads • VR/ AR tech. leveraged for marketing

Source: Roland Berger

#23 out of 141 countries in WEF's ranking for Effectiveness of Marketing & Branding to Attract Tourists

2014 Winner of E-tourism Asia Awards (Most Engaging Digital Presence) from Digital Innovation Asia

5x Fewer visitors on Thailand's official national tourism websites vs. New Zealand's

Currently, in Thailand, **the Digital Maturity level of developing national trip planning platform for tourists and adoption of digital marketing is at "connected" stage.**

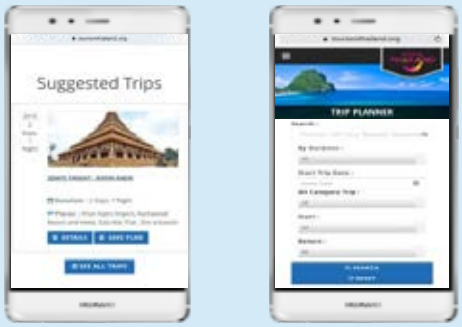
Existence of online tourism contents for Thailand is considered subpar compared to other leading destination in the region, such as Singapore or Australia. Information on the transport and accommodation is available only for leading airlines and large international hotel chains. Online information on local businesses, such as hotels, retail, restaurants, entertainment, attractions, and tours is still limited or mostly available in Thai language. Online information on the destination is also available only for main tourism cities (e.g., Bangkok, Phuket, Chiang Mai) while the under-explored secondary cities have limited presence online. This is mainly due to low technology adoption among local businesses and lack of centralized directory or listing platform. To plan itineraries, international tourists usually rely on blogs and travel reviews for information on local businesses or secondary cities, since the official sources are not widely known or the contents are not ready or not easily digestible.

Many initiatives have been planned and implemented on enhancing online tourism content at the national level, in both public and private sectors. Tourism Authority of Thailand has planned to upgrade Thailand's official online portal for tourists (tourismthailand.org), with additional 'Trip Planner' functionality. The new dynamic portal is expecting full-fledge launch in 2017. Although some projects have been developed and launched in this direction, attracting sufficient users and driving continual traffic to the 'official' platforms still remain a challenge, as most tourists still favor private portals due to the large database of contents and user-friendly functionality. In addition, consolidation and presentation of contents on the official websites can also be improved based on international benchmarks (See Figure 50).

In terms of marketing, Thailand already shows strong competencies in national tourism branding and marketing with several accolades and awards received. Tourism Authority of Thailand (TAT) was awarded for 'E-tourism Asia Awards: Most Engaging Digital Presence' by Digital Innovation Asia in 2014. However, the intensifying competition, especially among ASEAN players with similar natural and cultural offerings and value propositions, has called for further improvement on TAT's digital marketing competencies. A tailored, real-time, and innovative digital marketing campaigns should be designed to attract quality tourists in a cost-effective manner.

Case Study: Thailand's one-stop digital information platform for tourists

Thailand tourism agencies jointly plans to develop web and app portals to facilitate tourists in searching for information and planning through online channels for their visit in Thailand. The "Smart Trip Planner" function allows trip search customizable by destination, duration, or categories, with suggested itineraries and transport routes. The information provided would encompass online booking services, trip planning, event calendars, digital tour guides, and tourist landmarks. Early phase of the development with basic functionalities has already been launched in 2016. Subsequent phases in 2017 need to improve functionalities and add booking and payment options.



Source: Tourism Authority of Thailand

"We aim for our platform to provide more useful info. to encourage tourists to stay longer and spend more money in Thailand."

Minister of Digital Economy & Society

Figure 50 : Benchmarking of official national trip planning portals for tourists

Monthly visits (Sep '16)	513K www.tourismthailand.org	775K www.yoursingapore.com	2.70M www.newzealand.com
Example of visuals on websites			
Trip planner functionality	▌Fragmented library of contents, traditional narrative 'textbook' details with formal wordings ▌Search and filter function, rigid, directory-style user interface	▌Comprehensive, user-friendly, curated contents with eye-catching visuals and call-to-action wordings ▌Intuitive navigation and way-finding guides	▌Picturesque visuals and blogging-style with highly relevant, first-handed and persuasive language ▌Enhanced credibility with 'qualmark' national ratings
Example of attraction description	**Doi Inthanon National Park -** Part of the Himalayan mountain range, Doi Inthanon is Thailand's tallest peak at 2,565 m. above the sea level... covers an area of 482.4 sq. km. in three districts of Chiang Mai province... cool climate during December.... **Not attractive/ inspiring**	**Gardens by the Bay** - The waterfront destination for cool cats, along with stylish humans - where locals and visitors alike flock to see and be seen. Bella the ginger cat loves exploring this futuristic park, which is filled with statuesque 'Supertrees' and lush lakeside views.	**SKYCITY Auckland** - a fantastic selection of bars, award-winning restaurants and cafes, two first-class hotels and the world-class SKYCITY Casino. If you're visiting Auckland for just one day then a trip up the Sky Tower which stands above all other high rise buildings high is a must.

Source: Official tourism websites of Thailand, New Zealand, and Singapore, Roland Berger

HOW TO DRIVE THAILAND FORWARD?

The improvement of the official trip planning platform for tourists and national digital marketing is highly relevant to cope with the changes in consumer behaviors and rising competition. Consumers will continue to evolve and countries need to anticipate these changes in order to attract and serve tourists more effectively.

In the next five years, Thailand should leverage digital channels to build robust national information gateway for tourists and to reach prospective tourists at the right moment across touch-points, in order to elevate the overall experience for the new generations of tourists. The proposed priorities for developing personalized trip planning experience for tourists are outlined in two key initiatives:

22 Develop national trip planning platform for one-stop information gateway for tourists

- Identify data needs for trip planning content, ensuring holistic travel considerations
- Enhance content and interface for personalized trip planning
- Develop web & mobile enabled trip planning platforms and develop a dedicated mobile application
- Promote adoption of trip planning platforms through app installation and reviews engagement campaigns

Recommended KPI

Traffic, bounce rate, revisit to platforms

% attractions with information available online

23 Optimize national digital marketing campaigns

- Use information from national database (National Tourism Information System) and digital engagements to design campaigns based on tourist preferences and behaviors
- Optimize social media channels for advanced targeted campaigns
- Develop rich media tourism marketing contents and leverage advanced digital marketing tools, such as real-time bidding (RTB)
- Establish collaborative local/ international network of tourism suppliers and promote public-private joint marketing campaigns

CPA (Cost-per-acquisition) for each campaign

 # ranking for Thailand in TTCI's Effectiveness of Marketing & Branding to Attract Tourists[1)]

 # ranking for Thailand in TTCI's digital demand on natural and cultural tourism resources[2)]

1) Based on Executive Opinion Survey by World Economic Forum
2) Assessment of country attractiveness based on the correlation of online tourism-related search data across the relevant brandtags and destination-specific keywords (e.g., Nature = Beaches, Adventure, Diving, Animal Watching, etc.; Cultural and Entertainment = Historical sites, Local people, Museums, Local gastronomy, UNESCO, etc.)

Immersive and convenient traveling experience with Smart Tourism Destination

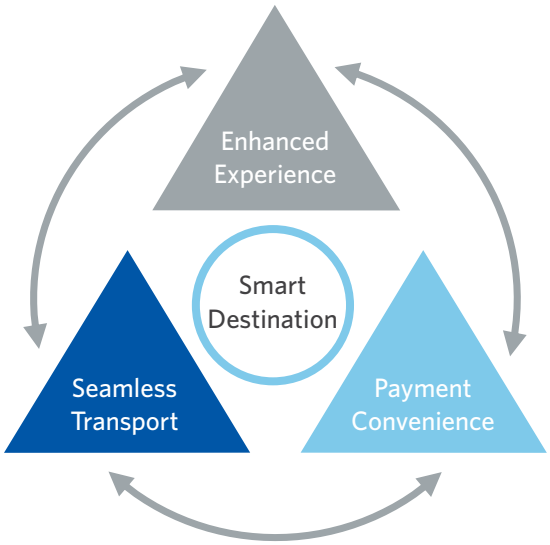
Digital technology has become an integral part of the everyday life, from browsing morning news on smartphone, or navigating to work using Google Maps, to paying for grocery with just a mobile tap. Travel and tourism industry has been very active in adapting and developing into the new era of digital-savvy consumers.

Many destinations embrace the digital trends and integrate the latest technology with the aim to increase the value of the existing attractions. Such example includes interactive information stand, GPS audio guide, tourist-friendly transport app, and augmented reality tour.

OVERVIEW

Smart Tourism Destination concept incorporates technology and digital services into the existing tourism attractions and tourist touch-points. The concept aims to create immersive experience for tourists by providing richer, more dynamic, and personalized information at attraction. It also aims to improve convenience in transportation and payment throughout traveling journey. The concept consists of three key elements where technology can play a critical role: enhanced experience, seamless transport, and payment convenience.

Figure 51 : Three elements of Smart Tourism Destination concept



Enhanced Experience – Destinations can better showcase their unique story and history with the help of digital technology. Smart technologies and IoT help to add value to attractions by enriching and visualizing the existing information. For example, tourists can immerse into the ancient world by looking through smartphone screen with Augmented Reality (AR) application. They can be guided with interesting stories of the neighborhood along the walk with location-based audio guide application. Smart display kiosk at the museum can show visualized floorplan and suggested exhibitions in selected language. These digital technologies provide the opportunity for tourists to participate in experience creation and reinforce long-lasting memory.

Seamless Transport – Transportation is another critical element that greatly contributes to the traveling experience. Online transportation portal allows tourists to browse, plan, book, and navigate to attractions using laptop or smartphone anywhere at anytime. This digital service aggregates all public transportation information and booking functionalities into a single platform. This platform provides convenience and flexibility for tourist to travel within the destination. Single ticketing system, especially at major tourist cities, further adds convenience and seamlessness to the traveling experience. The ease of transportation greatly helps to enhance overall satisfaction and to promote secondary provinces by making it easier to search and navigate across attractions.

Payment Convenience – This concept focuses on improving availability and accessibility of digital payment to better facilitate transactions at numerous point of sale nationwide. Tourist traditionally needs to have local currency ready in cash throughout the trip. However, spontaneity of traveling sometimes results in shortage of available cash, which obstructs intended spending. Payment convenience creates conducive environment to make payment possible anywhere and anytime. It ranges from providing more credit and debit card payment portal to offering NFC-enable tourist SIM card for contactless mobile payment. Availability of digital payment options creates more convenience by providing cashless traveling experience.

Case Study: Spontaneous trip to Singapore? Passport and smartphone are all you need!

Singapore offers impeccable digital services to its tourists throughout all tourist touch-points. Tourists are welcomed with automatic immigration services at Changi's new terminal 4. NFC-enabled SIM card allows payment in most public transportation and more than 30,000 stores across the nation. Singapore opens opportunity for technology startup and business to innovate. For example, W Singapore offers keyless check-in using phone NFC. Another example is the driverless taxi developed by local startup to be launched in 2018.

Source: Your Singapore, SmartNation.sg

BENEFITS

Smart Tourism Destination creates immersive and convenient experience throughout the trip. The development of enhanced experience, seamless transport, and payment convenience concepts bring benefits not only for the tourist, but also for the industry overall.

Tourists can enjoy more immersive experience at attractions with the integration of digital technology such as interactive smart displays showing information and media, location-based audio guide giving vivid storytelling throughout the walk tour, AR application bringing historical figures to life. These digital technologies transform normal attraction visit to an exciting and engaging experience.

Digital service also improves the way tourist travel around the destination. Tourists find it easier and more convenient to travel with comprehensive transportation app on their smartphones. Digital payment facilities add convenience to shopping, transporting, or even hotel booking experience. With these digital services, tourist can better explore the destination with greater ease, convenience, and flexibility.

Tourism industry can greatly enhance competitiveness with Smart Tourism Destination concept. Digital technology helps to enhance the story and history of each attraction, creating memorable and worth-sharing memories. This memory is the driver of positive reviews that reinforce repeating visitors and destination's attractiveness among other tourists. Tourism businesses have greater potential to generate additional revenue streams from add-on digital services at attraction. Proliferation of digital payment makes it more convenience for tourism business to process sales and transactions. It also encourages tourists to spend more.

In addition, digital touch-points are capable of collecting additional data. Conventional static information stand does not have interaction functionality, thus it could not obtain the insights from the users. Smart display, on the other hand, can keep statistics for performing data analytics such as the most view topic of attraction, the most popular zone, or the most popular language viewed. This set of data is valuable for attraction owner to cater information, media, and offerings suitable for tourist's needs.

Overall, the application of Smart Tourism Destination concept creates value to attraction by bringing out the value from its story, history, and heritage as unique proposition.

"Grand Palace has stunning architecture but it is a shame that there is no information about what we are seeing. Most tourists ended up walking aimlessly"

Tourist Review on Trip Advisor

"Thailand usually showcases its attraction as how it is. Not much attempts have been made to build story around the attractions even through the true beauty lies in our culture and history."

Management at Thailand Tourism Council

Illustrative: Kai's Unique Traveling Experience at Cultural Attraction in Smart Tourism Destination

Locating and traveling to the destination

Upon arriving at the airport, Kai was prompted to download official Thailand tourism app for free Wi-Fi. He later saw a video of temple in the North of Thailand. He opened the app to scan the QR code shown which marked the location of the temple and suggests multiple transportation options.

Diving into the story behind the stone

Once arrived at temple, Kai was prompted by the same app to utilize its AR function at the temple. He looked at the ruins through his smartphone and impressed by how the temple looked like in ancient time. In-app audio guide told him interesting story throughout the walk.

Smartphone as traveling companion

While walking around old town Chiang Mai, he was prompted by the app for suggested with nearby restaurants with rating and reviews. Kai didn't have enough cash on him, so he paid the bill using NFC tourist SIM. "Smart Transport" app helped him plan, book and pay for train back to Bangkok.

Sharing the memory for next time

Kai shared his unique trip with his friends through social network portal on the app. Later that year, the app prompted him with deals of new trip to Thailand and suggest a music festival he mentioned on his Facebook earlier.

WHERE DOES THAILAND STAND?

Figure 52 : Developmental maturity phases of tourism digitalization

Static/ Analog	Scattered	Connected	Optimized/ Automated	Predictive/ Engaged
• Static info. presentation • Limited digital service	• Certain media at attraction • Online transit info. available	• Some attractions IoT-equipped • Online payment at attraction available • Language-barrier free	• Seamless transport • IoT widely used in attractions • VR and AR commonly used	• Seamless connection to visitor online identity for personalize experience • IoT in general locations/ touch points

Source: Roland Berger

65%
93%
Trip Advisor Excellent & Very good reviews for the National Museum of TH vs. UK

Isolated travel apps available, lacking integration and multi-language support

Phuket, first Smart City pilot in Thailand, Smart Tourism as a priority of development

Currently, in Thailand, the digital maturity for Smart Tourism Destination development is at "scattered" stage. Bangkok was ranked the most visited city in the world in 2015. Yet none of Thailand's attraction is ranked in the top 20 most rated attractions. With large number of incoming tourists, Thailand still faces challenges in becoming the most memorable and worth-sharing experience among tourists.

Thailand's rich culture and history can be better showcased with the help of technology. Take the national museum as an example, Bangkok National Museum – like most national museum around the world – is the main museum showcasing the culture and unique history of the nation. However, Bangkok National Museum has been ranked much lower than international counterparts, such as British Museum, by visitors on Trip Advisor. Several initiatives could be implemented throughout the nation to better present the uniqueness of Thailand and deliver memorable experience such as audio guide, engaging materials, and interactive media and activities.

Thailand is lacking centralized multilingual transport information and scheduling portal, despite several public transport services connecting throughout the nation. For example, tourist usually needs to search on travel blogs or reviews to find how and where to catch the bus from Bangkok to Pattaya, which creates complication for tourist in traveling within the destination.

In order to move to "connected" or "optimized" stage, Thailand should focus on introducing smart technology and IoT to deliver richer and more engaging information at attractions. Transportation and payment services should be made more convenient with the help of digital technology.

There have been some digitalization attempts made in this direction led by the Thai government, mostly in main tourism cities. Phuket Smart City pilot is a good example of Smart Tourism Destination pilot in Thailand. With more than 12 million international tourists in 2015, Phuket is aiming to enhance digital infrastructure with free Wi-Fi hotspots in all tourist attractions. It also offers Phuket traveling app as a one-stop guide for tourists throughout their stay on the island.

"There are a lot of astonishing temples in Thailand, but after a few visits they all starting to look the same. It would be nice to understand the story behind each architecture and its social importance"

Tourist Review

Case Study: Qixxit – Integrated mobility platform for seamless transport throughout the nation

Germany's national rail operator, Deutsche Bahn, developed multimodal and intermodal national-scale trip planning app called Qixxit. The users fill in where he/she want to go then the system picks out several chains out of 15 modes of transportation; such as train, taxi, bus, plane, car sharing, bike sharing, other public transportation and even personal car and bike as alternatives. The app also allows in-app ticket purchase through credit card. Qixxit has more than half a million downloads since launch in 2014.

Source: Hacon, Red-dot

Case Study: South Korea's 2018 Winter Olympic is to become the world's first language barrier-free game in the history with real time translation app

With nearly 2m visitors from over 100 countries expected for the 2018 Winter Olympics, South Korean government develops 'Genie Talk' – speech-to-speech translation app in 8 languages; English, Mandarin, Japanese, French, German, Spanish, Russian, and Korean. The technology is available on three platforms: Smartphone App – 1) enhancement of existing "Genie Talk" translation app developed in 2012; 2) Dedicated physical real-time translation device; and 3) Plug-in gadget for smartphone which provides real time access to the automate translation service with or without internet connection.

Source: PyeongChang Winter Olympics, Business Korea

More than 2.2 Million
app downloads since first launched in 2012

Case Study: Co-creating the museum experience with NFC Pen at Smithsonian Design Museum

Cooper Hewitt Smithsonian Design Museum is the only museum in the United States which focuses on historical and contemporary design. In light of digitalization trend, the museum now offers a series of interactive features to enhance the experience and let visitors be a part of the learning in every exhibitions. One of the most renown features is "The Pen". The Pen is a digital stylus given to visitors at entrance. It allows tourists to interact with objects on display. The Pen's tip works as stylus, which allows visitor to draw and write on the digital HD touchscreen tables throughout the museum. The museum also deployed 3D projection technology in one of its exhibition "Immersion Room" where visitor can select or create a pattern of wallpaper to be projected to the wall of the actual room.

Source : Cooperhewitt.org, smithsonianmag.com

"The Pen" at Cooper Hewitt Museum

Interactive digital HD touchscreen table

Immersion Room 3D projection

9% visitor growth p.a. since "The Pen" launch, up from 7% before the launch

"Loved this museum and the interactive exhibits. Upon entry, you receive an electronic pen to use during your visit so you can save your favorite exhibits and designs you create on their interactive tables."

Visitor Review, Trip Advisor

HOW TO DRIVE THAILAND FORWARD?

Smart Tourism Destination helps bring out the best of Thailand unique stories and ensure tourists are having the most convenient journey. In the height of increasing competitions among destinations, Thailand needs to utilize technology to create one-of-a-kind experience and facilitate tourist through all touch-points.

In the next five years, Thailand should promote the development of Smart Tourism Destination Concept though out the nation on the three core elements.

The proposed priorities for Thailand Smart Tourism Destination development are outlined in three initiatives, which focus on promoting enhanced experience at attractions and adding convenience throughout transportation and payment at destination. Private sectors should be the key driver and developer of these technologies. Hence, strong collaboration and facilitation efforts from public sector should be highlight to ensure the success.

24 Develop digital solutions to promote experience enhancement at attractions

- Enhance existing information and media offerings at attraction with smart technology and Internet-of-Things (IoT)
- Develop interactive and virtual technology to deliver vivid and engaging experience
- Promote digital literacy among tourism business/operator and travel guide to support digital experience creation

Recommended KPI

# of POIs with Smart Display/ AR/ VR

% Spending increase at Smart POIs

25 Develop digital solutions to improve and facilitate tourist mobility

- Develop Smart Transport app for tourists with real-time schedule, integrated online transport information and e-booking functionality
- Incorporate real-time mobile translation technology and utilize translation technology to overcome language barrier at attractions

 # Users of Smart Transport app

26 Develop digital solutions to facilitate transaction at destination

- Establish collaboration among financial services and digital providers to develop secured and convenient digital payment system for tourist, especially to facilitate transportation
- Educate and encourage tourism businesses to provide digital payment options for tourists
- Ensuing security in digital transaction through close collaboration with providers and regulators

 # Attractions with digital payment options

Amount of tourism receipts made with digital payment

Rest assured in your journey with robust public safety and security solutions

Tourism is about exploring new places, while leaving the anxiety of daily life behind. However, in the height of insurgency, crime, and disaster, a truly care-free traveling experience has been more difficult to obtain. In order to ensure safe and secured experience for tourist, it is critical for the destination to have a solid public safety and security infrastructure in place to service both its residents and visitors.

OVERVIEW

Public safety and security consists of four key elements (See Figure 53). First is Preemption, which involves proactive actions to prohibit threats from entering the country. Preemption primarily focuses on border and immigration security. Second is Prevention, which involves consistent and proactive monitoring of any abnormality within the destination. Detection is the third element, which involves the ability to identify threat in a timely manner. Last is Response, which involves the set of actions and procedures to manage, rescue, and recover in critical situation.

Four key systems should be developed to cover the core elements from preemption to response. These systems are the basis for safe and secured traveling experience, which includes Immigration and Border Security system, Intelligent Surveillance System, Convergent Command Center, and Emergency Alert System.

Figure 53 : Four elements of public safety and security system

Immigration and Border Security – Airport is the first touch point of most foreign visitors, yet it is the most targeted place for threats. Immigration and Border security system ensures strict detection of unwelcomed visitors while facilitating welcomed visitors as a mean to foster good impression and support the growth of tourism industry. Immigration and Border security system consists of: Advanced Passenger Processing system (APP) which pre-screens incoming visitors before boarding to destination, Automate Immigration Gate with biometric authorization of pre-screened visitors, and Intelligent Surveillance System at the airport to help detect suspicious activities and individuals.

Intelligent Surveillance System – The coverage and the readiness of CCTV network throughout the destination, especially at key attractions, are the keys to ensure safety and security for tourist. Video analytic system adds cognitive ability to surveillance network and enhances the ability to detect and resolve any issue in timely manner.

Convergent Command Center – Each tourist agencies have invaluable set of information which, once combined, forms a comprehensive database for emergency and security command. For example tourist information and statistic or hospitals nearby tourist attractions. This database can assist first responder unit in performing effective assisting and rescuing tasks. Data analytic and predictive intelligent system leverages existing pool of data to derive the insights which can further enhance the capability to detect and response.

Emergency Alert System – Timely alert and warning can have tremendous effect in life saving during disastrous time such as natural disaster or terrorism attack. Tourists are often left out from the local language alerts and warnings, mostly due to language barrier, lack of access to communication channels, and limited knowledge of local emergency procedures. Inclusive emergency alert system provides the service in multiple languages and ensures availability of service nationwide.

For the solutions to work effectively in a tourism context, they have to take into account the unique characteristics of foreign visitors. The services and communication touch-points should be **multilingual, user-friendly,** and **accessible** to tourists.

BENEFITS

The comprehensive safety and security solutions build a robust infrastructure to ensure safe and secured atmosphere throughout the nation. Tourists, residents, officers, and the government can gain several benefits from higher confidence in self-safety to strengthened national security.

Tourists and residents achieve greater confidence in safety. In normal situation, tourists and residents feel more protected with the expansion of surveillance system and the readiness of safety application. Integrative safety and security infrastructure also helps to reduce crime rate. In critical situation, tourists and residents are better informed and assisted, which reduces the chance of severe loss of life. Timely alert of threat also helps business prepare for the situation, which results in short recovery period and reduced disruption of business.

Security Officers, especially those in command and first responder units, are granted with enhanced ability and effectiveness to perform the duty. Centralization of security data enables more well-informed commands, which in turn, add effectiveness to the rescue tasks. Surveillance and detection procedure are more accurate using intelligent technology, which helps to detect abnormality. Predictive system helps to increase efficiency of security force deployment, by indicating the hotspots prone to crime or disaster. In large scale emergency, technology increases the ability of officers to warn people in critical areas, and help to guide inflicted people to safe locations. Crowd-source technology helps officer to indicate threat faster with more coverage.

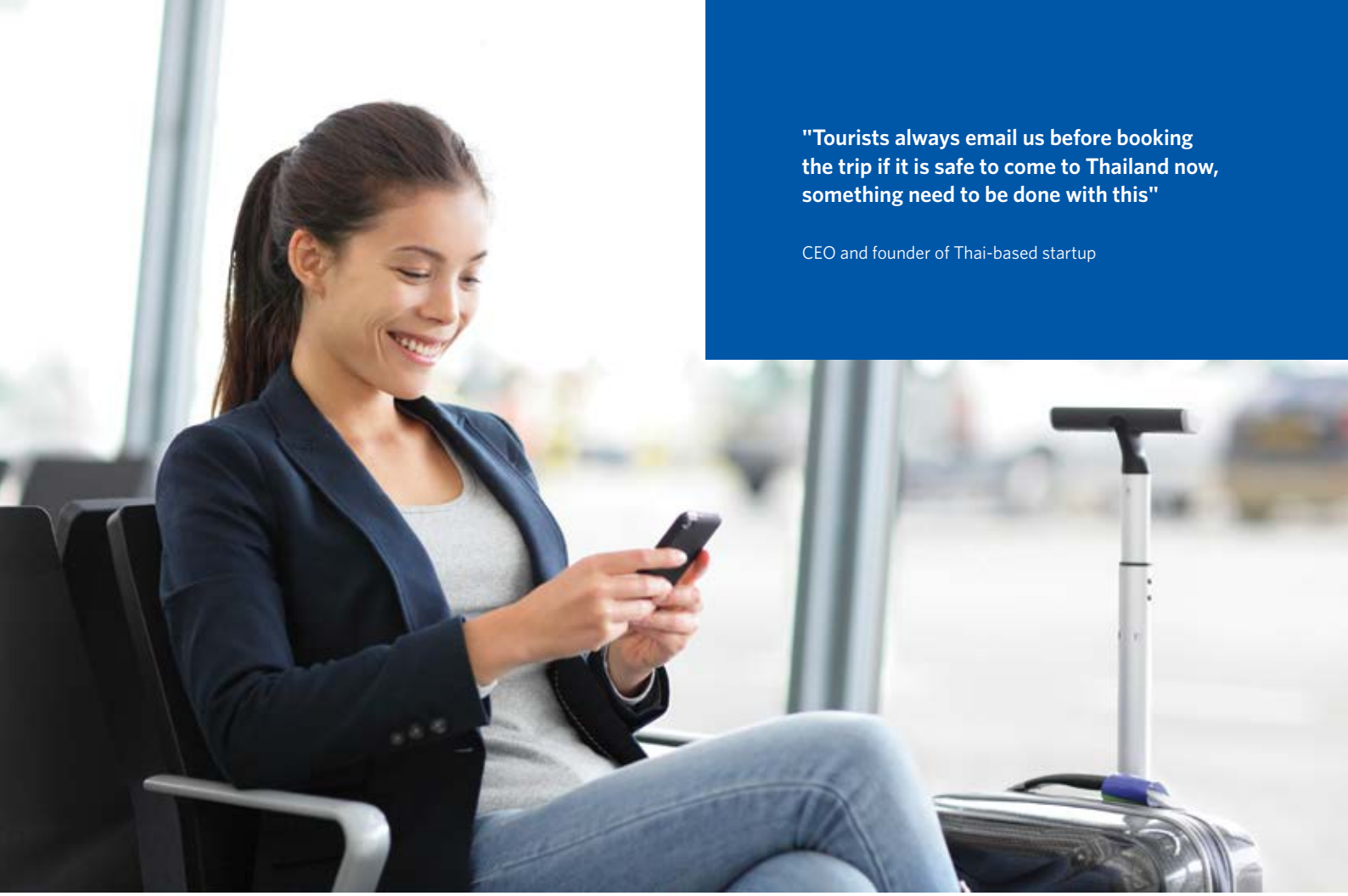
Government sees significant benefit from intelligent and rigorous safety and security system, especially in the protection of national security. Preemptive border and immigration system mitigate the chance of terrorism and international crime. At the same time, the convenience of automate immigration gate reduces time needed to wait in line, improving tourists impressions. Solid safety infrastructure and greater confidence of tourist are crucial factor to enhance the image of safe tourism destination. Prevalence of CCTV network also yields additional benefits for government on top of safety and security of the nation. For example, government can utilize CCTV for monitoring of transportation and traffic flow, or monitor flow of people and tourists for crowd management.

"To achieve safety and security initiative we need participation of the locals to be eyes and ears"

Former Minister of Tourism and Sports

"Tourist police have 900 officers to take care of 30 million tourists. We need to shift officer from the north to station more in the south because that's where most incidents occur and we don't have enough resource"

Tourist Police



"Tourists always email us before booking the trip if it is safe to come to Thailand now, something need to be done with this"

CEO and founder of Thai-based startup

Illustrative : Rest assured in your safety with comprehensive safety and security system in Thailand

Safe and convenient immigration

Before boarding, Jane provided her info. in advance for Thailand Immigration, allowing her to use fast-track immigration with face recognition and finger scan.

Worry-freely enjoying the attractions

While visiting a temple, her wallet went missing.
She seek out for local police who reviewed holistic CCTV footage throughout the attraction which helped her identify where she had left the wallet.

Timely alert of emergency & harmful incidents

Jane was interrupted by loud alert from Thailand Safety app with push warning about severe Monsoon. She quickly followed the guidelines and went back to the hotel.

Fast and Reliable Security Unit

She dialed emergency number when her child went missing in the crowd. Her case was quickly directed to local and tourist police who closely collaborated via convergent command platform to monitor CCTV network around the area. Her child was found shortly after.

WHERE DOES THAILAND STAND?

Figure 54 : Developmental maturity phases of tourism digitalization

Static/ Analog	Scattered	Connected	Optimized/ Automated	Predictive/ Engaged
• Lack of public security platform • Manual surveillance	• Data is not yet converged into single center • Mostly analog CCTV	• Digital security platform is common • Data from public security centrally linked	• Security systems are connected using cloud • Proactive intelligent surveillance	• Comprehensive security system connected using cloud • Preemptive surveillance and detection

Source: Roland Berger

Only 0.03 tourist police per 1,000 incoming tourists in 2015

CCTV coverage in Thailand's major cities is more than 10X less than London

Phuket, first Smart City pilot in Thailand, has Smart Security as one main component

Thailand has been active in improving its safety and security system, as seen from various CCTV installment initiatives in many provinces, especially in the rise of terrorism and crime concerns. **However, the attempts are still scattered and not fully utilized, placing Thailand's public safety and security system at "scattered" stage.**

Although CCTV initiatives are common, most are not effective or fully utilized. In some major tourist cities, only 40-50% of CCTVs are functioning, mostly due to lack of connectivity, premature plan roll out, and poor quality hardware. Majority of footage from public CCTVs are centralized in local police department for monitoring and traffic management purpose. However, footages from each department are not readily available for inter-city or cross-entity exchange. In addition, low resolution and limited storage capability make it difficult to utilize CCTV for investigation.

Many local administrations have initiated several programs to strengthen safety and security. Khon Kaen administration partnered with local businesses under community partnership to install 1,000 private CCTV stations with public subsidy, where CCTV coverage includes public areas. The CCTV installed is owned by private but the footage can be easily shared with local police to assist investigation. Overall, Thailand's major cities still have lower CCTV coverage compared to international benchmarks (See Figure 55).

Figure 55 : Benchmark of public CCTV network in key tourism cities [2015]

	Pop. + Visitors [m]	# Public CCTVs	#CCTVs per 1,000 inhabitants
BKK	61.7	58,614	1.05
PKT	13.6	1,422	0.11
PTY	11.0	501	0.05
LDN	39.7	422,000	10.6

Source: Manager News Agency, BMA, cctv.co.uk, Roland Berger

Apart from the CCTV efforts, Thai tourist police has recently launched "Thailand Tourist Trips and Tips Augmented Reality (AR) Book", aiming to improve confidence in safety among tourists. The app features the do's and don'ts in Thailand with the goal to familiarize foreign tourists with local norms, which reduces the chance of them getting into dangerous situations. It also provides directory of emergency hotlines that tourists can directly dial from the app. Nonetheless, the app can be further popularize and optimized to offer more comprehensive safety assurance tools such as crowd-sourcing crime and accident report portal, emergency alert, and speech-to-speech translation service.

In order to move to "connected" stage, Thailand should focus on digitizing security data and converging the data into single security management platform. Surveillance infrastructure should be further developed to cover all tourist attractions. In addition, all public safety and security services should be made accessible and available for tourists at ease.

Case Study: Phuket Smart Safety

Phuket Smart City 2020, is the first pilot smart city under Thailand 4.0. The initiative is under PPP collaboration among SIPA, MICT, public entities, various private businesses and universities. More than USD 11 million is to be invested in 2 development phases.

Phase 1 (2016 – 2017) focuses on establishing CCTV networks in all attractions and supporting private investments.
Phase 2 (2017 – 2020) focuses on increasing safety in marine travel and tourism, implementing smart technology for surveillance and weather monitoring. The province also aims to develop a database of foreign tourists on the island to enhance rescuing and assisting task concerning tourists.

Source: Manager News

Case Study: "Ring of Steel" security at Beijing Olympic Games 2008

Beijing Olympic welcomed 6.5 millions visitors and more than 100,000 athletes and spectators from around the world in 2008. The Organizing Committee had invested more than USD 6.5 billion in safety and security system, which included Multi information gathering channels, Centralized database, Intelligent surveillance system, Convergent command system, and Response and alert system. The comprehensive security systems and large number of security force deployed granted the title of "The most secured Olympic in world's history".

Convergent Security Command Center

More than 94,000 security staffs deployed

Source: Honeywell

"Security is of the utmost importance in relation to the full success of the Olympics."

China's Minister of Public Security Meng Jianzhu

Case Study: Japan's tourist - inclusive emergency alert system is a life saver in disastrous time

With over 1,500 earthquakes occurring every year, Japan has to be in constant alert of earthquake possibility. The nation built a rigorous detection system linking directly to the National Satellite Emergency Broadcasting system (J-Alert). The system sends signal to TV, radio, public speaker and cellular transmitter which pushes short warning text to users of Japanese cellular network in 4 different languages within 4 seconds after detection. Those outside of critical areas can receive updates through dedicated mobile application, such as "Yurekuru" which also offers crowd-sourced report of disaster intensity and damage in each location, or "Safety Tips" which was developed for foreign visitors who need assistant in evacuation procedure, location of nearest shelter and communication.

While J-Alert, Yurekuru, and Safety Tips help enhance safety and security during the incident, Japan also devised strategy to improve recovery after the incident. "J-anpi" is a nation-wide person searching portal for safety status, allows affected people to search and reunite with lost family and relatives on mobile phone. In addition, telecom providers e.g., DOCOMO, offer a person finder feature through mobile number search. This illustrates how public and private cooperation is important in disaster management for national security.

"Safety Tips" app gained > 5.5 million downloads since launch

J-anpi

- Share current status
- Leave short text
- Search people by mobile number

Source : NTT DOCOMO, Japan Tourism Official Guide, World Bank

HOW TO DRIVE THAILAND FORWARD?

Safety has been one of the most concerning factors hindering competitiveness and perception of Thailand tourism. Public Safety and Security system enhances safe and secured environment for tourists and residents. Officers are granted with enhanced ability and effectiveness to perform their duty while the government sees significant benefits in the promotion of national security.

In the next five years, Thailand should focus on developing a holistic safety and security infrastructure covering all phases from preemption to response. Four key systems should be developed, namely Immigration and Border Security, Intelligent Surveillance System, Convergent Command Center, and Emergency Alert System. Detailed development steps are proposed in the key initiatives below:

27 Develop integrated and intelligent public surveillance system with nationwide coverage

- Evaluate and identify tourism hotspots in need of constant surveillance
- Roll out surveillance CCTV network installation program with video analytic capability in prioritized areas under close private partnership

Recommended KPI

% Coverage of CCTVs across key tourist destinations

28 Establish Convergent Command & Control center with intelligence capability for effective prevention, detection, response and recovery for tourist

- Design data integration policy/ architecture among emergency units
- Established secured datacenter and convergent command center in the administration

% Local admin. with centralized command platform

29 Establish intelligent emergency alert system and application for warning and assisting tourists

- Establish / strengthen PPP collaboration in emergency management
- Develop single warning and alert mobile application suitable for both foreign visitor and local residents
- Develop emergency-proof warning system (e.g., wireless alert system)

% of Disasters detected and warned

# of installation on emergency app

30 Develop preemptive immigration and border security system to foster security, facilitate arrival flows, and improve efficiency

- Support the completion of Thailand Immigration Center and Advanced Passenger Processing system in all international airports and borders
- Implement automate immigration gate at all international airports and support the enhancement of security system at borders entry points

# of Airports with pre-screen system and automate immigration gate

CHAPTER 6

Digital Enablers

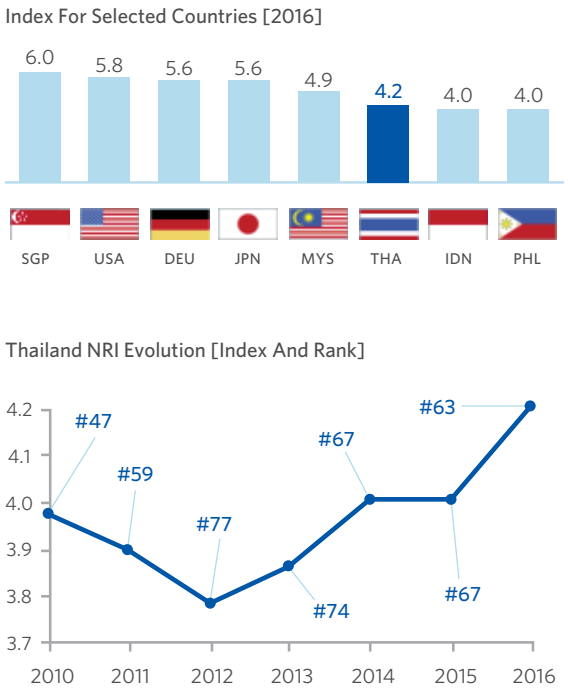
ICT readiness should be improved to drive Thailand towards being a regional digital hub

Thailand has a significant room to improve ICT readiness. The country was ranked #63 out of 139 countries in the World Economic Forum's Network Readiness Index 2016. Although the ranking shows that Thailand is ahead of many regional peers, it also highlights that Thailand is still lagging behind regional digital leaders like Singapore and Malaysia in terms of network readiness. This emphasizes the importance to quickly improve the national ICT infrastructure to support the digitalization of Thailand's economy.

The International Telecommunication Union compiles the ICT Development Index (IDI) covering 3 dimensions - access, use and skill. In 2015, Thailand is ranked #74 globally out of 174 countries. Similar to the ranking for the Network Readiness Index, Thailand is lagging behind developed economies, but is ahead of most regional peers (see Figure 57).

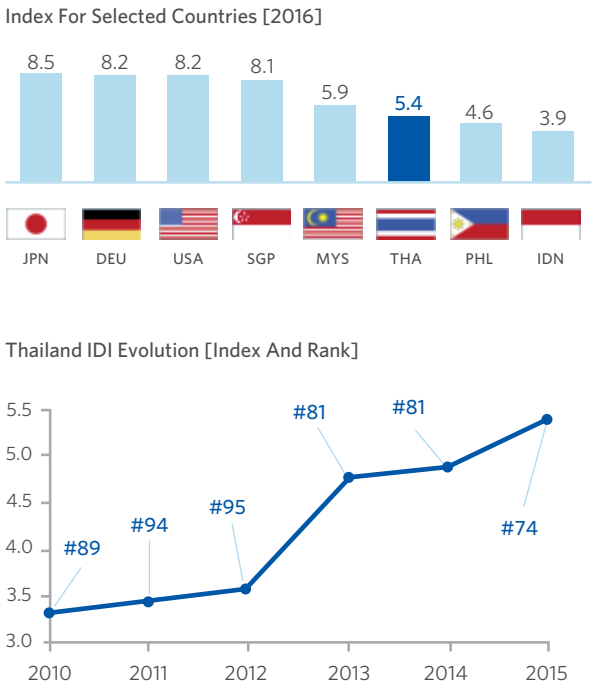
Significant improvement of broadband coverage, penetration and download speed coupled with government and business cloud adoption helped Thailand to improve its rankings in the last five years. For instance, Thailand's ranking improved by 20 ranks in the last 5 years in ITU's ICT Development Index. However, to become a regional digital hub, Thailand must further enhance its ICT competitiveness and become a tier-1 ICT country, both in terms of infrastructure, adoption, innovation and capabilities.

Figure 56 : Network Readiness Index (NRI)



Source: World Economic Forum

Figure 57 : ICT Development Index (IDI)



Source: International Telecommunication Union

Four key enablers have been identified to realize the digitalization plan including broadband infrastructure, cloud infrastructure, innovation and human capital. Improvement on these four key dimensions is required to unlock the substantial benefit of digitalization for aging society, agriculture and tourism.

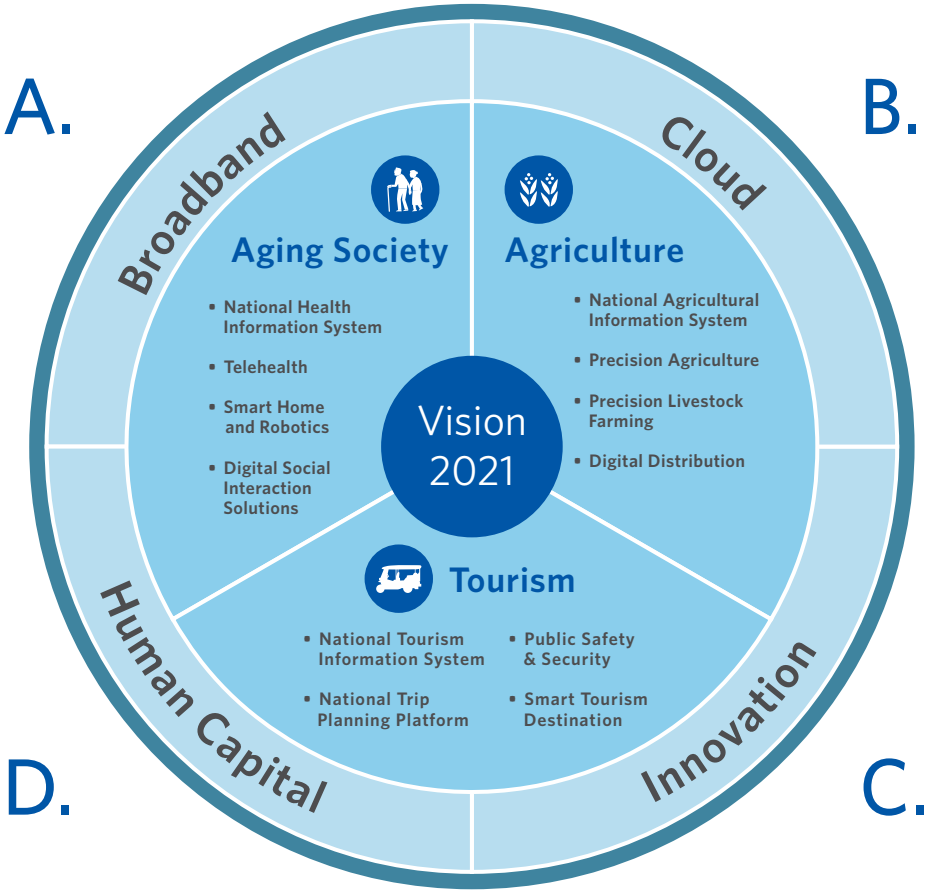
A **Broadband** infrastructure is a critical to support the development of digital solution and adoption of digital tools. Thailand is lagging behind broadband coverage and speed with particular room for improvement in rural areas. It is important for Thailand to improve coverage, affordability, speed and adoption of fixed and mobile broadband.

B **Cloud** infrastructure offers flexible and cost-effective alternative to store and manage large data sets. Thailand should focus on improving cloud infrastructure, supporting expansion of cloud services, and encouraging cloud services by both businesses and government agencies. To become a regional digital hub, Thailand needs to attract leading global players to allocate their cloud servers in the country.

C **Innovation** is the creation and implementation of ideas and technology which are critical to support the sustainable development of the nation. It involves establishing and reinforcing startup ecosystem and supporting the growth of R&D efforts. Thus, Thailand should emphasize on developing innovation-fostering environment as the key to support the growth of digitalization.

D **Human capital** improvement is important to enhance overall Thai competitiveness. Inefficient math and education curriculum and limited English proficiency hinders human capital development. Students and working professional should be equipped with up-to-date ICT skills to be ready to adopt and benefit from the latest digital technologies. It is critical to strengthen the education system and integrate new trainings for a future-ready workforce.

The current maturity level of these enablers have been assessed, and initiatives to bridge the gap are proposed in the subsequent pages.



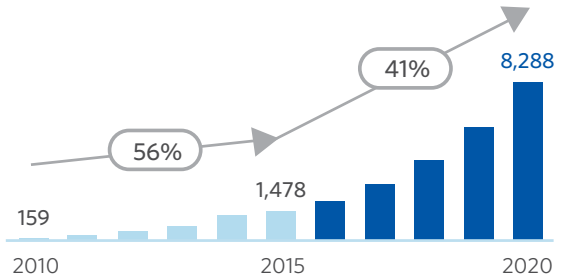
Broadband network – the blood vessels of a digital economy

Development of broadband infrastructure lays the foundation for a digital economy. Broadband enables business and government entities to improve productivity, enhance efficiency and become more competitive. It also widens opportunities for people to benefit from digitalization by providing access to information and new opportunities.

International Connectivity

In order to become a regional digital hub, Thailand needs to improve its international connectivity. International bandwidth demand in Thailand has increased almost 10 times in the last 5 years and is expected to grow exponentially at ~40% p.a. in the next 5 years, from 1.5 Tbps in 2015 to 8.3 Tbps in 2020. Thailand will also likely be serving as a conduit for demand from Indo-China region. Currently, there are 6 submarine cables connecting Thailand to the rest of the world. The combined capacity[1)] of these 6 subsea cables is 41 Tbps. Majority of which is connected via Singapore, which is a large IP transit hub. Besides, there are 2 key terrestrial cables (TM's link, TIME's CPCS) with managed bandwidth. Low capacity at a time of rising demand has resulted in substantially higher IP transit price compared to Singapore (USD 9 vs. USD 3 / Mbps / month)

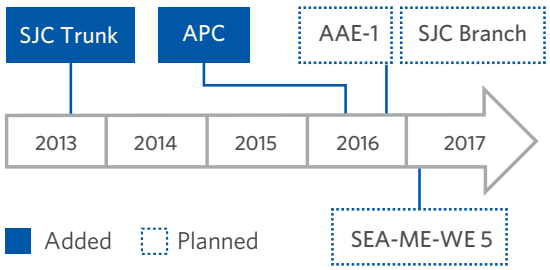
Figure 58 : International bandwidth demand in Thailand [Gbps]



Source: NBTC

In order to improve international internet bandwidth, Thailand needs to expand its international internet gateway facilities in the next 5 years. Some investments have already been planned for the expansion of sub-marine cable network. In the next 2 years, 3 new cables with combined capacity[1)] of 179 Tbps are planned. These will connect Thailand to countries outside of ASEAN. One of the planned developments is AAE-1, which will connect Thailand with Africa and Europe. Similarly, SEA-ME-WE 5 will connect Thailand with the Middle East and Western Europe. Meanwhile, SJC Branch will connect Thailand with China and Japan. In addition, capacity between Thailand and other SEA countries will be expanded connecting Thailand with Myanmar, Cambodia, and Malaysia. These new developments will serve rising demand, thereby supporting digitalization and reinforcing Thailand's competitiveness as a digital hub.

Figure 59 : Submarine cable network expansion



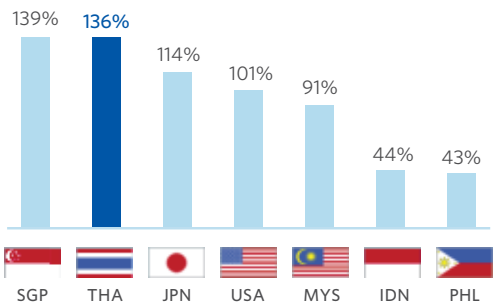
Source: Development of Thailand International Network Infrastructures, CAT

Broadband Penetration

In 2014, Thailand's mobile penetration reached 136%, which is one of the highest in Asia-Pacific. On the contrary, fixed broadband penetration is only at 15% of households, which is lower than developed economies. Moreover, there is huge disparity in the penetration rate between urban and rural areas in Thailand. For instance, in rural parts of Northeastern, and Southern Thailand, penetration is less than half of that in Bangkok and other major urban areas. High speed fiber-to-the-home (FTTH) solution is adopted by only 1% of households. FTTH is virtually non-existent outside of Bangkok.

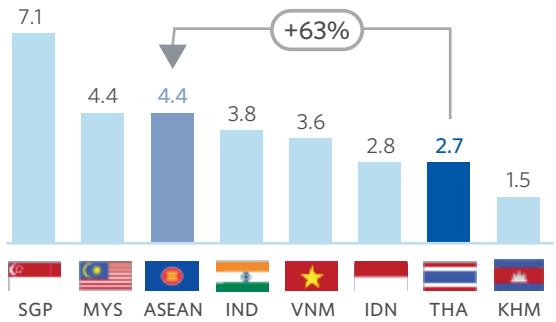
1) Capacity of entire cable – not exclusive to Thailand

Figure 60 : Mobile broadband penetration [%, 2015]



Source: WCIS, The Global Information Technology Report 2016, Thailand National Statistic Office

Figure 61 : Mobile data tariff [USD/GB, 2015]



Source: Tech in Asia

Broadband coverage

Overall broadband coverage has high improvement potential, especially in rural areas. According to Open Signal data, (2016) mobile coverage in most rural areas reached as high as 50%-60%, while fixed coverage in most rural area is in the 15-25 % range. However to create a full-scale, digitally driven economy, MDES intends to drive National Broadband Network roll-out to cover 70,000 villages across the country. In its first phase, 99 villages across the 5 regions will be equipped with the broadband network. Furthermore the ministry is planning to work with TOT to provide Internet access to 24,700 villages by the end of 2017 as part of a huge scale-up project. The ministry will not provide broadband service directly to the public, but rather acts as a wholesaler to service providers both public and private sectors. With connectivity the government will provide e-commerce opportunities, e-healthcare and e-government services to the villages.

Additionally, following a late 2015 spectrum auction, 4G/LTE started rolling out in Thailand. All operators have ambitious nationwide LTE coverage plans with 4G users expected to reach 20 million by the end of 2016, according to the National Broadcasting and Telecommunication Commission.

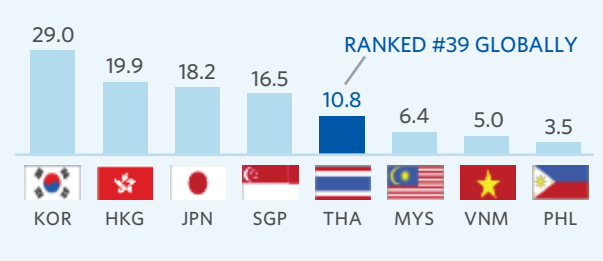
Broadband affordability

Thai customers are sensitive to price. Fixed broadband is more expensive compared to mobile broadband. In PPP terms, price of fixed broadband in Thailand is similar to developed economies such as Germany, which has GDP per capita three times higher than Thailand. On the other hand, mobile data tariff is one of the lowest in ASEAN. In 2015, at average price of USD 2.7 per GB, the price is 63% of ASEAN average (USD 4.4/GB). In addition, mobile voice tariff is one of the lowest in ASEAN countries at USD 0.09 per minute, compared to USD 0.19 in Singapore and Indonesia. This means mobile broadband is much more affordable, resulting in significantly higher adoption compared to fixed mobile broadband.

Broadband speed

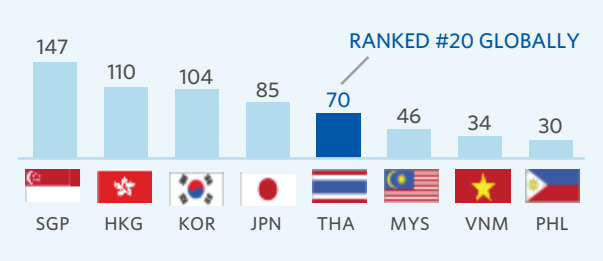
Average connection speed in Thailand and average peak connection speed are ahead of most regional peers, but still lag behind regional leaders. The launch of 4G/LTE has improved speed of mobile broadband connection, and further 4G roll-out will further enhance speed. At the same time, the expansion in international connectivity via the development of international submarine cable capacity will help to increase internet bandwidth and reduce latency.

Figure 62 : Average connection speed in Q1 2016 [Mbps]



Source: Akamai

Figure 63 : Average peak connection speed in Q1 2016 [Mbps]



Source: Akamai

Case Study: South Korea – World's leader in Mobile Broadband

Healthy competition among operators to offer better customer experience lead to high broadband speed in South Korea. In addition, in 2014, SK Telecom upgraded infrastructure, which enabled mobile BB speed of up to 4X as fast as LTE.

Case Study: Hong Kong – Global top 5 in broadband avg. speed and avg. peak connection speed

Hong Kong ranked world's 2nd in peak BB connection speed at 110 Mbps and 4th in average BB connection speed at 19.9 Mbps. High speed is a result of high-quality infrastructure. Two thirds of fixed broadband connection in the country are fiber, enabling its striking peak connection speed.

Case Study: The UK – Fiber optic network for faster internet

To address the limitation of broadband speed, the government invested USD 2.13 bn to replace obsolete broadband line from old copper to fiber optic networks. The plan aims to have 'superfast' internet reaching 95% of UK homes and businesses by 2017, reaching speed of up to 1 Gbps.

The Government invested
USD 2.13 bn
for "superfast" internet

WHERE DOES THAILAND STAND?

Figure 64 : Digital maturity phases of broadband

Static/ Analog	Scattered	Connected	Optimized/ Automated	Predictive/ Engaged
• No 4G/LTE deployment • Limited BB coverage • Predominantly 2G connection	• 3G national coverage • 4G/LTE coverage is less than 10% • Download speed is less than 5 Mbps	• 4G/LTE coverage at 10-50% • Avg. download speed 5-15 Mbps	• 4G/LTE coverage is 50 – 90% • Average download speed 15-30 Mbps	• 4G/LTE coverage more than 90% • Average download speed >30 Mbps • Advanced technology deployed

Source: Roland Berger

#63
(out of 139)
in Network Readiness Index

#74
(out of 174)
in ICT Development Index

136% mobile and
15% fixed
broadband penetration

HOW TO DRIVE THAILAND FORWARD?

Improvement of international internet bandwidth, broadband coverage, download speed and affordability are critical to create a full-scare, digitally driven economy. Improved coverage and affordability will give more people access to broadband services, and allow more people to benefit from and contribute to digitalization. Higher download speed, especially in rural areas, will drive adoption and allow users to benefit from the latest digital solutions and apps available.

30 Set up and meet new Broadband speed and coverage targets to facilitate initiatives across the 3 sectors

- Improve overall broadband infrastructure to facilitate digitalization of the 3 sectors and meet coverage and speed targets (on next page)
  - Invest in international connectivity capacity
  - Continue to roll-out 4G to improve broadband speed and network quality
  - Invest in fixed broadband to reach more households, especially "last mile" investment in rural areas
- Support adoption of broadband by priority sectors such as farmers, schools, hospitals
- Ensure accessibility to broadband and affordability of broadband to low-income households in rural areas

Recommended KPI

% fixed broadband penetration

% broadband coverage in rural areas

Average download speed (Mbps)

Broadband targets

AGING SOCIETY

		Targets	
		Coverage	Average download speed
Telehealth – Basic	Basic video system for teleconsultation involving live conversation and standard-definition images	100% of community hospital	0.5 Mbps
Telehealth – Advanced	Service for sub-specialty treatment involving high-definition live videos and sharing large data such as X-ray images	100% of community hospital	4 Mbps for HD 25 Mbps for ultra HD
Smart Home – Basic	Use of basic sensors (examples: Thermostats, automatic switches, fall sensors)	80% of villages (moo-ban) 100% of urban areas	0.5 Mbps
Smart Home – Advanced	Use of IoT appliances and sensors requiring high bandwidth (example: webcams, robots)	80% of villages (moo-ban) 100% of urban areas	2 Mbps

TOURISM

Web browsing	Tourists to be able to search for information, browse the internet and share experience	100% of tourist attractions, accommodation, and airports	1 Mbps
Digital communication	Tourists to be able to communicate with families and friends at their home (example: VOIP, video streaming)	100% of tourist attractions, accommodation, and airports	**Email and VoIP** 0.5 Mbps **Video streaming** 1 Mbps SD 4 Mbps HD 25 Mbps ultra HD

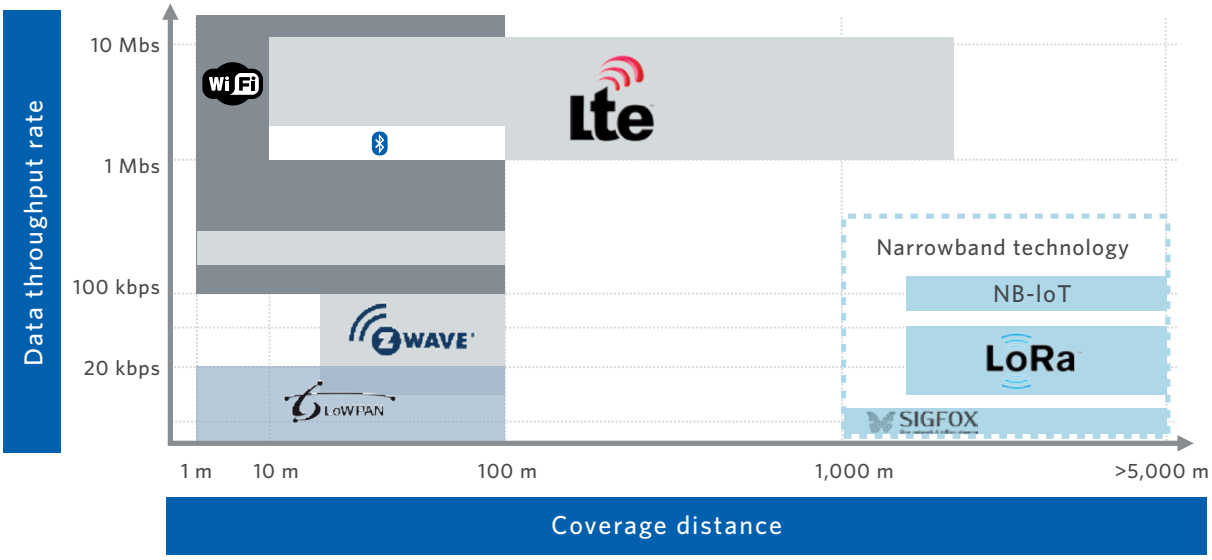
AGRICULTURE

		Targets	
		Coverage	Average download speed
Narrowband	Solution requiring continuous transmission of data to very remote areas without frequent battery change (Example: smart irrigation systems, in-field data collection)	80% of villages (moo-ban)	0.5 Mbps
Broadband	Solution requiring transmission of large data set (Example: live HD livestock monitoring)	80% of villages (moo-ban)	4 Mbps

Various connectivity solutions for agriculture IoT systems and sensors are available. Basic sensors (e.g., weather, soil, moisture) can be connected with conventional mobile and fixed broadband technologies including Wifi, LTE and Bluetooth). However, long-range equipment necessary for larger fields (e.g., tractor sensors, drone sensors) requires narrowband solutions enabling up to 10 km range connectivity. The leading narrowband technologies include Lora and Sigfox. These technologies ensure long-battery life and are reliable in continuously sending data over long distances (see Figure 65).

NB-IoT standard also allows a wide range of devices and services to be connected using cellular telecommunications bands. The NB-IoT industry chain is more open, has more choice of chips and uses equipment more conducive to the development of industrial ecology. The NB-IoT uses operator-controlled spectrum enhance reliability and minimize interference of the network, thus NB-IoT is especially suitable for large coverage and high reliability scenarios, such as intelligent urban solution, smart agriculture, and intelligent environmental protection. And it can also make the most of the existing sites and operational capabilities. NB-IOT is widely supported by carriers.

Figure 65 : Overview of technology



Source: Roland Berger

Cloud services for secured, flexible and cost-effective data storage

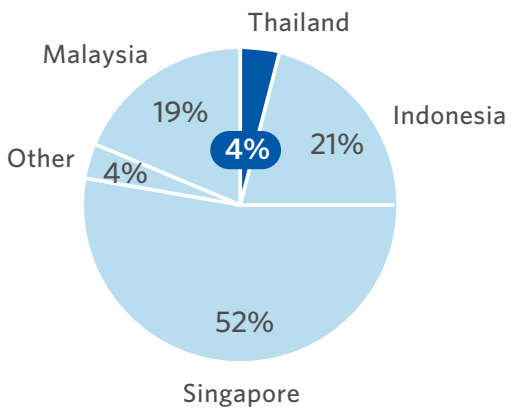
In the past decade, the amount of collected and stored data has increased exponentially. In order to leverage data insights for policy design and business planning, raw data should be effectively collected and stored. Cloud offers flexible platform for cost-effective and secured management of large datasets. The development of cloud infrastructure and the proliferation of cloud services by public agencies and businesses are both critical to improve national competitiveness.

Cloud Infrastructure

Thailand still lags behind most regional peers in terms of cloud infrastructure development. According to the ranking by Asia Cloud Computing Association (ACCA), Thailand is ranked #10 out of 14 member countries in the 2016 Cloud Readiness Index. Thailand is behind regional leaders such as Hong Kong, Singapore, New Zealand and Australia, as well as other SEA peers such as Malaysia and Philippines.

Modern data center infrastructure is important for the development of cloud services. Thailand is lagging behind in terms of data center availability. Thailand's 16 colocation data centers account for only 4% of total data center space in Southeast Asia. Thailand data center infrastructure lags behind Asian technology hubs like Singapore and Hong Kong, and regional peers like Malaysia and Indonesia in terms of capacity. In addition, all data centers are built with close proximity to Bangkok, and are owned by 10 entities including both state enterprise (CAT), and private sector (e.g., TCCT, CS Loxinfo, True IDC, NTT).

Figure 66 : Data centers space in SEA [square meters]



Source: NBTC

Figure 67 : Map showing the number of data centers in each Southeast Asian country

Source: Data Center Map, BroadGroup

Improvement of cloud infrastructure in Thailand is necessary to support the digitalization efforts of Thai businesses. Not only is it critical to expand the capacity of data centers to serve the growing demand, but the quality of the infrastructure developed must also be adhere to international standards. Given the high cost associated with data center development, the government may encourage collaborations among private sector to co-develop cloud infrastructure. In addition, leading international data center providers may also be promoted to collaborate with local private sector. This will help bring in international expertise and world-class technologies, which will help boost confidence in Thai cloud infrastructure among regional and global MNCs.

Case Study: Super Nap, Thailand's largest and most advanced data center

Super Nap Data Center is set to open in Q1 of 2017. With 6,000 servers, it is set to be the largest data center in Thailand. It will also be one of the most advanced data centers in Asia Pacific. Super Nap will be the first data center in Asia to receive the "Uptime Institute rated Tier IV Gold " status. The project is a collaboration between Super Nap International, a US-based global leader in data center, and 4 Thai entities – the Crown Property Bureau (Thailand), Siam Commercial Bank, Kasikorn Bank and True IDC. The Data Center is under construction inside Hemaraj Industrial estate in Chonburi on an area of 12 hectares. Located only 27 kilometers away from the landing point of international submarine cable connecting Thailand with ASEAN and the world, it aims to attract both Thai firms looking to expand in the ASEAN region and multinationals with operation in the region. Super Nap will enhance competitiveness of Thailand in cloud services. It will assist Thai businesses, including startups, in digitalization efforts.

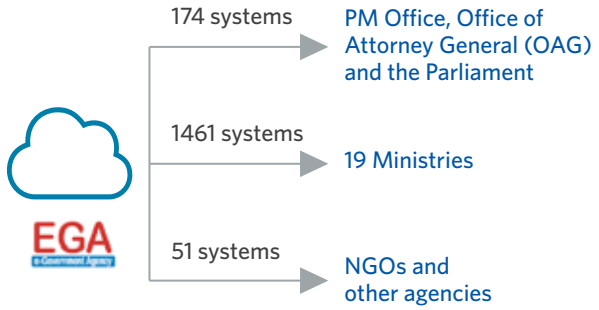
Cloud Services

Based on a report by a leading telecom operator in Thailand, cloud service market size in Thailand reached USD 100 mn in 2016 and is expected to grow to USD 186 mn in 2020.

Private sector demand is driven by increasing need for cost-effective and flexible data management solution. Based on IMC Institute Research conducted in 2015, 57% of local business adopted cloud service in their operation. Among these adopters, 92% used Software as a Service (SaaS) and 58% used Infrastructure as a Service (IaaS). Large enterprises are the major users of cloud services, but SMEs and startups are seen as the key drivers of future growth. Currently there are many local players offering Cloud service solutions for SMEs including TRUE IDC, CS Loxinfo, TCC, CAT, and AIS.

The Thai government is taking a centralized approach towards government cloud services. The e-Government Agency (EGA) provides government cloud services (G-cloud) covering ~1,680 systems. All 19 ministries and the PM Office are already using the G-cloud, but some data deemed as confidential and sensitive are still stored on own systems.

Figure 68 : Overview of G-cloud service in Thailand



Source: EGA

To encourage more usage, government should promote adoption across both the private sector and government agencies. Government can support businesses in adopting cloud services by providing knowledge about benefits of cloud services, and information about available service providers. For example, Singaporean government develops Cloud Service Provider Registry to act as centralized database of existing cloud service providers and the services offered by each provider. In addition, a combination of incentives and rules can be used to encourage adoption of cloud services by government agencies. Furthermore, the government can also support infrastructure improvement and provision of more variety of cloud services, catered to different types of users, including the development of public cloud as these are suitable for SMEs and startups.

Case study: Australia – Encouraging government agencies to use cloud services

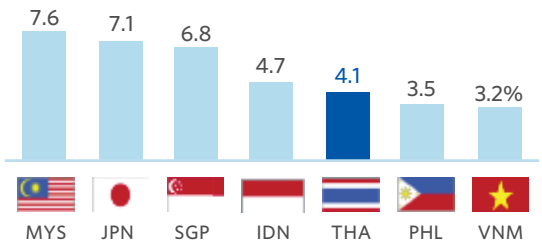
To encourage cloud adoption, Cloud Computing Policy (2014) mandates government agencies to adopt cloud where it is "fit for purpose, provides adequate protection of data and delivers value for money" when obtaining new/ or replacing ICT infrastructure and services. Australia now ranks #4 in Cloud Readiness in 2016 – up from 7th in 2012[2)]

1) According to Cloud Readiness Index (CRI) by ACCA

Cybersecurity

Low cybersecurity is one of the key factors that can limit the use of public cloud services. Thailand still lags behind most regional peers with regards to cybersecurity, thus limiting regional competitiveness of Thailand in cloud services. By 2017, Thailand is expected to pass a series of cybersecurity-related bills, such as Electronics Transaction Bill, the Personal Data Protection Bill, National Cyber Security Bill, and the Computer Crime Bill. These bills more clearly define the areas of legal violation and associated penalty, ensuring strict alignment with international standards, with the aim to make all parties take greater responsibilities regarding data privacy and security, and enhance users' confidence.

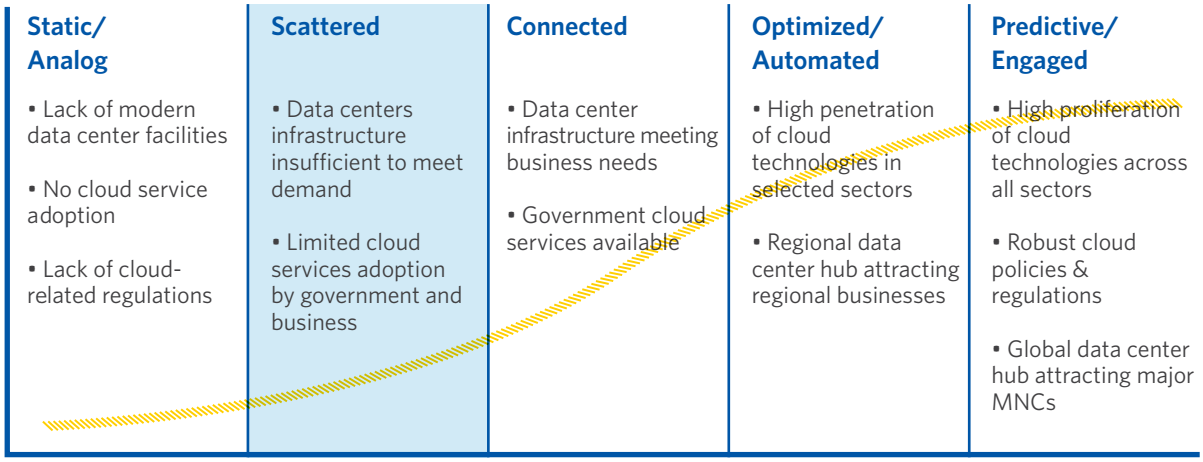
Figure 69 : Index of cybersecurity [Index out of 10]



Source: Asia Cloud Computing Association

WHERE DOES THAILAND STAND?

Figure 70 : Digital maturity phases of cloud infrastructure



Source: Roland Berger

#10 (out of 14)
in Cloud Readiness among ASEAN countries

4% contribution
to total SEA data center space

1,680 systems
provided for government agencies on G-Cloud services

HOW TO DRIVE THAILAND FORWARD?

It is critical for Thailand to improve its cloud infrastructure to be able to effectively and securely manage the continuously growing data volume. Moreover, to minimize investment cost of agencies and businesses, sharing of public, consolidated cloud platforms should be encouraged.

32 Encourage further expansion and adoption of government cloud services (G-cloud)

- Design incentives and regulation to encourage more adoption of G-cloud by government agencies
- Enhance quality of government cloud services through continuous infrastructure improvements and upgrades
- Engage with government agencies to understand concerns regarding G-cloud service to identify key areas of improvements
- Continue to promote awareness and understanding of benefits of G-cloud

Recommended KPI

# of systems covered in G-cloud services

Capacity of G-cloud services

Satisfaction with G-cloud

33 Design new regulation and incentives to encourage adoption of cloud services by businesses and individuals

- Enhance cybersecurity through improved law and regulation on data protection and privacy to build confidence among multinational companies in the security of public cloud services offered in Thailand
- Support NGOs, SMEs and startups with subsidies to adopt cloud services – include as part of incentives for startups in priority sectors
- Develop National Registry of cloud service providers to allow users to conveniently view and select offerings
- Promote awareness and understanding of cloud services to the general public and businesses in Thailand (including startups, SMEs)
- Encourage provision of diverse types of cloud services in Thailand including both public and private cloud services
- Encourage development of cloud infrastructure to expand capacity and enhance quality of cloud infrastructure to be world-class standards

Market size for cloud services

# of providers of cloud services

# of users of cloud services

Total capacity of cloud services

Innovation – The driving force towards digital economy & society

Technology evolution and innovation have been the pivotal growth factor in the development of many advanced global economies. Many governments are developing innovative ecosystem by supporting local startups and nationwide R&D efforts, in close collaboration with the private sector.

The common aim is to foster innovative mindset and capability, necessary to leapfrog the development of the nation. In order to become an innovation hub, Thailand needs to foster the growth and collaborative efforts among startups, academics, the private and the public sector.

Startup Ecosystem

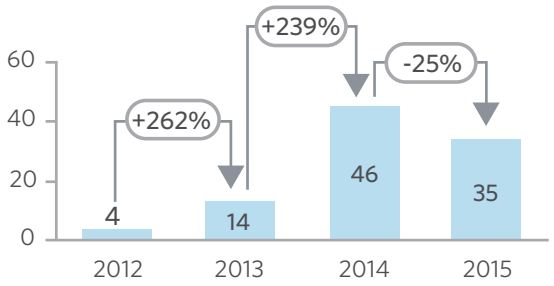
The startup ecosystem is one of the key engines driving innovation. According to the report from MIT's study on startup environment in the United States, "a doubling of successful startups predicts an increase of 6.8% in GDP within 11 years." In addition, the expansion of new startups also creates more job opportunities and elevates workforce skillsets. Startup-led innovation has become a significant industry disruption and has changed the way people live and work.

Three key elements supporting the growth of startup should be considered, which includes funding availability, government support, and regulation procedures and policies. These elements play important role in thriving a startup ecosystem.

Strong and supporting early-stage funding community for startup is critical for a startup to grow. The most common important source of fund for startup is Venture Capital (VC). In Thailand, the amount of VC funding for startup has increased significantly from THB 4 million in 2012 to THB 35 million in 2015 (Figure 71). Yet Thailand's total VC funding during 2015 only accounts for 3% of total funding in ASEAN, while funding in Singapore represents 73% of ASEAN funding (Figure 72). According to WEF's Global Information Technology Report 2016, Thailand scores 3.3 out of 7 in availability of venture capital which is far behind peers like Malaysia (score 4.8), Singapore (score 4.6), and Indonesia (score 3.8). Apart from VC funding, government and private companies should also take more significant role in engaging and supporting the growth of startups. Several public and private startup accelerator programs have been developed in the recent years. However, the total available fund is still lower than most leading regional peers.

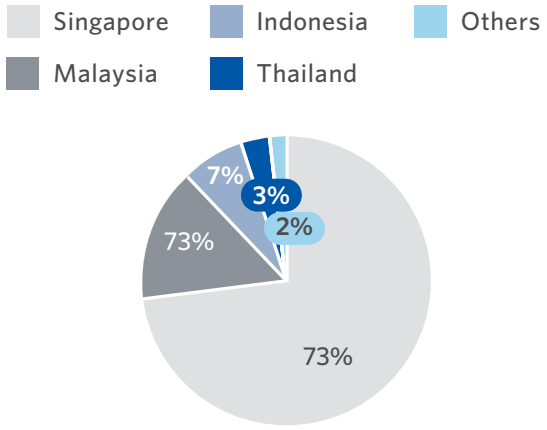
Government is another key patronage of startup growth. Several government entities have the objective to support local startup such as NIA, SIPA, and NECTEC. For example, NIA has launched "Innovation Coupon" program in 2010, which provides startups and SMEs with the opportunity to connect with Innovation Service Provider (ISP) from academic and private sector. Selected business ideas from startups and SMEs are provided with mentorship from the ISPs. In addition, nationwide initiative to support startup has also been introduced in 2016. "Startup Thailand" is a major government initiative to foster the growth of local startups under close collaboration with the private sector. Mostly financial and technology companies participate in the initiatives, which include the arrangement of series of startup events across the nation. Since the launched, three "Startup Thailand" events have been arranged with the aim to showcase local startups and to inspire public audience. The event also aims to reinforce business opportunities between startups and large corporations.

Figure 71 : Startup funding amount raise in Thailand [THB mn, 2012-2015]



Source: Startup Thailand, Techsauce, MaGIC

Figure 72 : 2015 ASEAN split of VC funding [%]



Source: Startup Thailand, Techsauce, MaGIC

Business incorporation procedures are another critical element entrepreneurs consider before incorporating their new businesses. Although it takes only 6 steps to incorporate a business in Thailand, the overall process will require 28 days, comparing to 3 days in Singapore and 4 days in Malaysia. The long procedure is one of the factors that can discourage startups, both Thai and international, to locate their business in Thailand. In addition, protection of intellectual property is another critical factor affecting investor's decision. According to WEF's Global Information Technology Report 2016, Thailand ranked #113 from 139 countries in intellectual property protection, far behind regional peers (Singapore #3, Malaysia #23, Indonesia #48). This indicates the need to improve national policy to better facilitate incorporation and operation of startup, which ultimately enhances the level of confidence among entrepreneurs.

Case Study: MaGIC – One Stop Startup Platform in Malaysia

Established in 2013 by Ministry of Finance, the Malaysian Global Innovation & Creative Center (MaGIC) is a public-led facility aiming to support Malaysian startup ecosystem. MaGIC was launched by president Barack Obama and the Prime Minister of Malaysia in 2013. The platform is also supported by international startup leaders like Stanford University and UP Global (International accelerators community).

MaGIC platform offers a wide range of services to help nurture young startups. At the price of USD 35 per month, startups can gain access to co-working space, meeting room, various trainings and workshops, legal services, and administrative supports. MaGIC has also developed vast network of Malaysian experts across industries. This network provides mentorship support for local startups seeking for advices, industry insights and business growth suggestions.

MaGIC Co-working space

Case Study: Silicon Valley

Home of Apple, Google, eBay, and up to 27,000 startups, Silicon Valley offers pool of talent with computer programming skills and the facilities necessary for startup e.g., co-working space, digital lab, and proximity to other tech startups. Silicon Valley has great number of VC and incubators, providing high potential of funding for startup. 40% of US active VC funds are available in Silicon Valley and San Francisco, supporting the growth the startup ecosystem.

Digital R&D Efforts

The second component supporting innovation is research and development efforts. Digital R&D in Thailand is still in early stage with scattered investments and limited centralized research facility. R&D efforts are concentrated in Bangkok where most research facilities and technology companies are located.

Universities are one of the main contributors of innovation. Currently, most universities and research institutions with digital research capability are concentrated in Bangkok, These universities have developed a broad range of digital technology research capabilities including software, hardware, computational intelligence, and ICT network. However, the overall quality of research outputs are still considered lower than international standard, as observed in a lower number of research citations on similar topic compare to global average.

Private sector has initiated several R&D initiatives, yet large-scale initiatives are still lacking. Various local companies have invested in R&D, mostly through close collaboration with international companies. Most of the efforts are in Biotech field due to the number of large agricultural and food nutrition companies in Thailand (e.g., CP Group and Mitr Phol). However, large R&D investments from international corporations in Thailand are limited. To tackle this, Thailand Board of Investment announced the offering of tax incentive on R&D projects involving technology and innovation in 2014, with the aim to attract large foreign companies.

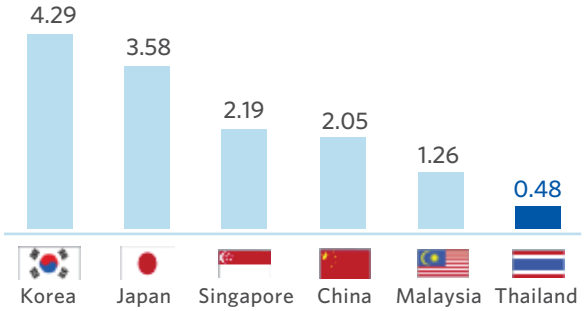
Government and public sector are the main supporters of R&D efforts in both academic and private sector. One of the prominent example is "Thailand Science Park", which was established and managed by NSTDA under MOST. The Park runs 5 research units and 4 development units with more than 2,000 personnel from 4 national research institutes and 70 private companies. In addition, "Software Park" is another facility developed by NSTDA, which incubates innovative local software startups by providing the opportunity to collaborate with leading international ICT partners such as Intel and Microsoft. There are currently 6 Software park facilities across the country.

Case Study: The Land of Innovation

R&D flourishes in Germany driven by the readiness of infrastructure, accommodating regulations, well-equipped research centers and competent human capital. There are ~1,000 public and private funded research institution, more than 600k research staffs, over 32k international collaborations for higher education and USD 88 bn domestic expenditure on R&D

National R&D investment is critical for the growth of nationwide R&D efforts. Gross Domestic Expenditure on R&D (GERD) in Thailand is low at 0.48% of GDP in 2014, comparing to APAC peers at average of 2.3% (Figure 73). Thai government contributed 24% of total GERD in 2014, as compared to 39% contributed by Singaporean government in the same year. Meanwhile, private companies allocated limited investment on R&D. This limited participation of private sector also reduces the potential for impactful and commercializable research output that can practically solve the industry's challenges.

Figure 73 : % of Gross Domestic Expenditure on R&D per GDP [%, 2014]



Source: UNESCO Institute for Statistic

"Most Thai companies are reluctant to spend on R&D because they look at it as a cost rather than an investment that will pay off in the future."

Deputy Prime Minister for Economy Thailand, Bangkok Post, 2016

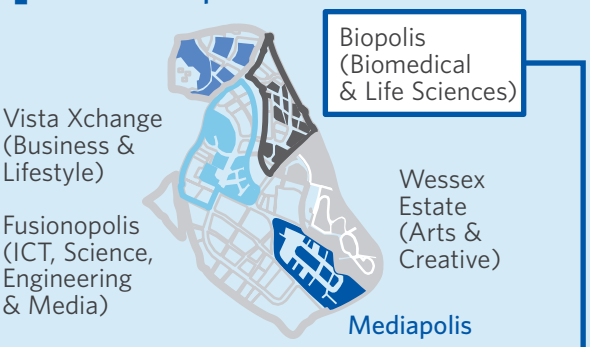
R&D Human Resource capability in Thailand is often obstructing the growth of nationwide digital R&D effort. There are 3.3 researchers per 10,000 citizens in Thailand compared to 64 researchers per 10,000 citizens in Singapore and 8 researchers per 10,000 citizens in Malaysia. Most of the talent is concentrated in Biotech due to high availability of university and public scholarships in the field. Other scholarships are often non-industry specific. The incentive to attract more foreign researchers is still under consideration (e.g., personal tax waiver for foreign researchers and easier visa and work permit process).

"Commercialization of research and IP management is also underdeveloped in Thai universities. At present, as universities have limited research that can be patented, commercialized or transferred. Thailand also suffers from chronic shortages of qualified human resources in STI, and sufficient growth to meet market demand"

Science, Technology & Innovation Policy Review, UNCTAD, 2015

Case Study: One-North – Centralized R&D platform in Singapore

One-North Map



Biopolis Facility

Established in 2001, One-North is an integrated platform for IT and Life Sciences companies and research institutions. Located on 490 acres, One-North is a home to various companies, public and private research institutions focusing on biotech, ICT, and Physical science field. The proximity of these entities fosters collaboration and knowledge sharing. One-North also locates near educational and research institute such as NUS and INSEAD, which further encourages R&D collaboration from academic sector.

Great showcase example of One-North success is the Biopolis facility. Biopolis is one of the internationally-renowned biotechnology and biochemical facilities. Its large campus hosts universities, research facilities, pharmaceutical labs, several biotechnological companies, and a number of government agencies. The facility also offers proximity to R&D institutions with the aim to promote knowledge sharing, peer reviews, and collaborations among private and public scientific community.

WHERE DOES THAILAND STAND?

Figure 74 : Developmental maturity phases of Innovation

Static/ Analog	Scattered	Connected	Optimized/ Automated	Predictive/ Engaged
• R&D limited to a few university • Lack of sufficient VC funding	• No centralized R&D planning • Scattered digital clusters mostly in main cities • Limited VC funding	• Beginning of R&D under collaboration by the state and private • Improve regulation for startup and VC	• Strong startup/inv. incentive schemes • Well-defined R&D program and infrastructure	• Being model for R&D hubs • Complete startup ecosystem • Best in-class innovation parks

Source: Roland Berger

Only contribute **3%** of total startups VC funding in ASEAN

3 researchers per 10,000 citizens

Digital innovation **centered in BKK**

HOW TO DRIVE THAILAND FORWARD?

Driving the development of innovation and digital R&D capability is crucial for Thailand to move forward in the global value chain. Fostering startups ecosystem will enable them to become the new driver of economic growth and position Thailand as a startup hub in ASEAN.

34 Develop platform to serve and strengthen the startup ecosystem

- Design and develop startup nurturing platforms under collaboration with university and private sector
- Develop grassroots activities and training programs for startups
- Develop acceleration and incubation programs which are easily accessible for startups nationwide
- Develop nationwide startup nurturing facilities/incubators providing the necessary physical and operational supports for new business
- Establish startup mentorship programs

Recommended KPI

# of locally developed startup

# of nurturing/incubator facility

Value of VC deals

35 Strengthen national digital R&D efforts and capabilities

- Build the nexus of knowledge in digital from developing capability of local researchers on a national scale
- Build infrastructure to support R&D of digital technology
- Incentivize investment of private sectors in research and support high impact R&D

# of researchers per citizen

Capacity of research institution nationwide

36 Develop innovation as a service by universities and research facilities for private sector

- Design collaboration program between universities/research institutions and private sector
- Incentivize participation from universities/research institutions and private sector and promote the program nationwide

# of collaboration program

# of new innovation

Future-ready human capital fosters economic competitiveness and sustainable growth

Strong ICT skills are the driver of both enhanced productivity and technological advancement. The rapid technological transformation and globalization in recent years have prompted Thailand and international governments alike to focus on human capital development as a key strategy for promoting economic competitiveness and growth. With students today being the workforce in the future, it is critical to improve quality of the education system to produce future-ready workforce. The education system needs to provide students with necessary ICT skills, which match the industry needs and national priorities. At the same time, the ICT skills of workforce must also be enhanced to improve competitiveness of industries and drive digital innovation.

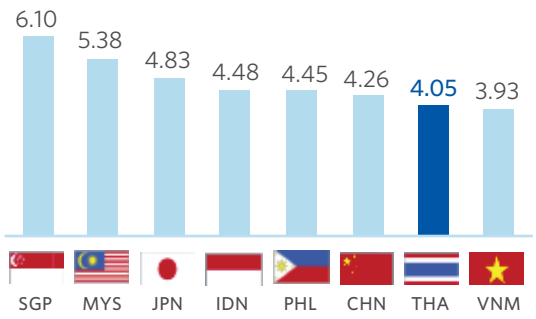
Education

Overall education quality in Thailand

Thai society has always placed high value on education. The country has invested substantially in the sector, spending over 4% of GDP on education which is higher than regional peers such as Singapore and Indonesia. Yet, the education system is not functioning as well as it should. Thailand still lags behind many regional peers in terms of quality of overall education systems (see Figure 75) quality of higher education, as well as capabilities in specific areas such as sciences, technology, engineering and mathematics (STEM), foreign language, and business. All these disciplines are critical for effective digitalization of Thai economy.

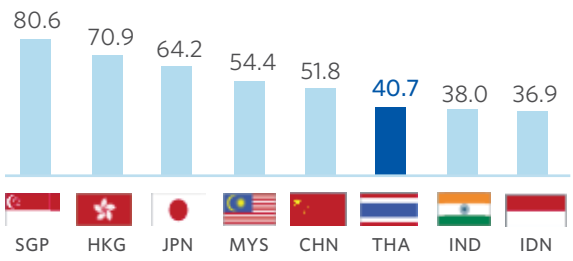
Higher education has a significant role in preparing a modern workforce and sustaining economic growth Nevertheless, several surveys of companies in many Southeast Asian countries point out that graduates from Thai higher education institutions do not have adequate work skills to succeed in today's market. Based on Universitas's study, the quality of higher education in Thailand is lower than regional peers. Thailand is ranked #46 out of 50 countries included in the study, with lower score than Singapore, and Malaysia.

Figure 75 : Quality of overall education system [out of 7, 2015]



Source: The World Economic Forum Global Competitive Index

Figure 76 : Quality of Higher Education Score [out of 100, 2016]



Source: Universitas

Capabilities in science, technology, engineering and mathematics (STEM) are core competencies required to enhance competitiveness of Thailand and drive digital innovation. However, Thailand still underperforms relative to regional peers in these subjects. According to the World Economic Forum's ranking of Quality of Maths and Sciences Education, Thailand is ranked #79 globally, which is behind regional peers. In addition, there are no Thai universities ranked in the world's top 200 universities for Computer Science and Information Systems program based on the QS University ranking of universities. Improving the higher education in these areas is critical to ensure future workforce is equipped with required skills.

On top of core competencies in Sciences, Technology, Engineer and Mathematics, business capabilities are important in translating the technical knowledge and skills into commercially viable digital innovation. The quality of Thailand's management schools lag behind regional peers. The World Economic Forum ranks Thailand at #77 globally in Quality of Management Schools, compared to rank #10 for Singapore and rank #22 for Malaysia.

Overall, there is still a large room for improvement in terms of education quality in Thailand. It is important to continuously improve national curriculum at all levels. This will ensure that the content taught are aligned with macro trends and national priorities. For instance, foreign language skills and digital capabilities are becoming more and more important to drive the country towards digital economy. Moreover, it is necessary to ensure that students are provided with sufficient resources.

Primary & Secondary Education Curriculum

In Thailand, lessons for primary and secondary education usually focus on equipping students with fact and knowledge. More emphasis can be placed on case studies, and on practical elements. This will enable students to see the relevance of the theories and apply them in the real-world situations. It is also important to build critical thinking ability from school age. Encouraging more classroom discussions will also help students to think deeper and enhances analytical and critical thinking ability.

Case Study: Open learning for successful education in Finland

Finland is ranked #4 globally by the World Economic Forum in the quality of the overall education system. The success can be attributed to open, playful and collaborative learning environment, teacher appreciation and empowerment, as well as innovative use of ICT. Teachers are selected from the top 10% of high-school graduates and are given freedom in terms of both content and digital tools.

Case Study: Coding lessons in school for "future-ready" labor

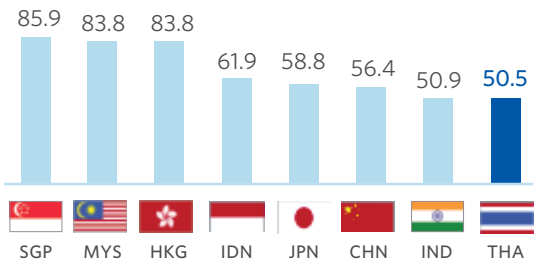
Estonia is providing coding lessons to school students from age 7. The initiative, called ProgeTiiger, is a collaboration between the government and a Finnish IT Company, Tiesto. The initiative follows a project to install permanent DSL connection in every school. Special materials are designed and teachers are provided with training to ensure that students of all levels are provided with high-quality teaching. Courses start with logic and basic computing in younger years, and, in later years, involve writing code and learning about software development. Many other EU countries, including the UK and Denmark, have also included coding into primary and secondary education syllabus.

Higher Education Curriculum

Curriculum should be updated to align with industry trends, and style of teaching can involve more project-based techniques to allow development of practical skills. According to many academics, Thailand's education system is ranked low in terms of quality partly because of inability to offer the right skills to people, making the workforce unprepared for the jobs.

Collaboration between education institutes and private sector can help align skills of graduates with industry needs. Private sector can potentially be more involved in design of courses. Representatives from private sector can be invited to be guest lecturers or guest speakers in universities. This not only equips students with more knowledge and skills, but the experience of the speakers can also help students to better understand the career prospects related to their studies. Partnerships between universities and private sector can also widen internship and project opportunities for students and lecturers. Though leading Thai universities are increasing collaboration with private sector, based on Universitas's study, Thailand still has room to catch up with regional peers on private sector collaboration.

Figure 77 : Rating of knowledge transfer between universities and companies [out of 100, 2016]



Source: Universitas

Collaboration between Thai and foreign universities can promote knowledge exchange and capabilities transfer. Partnerships with foreign universities overseas potentially involve conducting more joint research and promoting more exchange programs for students, teaching staff and researchers. Currently, on the Times University Ranking 2016, Thailand's university "international outlook score" is 44.1 compared to 96.2 in Singapore. Based on Universitas's scores, Thailand also has lower percentage of international students, and less international research collaboration than both Singapore and Malaysia.

Language proficiency can widen opportunities of Thai students to learn from foreign talent, and benefit from increasing economic integration. However, Thai students have poor English proficiency compared to other countries. Average scores for both TOEFL and IELTS are lower than Singapore, Malaysia, Vietnam, Philippines and Vietnam.

TOEFL	
Singapore:	97
Philippines:	90
Malaysia:	89
Indonesia:	84
Vietnam:	80
Myanmar:	80
Thailand:	77

IELTS	
Singapore:	7.2
Malaysia:	6.8
Philippines:	6.4
Indonesia:	6.4
Vietnam:	6.0
Thailand:	5.9

Education Resources

Teaching personnel, both in term of adequacy and capabilities, is very critical. According to UNESCO data, the ratio of students per teacher in higher education in Thailand has fallen significantly from approximately 34 in 2004 to 23 in 2014. In Malaysia, the ratio is 11, while in Germany, the ratio is 8. In addition to adequacy, capabilities of teaching personnel should be continuously developed. Not only must teaching personnel possess the technical knowledge in subjects they teach, they must also know how to deliver the knowledge to students effectively. Class presentations are very critical to develop understanding and interests among students in the subject being taught. Teachers in Thailand should be encouraged to take part in more teacher training courses.

Availability of internet and digital technology in Thailand school still lags behind many regional peers. Based on the World Economic Forum Global Competitive Index (GCI) 2015-2016, Thailand is ranked #54 globally in terms of "internet access in schools", compared to #2 for Singapore, #26 for Malaysia, #43 for Indonesia and #47 for China. Based on a survey by OECD, many schools in Thailand reported that their teaching capabilities are hindered by shortage of digital technology including modern computer, laptop ,and educational software tools.

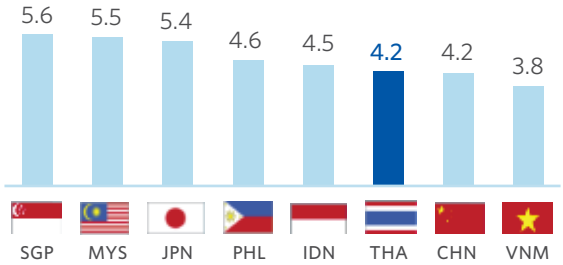
Workforce

"Thailand is extremely lacking skilled, competitive IT workforce. Most of our employed Thai staffs in IT are in lower positions; while the higher / management positions are 90% foreign in order to meet the company's requirements.

Head of Marketing Partnerships, Management at a leading online travel agency

ICT skills of Thai workers are not aligned with industry needs. Thailand has one of the lowest skilled workforce proportion in ASEAN with 16% showing as unskilled and only 39% of workers are seen by employers as suited for their jobs. Employers should develop the skills of existing workers to match industry needs. According to the World Economic Forum, Thai businesses' prioritization and provision of staff training still lag behind regional peers. Thailand is ranked #55 globally, while Singapore and Malaysia are in the global top 10 (Singapore #5, Malaysia #6).

Figure 78 : Extent of Staff Training Index [out of 7, 2015] – extent to which companies invest in training and employee development



Source: The World Economic Forum Global Competitive Index

More emphasis on training and employee development by companies will help align skills with industry requirements, enhance productivity and attract workers to the particular industry. In addition, government may also provide support to the private sector, especially SMEs and startups, to offer training for their workforce on core skills such as ICT and business skills. "Train the trainer program" may be rolled out to train SMEs and startups owners, and equip them with materials and capabilities to train their staff. Other government institutions can include mandatory training fund for businesses similar to the Malaysian government's initiative.

Case Study: Supporting SMEs in up-skilling the workforce

Malaysia's Human Resources Development Fund (HRDF) supports employers, especially SMEs, in offering training for staff. Employers pay monthly levies into the Fund. These employers are entitled to receive financial assistance for up to 100% of training costs. The HRDF also offers training programs, conducted by industry experts from the private sector. It also supports SMEs in designing training programs. Training and advisory support is provided by professionals from the private sector. By ensuring alignment of workers' skills with evolving industry requirements and enhancing competitiveness, the HRDF will help support national target to make 35% of all labor "skilled" by 2020.

WHERE DOES THAILAND STAND?

Figure 79 : Developmental maturity phases of Human Capital

Static/ Analog	Scattered	Connected	Optimized/ Automated	Predictive/ Engaged
• Lack of IT-specific support for education system • Low IT-fostered environment	• Limited IT-specific courses in higher education and university	• Digital literacy meeting regional standards • IT-education widely developed and enrolled	• IT workforce widely employed at all levels • Universities among regional's leader in quality	• Proliferation of IT-specific areas in education • Universities among world's leading in quality

Source: Roland Berger

84% unskilled labor; while only 39% are suited for the jobs

#47 out of 76 in OECD Math and Science ranking

None of the Thai university made the world's **top 200** for Computer Science & Information System

HOW TO DRIVE THAILAND FORWARD?

Human development and strong digital knowledge are critical to a successful digitalization and the shift towards knowledge-based economy. The quality of education must be improved, from primary and secondary schools to universities. Thailand should create a pool of future-ready workers, whose skills and capabilities are aligned with current trends and requirements. In addition, existing workers must be provided with the opportunities to receive training order to develop their skills to align with evolving industry needs.

37 Include coding lessons in primary & secondary schools, and improve interest in sciences, technology and ICT subjects among students

- Design standard programming curriculum for primary and secondary schools nationwide including a standardized examination
- Develop teaching personnel for coding lessons through development of training programs for teachers
- Set up remote learning program for coding to educate students in schools with no access to qualified coding teaching personnel
- Develop IT infrastructure in schools to facilitate coding/ICT education
- Promote continuous improvement in the quality of sciences, technology & ICT education through regular engagement with experts and private sector, and incorporation of more practical elements and real-life examples to courses, on top of theory
- Promote awareness and interests in sciences, technology and ICT-related careers among secondary school students through collaboration with employers in designing special classes & programs
- Encourage private sector to offer programs to develop talent in sciences technology and ICT from school age e.g., special training courses, inter-school competition

Recommended KPI

Establishment of national curriculum on coding

Number of primary schools offering coding classes

Number of secondary schools offering coding classes

% of Thai student spassing a standardized programming examination

38 Improve quality of sciences and technology education in universities to produce future ready workforce

- Involve private sector in the design of syllabus and courses to alignknowledge and skills of graduates with industry needs
- Include more practical elements in courses to equip graduates with actual skills involved with careers in the particular field
- Promote awareness and interest of different careers in sciences, technology and ICT
- Have more guest/special lecturers from private sector to teach specific courses and invite famous, inspirational, successful people, including alumni, from variety of career paths (e.g., researchers, large corporate, startups) to give talk to students
- Partner with private sector to develop projects and competitions to allow students to explore interests outside of class e.g., digital startup business plan competition
- Partner with private sector to offer more internship opportunities and encourage more employers to participate in career fairs to broaden understanding of the possible career paths
- Provide more opportunities for students in sciences, technology and ICT related courses to enhance core skill beyond major subject e.g., language, business courses
- Promote collaboration with international institutions through student exchange, lecturer/researcher exchange and collaboration on research

Recommended KPI

Number of top 200 universities from Thailand based on QS University ranking

Index for Quality of Maths & Sciences education from World Economic Forum

Index for Quality of Higher Education from Universitas

Knowledge transfer between universities & companies from Universitas

39 Encourage training and development of workforce, with focus on ICT capabilities

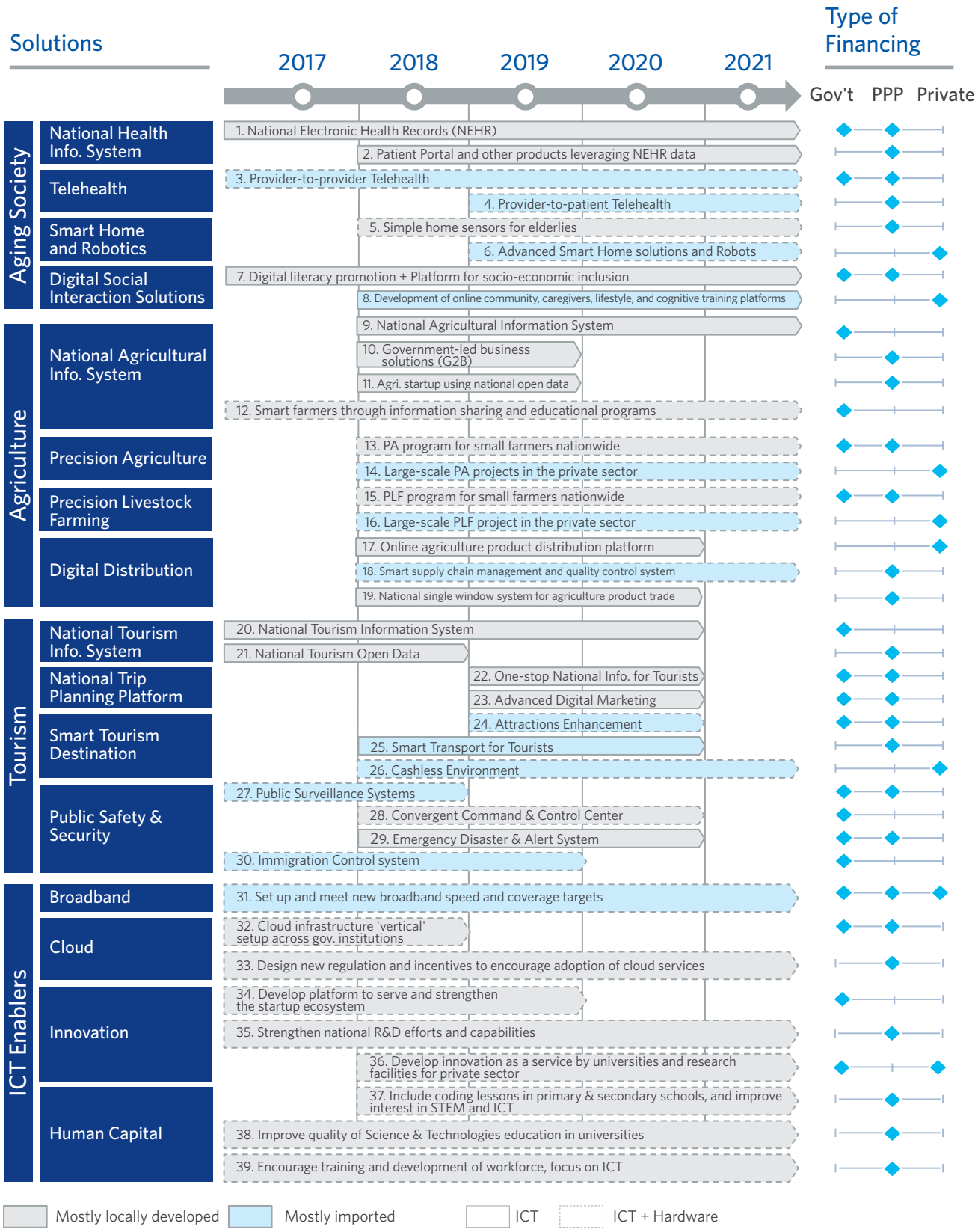
- Design and launch government-led training programme on ICT capabilities, focusing on "training the trainers" e.g., company representatives, SMEs owners
- Encourage private sector, including SMEs, to invest more in training and development of employees including in ICT capabilities
- Support SMEs in training their employees on ICT skills including potential financial support and training materials provision
- Raise awareness of 'benefits of digital literacy and skills' to entire population
- Develop and make widely accessible the self-learning tools to allow people to learn and develop digital skills

Extent of staff training provided by employers

CHAPTER 7

Digitalization Roadmap and Detailed Initiatives

5-year digitalization roadmap for the three sectors and key enablers



1 Develop National Electronic Health Records accessible by medical personnel and analyze data for resource planning and disease prevention

ISSUES & CURRENT SITUATION

Limited electronic sharing of patient records across hospitals

- Many use electronic, but only on private data server, while some in rural area still use paper records
- Existing NHIS is not well supported and promoted
- Uncoordinated efforts to develop NEHR

Difficulties of obtaining comprehensive information for clinical decision

- Doctors need to contact hospitals one-by-one to obtain medical history.
- Patients have to recite medical history, which is subject to errors

Pressure to optimize healthcare spending

- Rising health expenditure at 10% p.a. (faster than population growth)
- State expenditure accounts for 86% of total spending
- Elderly support ratio to half by 2030

RECOMMENDED ACTIONS

Develop central online platform to unify data from different healthcare providers, starting with those under MOPH jurisdiction

- Partner with 3rd party IT professional to set up required IT system: cloud-based data server , authentication server for data protection
- Build collaboration with other organizations to further enhance the system
- Engage with each healthcare provider, starting with those under MOPH jurisdiction in priority provinces, to establish connectivity of existing databases with the newly established central platform
- Set up a team exclusively responsible for monitoring and maintaining the system and continuously work with providers & other stakeholders to update data

Standardize software and integrate existing data already collected including data collected by each provider and data on elderlies collected by village volunteers

Design and roll-out national standard for data for recording patient records which applies to all healthcare providers including MOPH hospitals, other state & private hospitals

Involve healthcare providers in the design of NEHR system to ensure alignment with their needs, maximum usefulness and subsequent buy-in

- Use focus groups with doctors and medical personnel across country, as well as generation population, to get consensus on the design of the systems including the additional data sets to be included and the key features/characeristics of systems
- Adjust existing NEHR design based on input from focus groups

Create user-friendly interface for healthcare providers to access NEHR, update patient records and interact with other providers

Promote awareness of system to healthcare providers as well as general public through various media channels and deployment of mobile team to districts/sub-districts

Provide training to healthcare providers to be able to use systems

- Conduct training at district and provincial levels – short & effective programmes
- Identify local leaders and use train the trainer method

Encourage private healthcare providers to participate in the system through incentive schemes such as financial incentives, provision of data/analytics in return for sharing

Define legal and regulatory framework to protect privacy and confidentiality of data, but allow for data-sharing via anonymization

Use Big Data analytics software to analyze central database and use insights to formulate policy design

- Anonymize, organize and analyze data
- Use results of analytics for policy decisions e.g., expenditure planning, development of medicines

Implementation Timeline

2017 → 2018 → 2019 → 2020 → 2021

Recommended KPI

- Number of patients with records included in the National Electronic Health Records
- Number of healthcare providers contributing patient information to the National Electronic Health Records

Expected Benefits

- Continuity of care for patients – reduced needs to travel to large hospitals
- Improved access to information by providers to make decisions
- Convenient data sharing and referral of patients by doctors
- More effective re planning and preventive actions from Big Data

Ongoing Projects

- Thai Care Cloud, a NHIS established through collaboration between MOPH and Khon Kaen University
- Pilot trials in 5 provinces by NECTEC, SIPA and MOPH
- MOPH is using village volunteers to collect basic health information about elderlies in 1800 sub-districts
- Many large private hospitals set objectives to make patient records fully electronic in the next 2-3 years and use data to improve quality of health care services

2 Develop National Patient Portal for population to access the NEHR and provide open data to startups to develop innovative health applications

ISSUES & CURRENT SITUATION

Pressure to optimize healthcare spend
- Rising health expenditure with state expenditure accounts for 86% of total spending
- Elderly support ratio to half by 2030 exerting more pressure on state

Higher prevalence of chronic health conditions among elderlies

Not all elderlies taking preventive measures to remain health e.g., less than 50% exercise

Population often not aware of own health as records of check-ups not always accessible

RECOMMENDED ACTIONS

Encourage collaboration between researchers, public sector and private sector in development of National Patient Portal, starting with basic portal allowing access to own health conditions
- Identify and select private sector partner with credentials in software development
- Engage industry experts, and conduct focus groups to identify and prioritize the key features to be included in the first phase of National Patient Portal
- Focus on creating professional, easy-to-use user interface
- Include dashboard that conveys summary of conditions in easy-to-understand format that allows comparison of health conditions over time

Continuously augment National Patient Portal with additional features
- Include general health tips which patients can read through the Portal
- Compare patient's health conditions with national averages (e.g., average blood sugar level for particular age) and send alerts & provide recommendations to patients for out-of-line (e.g., high fat level in liver – go see doctor, reduce carbohydrate intake)
- Allow patients to input some data in own records, weighing between enhancing information comprehensiveness and accuracy e.g., calories intake, daily blood pressure readings, level of exercise
- Link data from personal wearables and smart home products (e.g., falls data)
- Include features that allow patients to interact with health providers e.g., eAppointment, ePrescription, eCertificate

Promote use of National Patient Portal by promoting awareness, highlighting the benefits and supporting adoption e.g., training

Foster ecosystem of healthcare startups developing healthcare applications
- Encourage start-ups to collaborate with researchers and public sector to develop innovative healthcare applications by building on research currently being conducted to design commercially viable healthcare applications
- Share healthcare data and analytics
- Develop challenger programme & competition for startups – use winner as example
- Connect startups with investors as well as industry experts (business matching)
- Help promote the products of the startups via the National Patient Portal, where patients can directly download the apps
- Streamline process to set-up businesses to encourage health startup formation
- Offer mentoring support to the startups

Ensure readiness of technology and regulation that permit and support development of more healthcare applications e.g., API integration, open data policy

Evaluate and decide on business model for sharing data and results of Big Data analytics to businesses and public e.g., what will be shared? what will be free and what will be charged for businesses/public etc.?

Implementation Timeline

2017 | 2018 | 2019 | 2020 | 2021

Recommended KPI

- Number of active users of the National Patient Portal
- Number of new locally developed healthcare apps launched
- Total number of downloads and users of these healthcare apps

Expected Benefits

- Reduced healthcare costs for individuals – More pro-active health management leading and more preventive measures
- More innovative healthcare applications for patients and for healthcare providers
- Growth of healthcare start-up ecosystems in Thailand
- Potential data as a service offered by the government

Ongoing Projects

- Over 30 software companies working with government to develop software NECTEC
- EGA working on "opening" data in many disciplines including healthcare

3 Develop nationwide network of provider-to-provider telehealth to improve access to health services of elderlies in rural area

ISSUES & CURRENT SITUATION

Low availability of healthcare personnel and infrastructure in rural areas

- 657 people per 1 hospital bed and 4153 people per 1 doctor in north Isan provinces

Severe problems of access to quality healthcare especially for poor and immobile elderlies living in rural area - high cost and long distance are barriers to accessing healthcare services

- They can access only sub-district health promotion hospitals, which only have nurses
- Doctors are at community and general hospitals, which could be located far away
- Specialists are usually located at general hospitals only

RECOMMENDED ACTIONS

Design priorities for provider-to-provider telehealth roll-out

- Focus on connecting general & regional hospitals to community hospitals to expand healthcare coverage in rural area
- Define priority provinces for roll-out process base on criteria such as aging index, poverty rate, and number of people per doctor
- Focus on high clinical need areas e.g., tele-stroke, tele-psychiatry, tele-radiology, tele-pathology, tele-education
- Set up telehealth center in state hospitals to be role model
- Also capitalize telehealth technologies to support education for lesser skilled medical personnel in rural area

Ensure infrastructure and support readiness for provider-to-provider telehealth roll-out

- Determine suitable connectivity type and required devices and systems to support telehealth
- Initiate with simple telehealth system devices such as cameras & viewing monitors, that allow for basic teleconsultation involving live conversation & standard-definition images for diagnostics & treatment decisions of basic symptoms
- Install more advanced equipment to support higher definition images and larger data transmission (e.g., X-Ray images) to allow diagnostic & treatment of more advanced symptoms
- Ensure scalable IT strategy that accounts for high interoperability

Develop medical personnel to support telehealth services

- General & regional hospitals should have medical personnel that is specifically responsible for telehealth services
- Design training curriculum and offer training to develop knowledge and skill covering both protocol and details of interaction
- Streamline onboarding process for telehealth personnel

Define regulation to support the launch of telehealth

- MOPH should develop clear policy and legal definition involving telehealth practices
- Amend current regulations to support provider-to-provider telehealth implementation such as regulations on prescription, or protection of doctors and patients
- Design appropriate compensation model of telehealth services for medical personnel
- Issue certifications for medical personnel and healthcare providers that can provide telehealth services

Promote awareness and understanding of provider-to-provider telehealth and their benefits to both medical personnel and elderlies

- Involve medical personnel at the design stage to obtain buy-in
- Focus on promotion at local health centers and SDHPH

Implementation Timeline

2017 → 2018 → 2019 → 2020 → 2021

Recommended KPI

- Number of hospital with established telehealth system
- Number of patients treated using telehealth

Expected Benefits

- Elderlies can receive better healthcare via tele-consultation with specialist
- Tele-consultation allows doctors to consult with each others, improving collaboration
- Tele-education could be used to improve the skill and train medical professional in rural area

Ongoing Projects

- Many MOPH led pilots to connect community & general hospitals to their affiliated SDHPH in rural areas
- Digital Economy and Society Plan emphasizes the need to employ telehealth to improve healthcare access
- MDES has collaborated with MOPH and EGA to develop telehealth system to link and modernize 116 general & regional hospitals
- Private hospitals are using more pragmatic and standardized telehealth technology for teleconsultation & education

4 Initiate the use of provider-to-patient telehealth, particularly remote patient monitoring (RPM) for chronic disease management

ISSUES & CURRENT SITUATION

Elderlies are not aware of the benefits of telehealth technology and preventive medicine

Poor accessibility to healthcare in rural area
- Low doctor availability in rural area
- Community & general hospitals could be located far away

Higher prevalence of chronic health conditions - 37.9% and 14.2% of elderlies are suffering from hypertension and diabetes respectively

Growing public health care expenditure from unnecessary hospital visits and re-hospitalization

Current laws and regulations are hindering provider-to-patient telehealth roll-out

RECOMMENDED ACTIONS

Support phased roll-out of provider-to-patient telehealth especially the remote patient monitoring services
- Identify a list of diseases that would be appropriate for remote patient monitoring technology
- Start with more simple technology - manual input of readings into system by patients with healthcare providers being alerted if readings exceed threshold
- In the latter stage, link personal wearable and home medical equipment with hospitals' systems allowing measured readings to be automatically transmitted to hospitals' systems
- Consider offering wearable and home medical equipment as part of treatment plan
- Streamline hospital discharge planning process to incorporate enrollment into telehealth program
- Ensure telehealth solution can easily be integrated into elderlies' daily activities to enhance preventive measures

Develop the infrastructure and personnel to support provider-to-patient telehealth service
- Ensure accessibility to internet for people living in rural area
- Develop infrastructure to support call center and emergency response team
- Develop RPM wearable devices that are suitable for elderlies and consider providing them as part of treatment program
- Offer training to develop knowledge and skill on various aspects of telehealth for related medical personnel

Promote awareness and understanding of RPM and its benefits to both medial personnel and patients
- Incorporate medical personnel at the design stage to promote involvement and buy-in
- Trusted clinicians should be the person to introduce the system to patient in order to build trust and obtain buy-in and compliance
- Promote the benefits of prevention medicine, chronic disease management and wearable devices to elderlies and their families via appropriate media and product trial

Promote and support private sector to develop personal wearables for elderlies
- Encourage development and adoption of personal wearables that come with smart phone apps & portals that allow elderlies to record and view own health conditions
- Link personal wearables with hospitals 'systems to support RPM roll-out

Define regulation to support provider-to-patient telehealth services, especially on privacy, confidentiality and prescription

Implementation Timeline

2017 | 2018 | 2019 | 2020 | 2021

Recommended KPI

- Number of hospitals / startups offering provider-to-patient telehealth services
- Number of elderlies enrolled in provider-to-patient telehealth services

Expected Benefits

- Reduction in healthcare expenditure for both elderlies and public
- Better preventive actions and management of chronic health condition, reducing hospitalization rate
- Provider-to-patient telehealth could be used for follow up/post-op patients, reducing unnecessary hospital visits
- Elderlies can receive tele-consultation services with medical specialists
- Enhanced effectiveness of "community-based care" for elderlies

Ongoing Projects

- Many private hospitals are developing RPM services, particularly for chronic disease management
- Thai startups are developing wearable devices for elderlies

5 Establish public-private partnership to develop commercially viable home sensors, and support adoption by elderlies

ISSUES & CURRENT SITUATION

More elderlies living alone with less living with their children – 9% living alone in 2014 vs. 6% in 2002 and 4% in 1994

Drop in elderly support ratio putting pressure on elderlies to be more independent – ratio expected to fall from 4.2 currently to 2.2 in 2030

Shortage of caretakers with large majority (90%) of care-takers untrained and unskilled

Growing number of severe accidents with death rates from fall doubled from 2007 to 2014 – many elderlies still live in risky home environment e.g., bedroom not on ground floor (35%), no handrail in bathroom (92%)

RECOMMENDED ACTIONS

Create platform for healthcare experts to share insights on challenges faced by elderlies with researchers & private sector involved with elderly sensor development to ensure solution truly addresses the challenges faced by elderlies

Encourage collaboration between government, researchers and private sector on developing and promoting adoption of simple home sensors for elderlies
- Define criteria for types home sensors products to receive government support, based on potential benefits and affordability
- Design type of support to be provided for both existing business and new startups e.g., financial support, mentoring support, data provisions

Design business plan and commercially viable business model
- Offer home sensor as solution, not just off-the-shelf product, to encourage take-up – offer installation service, include connectivity features in the package (not the physical product and connectivity features separately)
- Start in areas where home sensors will be most beneficial such as elderlies living alone, areas without strong community network support
- Investigate different pricing models for different target groups e.g., monthly rental as an alternative to purchase

Consider offering means-tested financial support to selected elderlies to promote adoption of simple home sensors
- Evaluate feasibility and sustainability of providing support through detailed cost-benefit analysis comparing provision of subsidized home sensors and building more nursing homes
- Design scope of support, and clear criteria of who can receive this benefit e.g., low-income elderlies living alone as priority

Ensure design of home sensor solution is simple and easy to use to trigger high adoption e.g., unobtrusive to daily, easy-to-use interface

Develop infrastructure and services that support home sensors for elderlies e.g., cloud-based platform, portals, and emergency call centers and response team

Promote simple home sensors for elderlies to the public focusing on elderlies, families and caretakers
- Raise awareness of the products via appropriate media channels
- Highlight benefits of products on elderlies & families by emphasizing the affordability, ease of use and high impact aspects

Integrate data from sensors into National Electronic Health records to enhance comprehensiveness of data for Big Data analytics e.g., data on falls can enhance understanding of nature and causes of falls

Implementation Timeline

2017 | 2018 | 2019 | 2020 | 2021

Recommended KPI

- Number of home installed with simple home sensors
- Number of startups offering simple home sensor products

Expected Benefits

- Better safety for elderlies living at home
- Enable continuous monitoring and early intervention
- Reduce severity of accident
- Allow elderlies to age at home more effectively, which reduce the need for nursing home
- Lower hospitalization rate and health expenditure
- Family members are more reassured regarding safety of elderlies

Ongoing Projects

- Many academics and local private players are researching on elderly home sensors e.g., NECTEC's home sensor for elderly patients
  - Researchers seek private sector help in developing business model and promoting the solution
  - Private sector seek government support in designing policies & incentives to encourage adoption

6 Support private sector, including startups, in developing advanced smart home solution and robots tailored for elderlies

ISSUES & CURRENT SITUATION

Some Smart Home products such as smart appliances and robots are **available, but expensive compared to average income of elderlies in Thailand**

Limited number of local providers for Smart Home solution

Misperception of being difficult to use and perception on lack of perceived benefits

More elderlies living alone and less with children – only 54.7% of elderlies are living with children in 2014 compared to 72.8% in 1994

Elderlies with mobility issues are having difficulty living alone – Shortage of caretaker, risky home environment

RECOMMENDED ACTIONS

Design clear strategy for government to support the private sector that develop smart appliances and robotic solution
- Define criteria for products to receive government support, focusing on those that could improve convenient and safety of elderlies
- Design type of support to be provided for startups

Support the growth of Thai startups developing Smart Home solutions e.g., streamlined process for business set-up, provision of useful data

Foster collaboration between researchers and private sector to accelerate development and commercialization of products

Cater design of the solution to the challenges of elderlies, by creating platform for businesses to work with people with understanding of elderlies' challenges
- Ensure easy-to-use design
- Consider affordability to increase demand

Raise awareness and highlight the benefits of products on elderlies & families, emphasizing on enhanced convenience and quality of life

Integrate data from smart appliances and caregiving robots into National Electronic Health records to enhance comprehensiveness of data for Big Data analytics

Implementation Timeline

2017 | 2018 | 2019 | 2020 | 2021

Recommended KPI

- Number of new Smart Home products launched
- Number of startups providing Smart Home solutions or caregiving robots

Expected Benefits

- Aging at Home – ability to remain in own homes, no need to move to nursing homes
- Growth of healthcare startup ecosystem for Smart Home solution in Thailand
- Lower healthcare costs to the government via less need for nursing homes
- Lower accidents reducing hospitalization demands

Ongoing Projects

- Many local private players are researching on Smart Home solutions and are looking for commercially viable business models to launch the products – suitable price to charge to create sufficient demand yet cover the cost

7 Develop public platforms to support socio-economic inclusion, and support the adoption of ICT among elderlies

ISSUES & CURRENT SITUATION

Low, but growing, adoption of internet among Thai elderlies

- Only 4% of elderlies are users of internet; this is higher compared to 2% in 2011. For the active users, social network is the most popular activity, followed by data searches, emails, reading and videos

More elderlies are relying on state's income support

- 14.8% of elderlies reported state income support as main income in 2014 compared to only 2.8% in 2007

Most elderlies do not see benefits of digital technology

they are overwhelmed by the variety of digital technology products and do not know which is relevant for them

RECOMMENDED ACTIONS

Promote awareness and attractiveness of digital technology and health literacy for elderlies to both elderlies and relatives

- Illustrate use cases and emphasize ease of use
- Highlight benefits of these digital tools for elderlies and for families

Enhance skills of elderlies to be able to use digital social interaction solutions

- Focus on getting family members to play a lead role in the training of elderlies to use digital solutions
- Set up local training centers
- Create open platform for e-education (self-learning)

Equip elderlies with the technology required to use digital social interaction solutions

- Ensure availability of smart phones or terminals that are affordable and easy-to-use for elderlies
- Support the set-up of internet connection at homes

Consider collaborating with private sector to develop digital public platform to support elderlies to work

- Collaborate with employers and elderlies to identify areas of work that are suitable for elderlies to support
- Design incentive scheme for employers to participate
- Develop application that helps match elderlies with specific jobs/tasks posted by employers and allows elderlies to carry out those tasks online

Consider collaborating with private sector to develop digital public platform to enhance social participation

Implementation Timeline

2017 → 2018 → 2019 → 2020 → 2021

Recommended KPI

- Number of elderlies actively using the internet
- Economic contribution from elderlies

Expected Benefits

- Elderlies more capable and willing to use digital technology, allowing them to fully leverage digital social interaction solutions
- Reinforce economic contribution from elderlies from telework
- Increase elderlies' income there by reducing financial burden on children and on the government
- Permit employees to be more active, improving mental health
- Help overcome labor shortage and allow employers to leverage skills & experience of elderlies

Ongoing Projects

- Digital Economy and Society Plan emphasizes the need to enhance digital literacy of elderly population

8 Support the development of new digital tools that promote social interaction and quality of life for elderlies

ISSUES & CURRENT SITUATION

Social changes increase need for digital tools to keep elderlies connected with families and society

- Less elderlies are living with their children – only 54% living with children compared to 73% in 1884
- More elderlies living alone – 9% living alone in 2014 vs. 6% in 2002 and 4% in 1994

Most commonly used digital tools are foreign-produced, but with increasingly more apps being developed by Thailand, mostly involving caretakers' platform and health tips

Shortage of caregivers - no clear labor standards and certification with most being untrained

RECOMMENDED ACTIONS

Provide support by the government to private sector developers in developing new digital social interaction solutions

- Identify key painpoints and challenges in elderlies' daily lives that are not met by existing digital interaction solutions
- Define types of digital social interaction solutions that are priority for Thailand and will receive government support

Equip private sector developers with data, insights and analytics to support product development and to ensure alignment of new products with the needs & challenges of elderlies

Support matching and collaboration between digital product developers and researchers & academics, who understand truly the needs of elderly population to maximize relevance of product

Provide infrastructure and services to support private sector developers to develop applications that promotes social inclusion and learning for elderlies

- Cloud-based platform as a service for software development
- Open lab facilities for startups

Design incentive scheme that support the growth of startups developing digital social interaction solutions e.g., financial & tax incentives, streamlined process for business set-up

Amend regulations to support the development of new social interaction solutions e.g., formal standards and certifications for caregivers for potential coverage under health insurance

Develop digital tools that support healthy lifestyle

- Physical and cognitive training tool and apps
- Health management apps

Develop digital tools that facilitate the search and hiring of caregivers and other services for elderlies

Develop digital tools that support elderlies to build online communities

Implementation Timeline

2017 | 2018 | 2019 | 2020 | 2021

Recommended KPI

- Number of elderlies using online community / social media
- Number of elderlies using apps that promote healthy lifestyle
- Number of new digital social interaction tools for elderlies (e.g., apps) developed locally
- Number of elderlies that employ caregivers at home

Expected Benefits

- More startups in Thailand developing apps to support aging society
- Bigger choices of products relevant for elderlies to use resulting in more adoption
- Better quality of life for elderlies
- Better health conditions with apps and tools that help maintain physical and cognitive conditions
- Elderlies connected with families and friends, reinforcing social inclusion

Ongoing Projects

- Government agencies and private companies, including large telecom players, are investing in new apps, many of which relevant for elderlies
- Thai startups have launched many online community relating to healthcare

9 Establish National Agricultural Information System (NAIS) to be the central online platform providing information for all agricultural stakeholders in the country

ISSUES & CURRENT SITUATION

Scattered agricultural data collection across public agencies

- Similar datasets are collected by different public agencies led to deviation and doubtful quality
- No single trusted data source

Access to the existing agricultural data/information

- Not all agricultural data/information are available in digital format
- Low awareness of data whereabouts

Digital literacy level of data providers and information system users

- Lack of qualified personnel to operate, monitor, and maintain the information systems
- Users, especially local farmers in the rural areas, have low IT literacy and are not aware of the importance of the data

RECOMMENDED ACTIONS

Integrate existing available agriculture-related datasets and identify additional high value data need to be further included in the forthcoming national agricultural information system

- Collaborate among public agencies to consolidate the list of available datasets / align and agree on a single trustworthy source for each dataset
- Determine missing high-value datasets needed to be further collected by various means including expert interviews, focus groups, and hackathons
- Assign responsible unit to collect additional datasets, if any

Develop a centralized online platform (NAIS) to unify Thailand agricultural data and information across all relevant databases and information systems of public agricultural agencies

- Collaborate with 3rd party IT professional to build NAIS
- Set up a team exclusively responsible for monitoring and maintaining this centralized information system and continuously update data and information by working closely with relevant organizations

Collaborate with stakeholders to raise the awareness about NAIS and establish data connectivity between organizations/units to NAIS

- Provide introduction and training about the newly established NAIS and its importance of the data to include along with obtaining buy-ins from all relevant stakeholders
- Set up plans with each stakeholder to establish connectivity of the existing databases/information system to NAIS

Promote NAIS to target users and general public

- Publicize NAIS in various media
- Provide education about NAIS to leaders in district/sub-district levels

Implementation Timeline

2017 → 2018 → 2019 → 2020 → 2021

Recommended KPI

- Establishment of NAIS
- Number of NAIS visitors
- Number of stakeholders contributing data/info to NAIS

Expected Benefits

- Centralized agricultural info system/databases for all
- Eliminating double work by public agencies
- Fostering Info/knowledge sharing culture
- Better informed farmers leads to better on-field performance
- Public agencies are more proactive in monitoring and managing data/info
- Aiding government to make better policies according to updated agricultural info

Ongoing Projects

- MOAC Agri-Map
- MOAC What2Grow
- EGA Farmer One database
- Thai National AGRIS center

10 Develop new government-led business solutions (G2B) by utilizing data and information available on public agricultural information systems and databases

ISSUES & CURRENT SITUATION

Under-utilization of data / information collected and stored in governmental databases and information systems

- Loss of opportunity to create value-added out of valuable existing agricultural datasets

Private sector in need for valuable agricultural data / information

- Private agribusinesses and organizations are often in need for certain agricultural datasets which are not possible to collected in-house but are usually consolidated by public agencies in order to make decisions
- Public agricultural agencies in need

RECOMMENDED ACTIONS

Establish an adhoc committee or assign a working team to define scope and formulate strategic plan to develop new business solutions using public agricultural data

- Recruit qualified members with expertise in assessing currently available agricultural datasets, conducting marketing research of the needs for any agricultural data by private sector, and designing business model
- Formulate strategic plan and obtain buy-ins from data owners (e.g., public agencies)

Develop and prepare resources necessary to commence the program including pilot projects

- Arrange business training programs for potential staffs who are going to handle this new project
- To pilot the initiative, select a private partner (targeting agribusiness conglomerate as first priority) and evaluate specific demand of agricultural datasets
- Collect and provide datasets to the private partner in ready-to-use format (i.e., API-ready format)
- Work with the private partner for continuous monitoring of data and service quality
- After the pilot project, share best practices and exchange ideas among the working team and public organizations to improve the setup for the actual launch

Promote the program and consider to provide tax incentives to increase private sector adoption

- Publicize the new program in various media by selectively targeting high potential private customers
- Create tax incentives and other benefits to attract more private players

Implementation Timeline

2017 | 2018 | 2019 | 2020 | 2021

Recommended KPI

- Number of the new G2B business initiatives
- Revenue generated from G2B solutions

Expected Benefits

- Best use of agricultural datasets collected by public agencies
- Assist Thai agribusiness who use the data to make the right business decision and grow
- Boost awareness on the importance of agricultural data
- Public agricultural agencies think out of the box and create new businesses

Ongoing Projects

- N/A

11 Foster startup ecosystem leveraging agricultural data and information available on public agricultural information systems and databases

ISSUES & CURRENT SITUATION

Lack of conducive environment to build agricultural startup companies

- Thailand startup community is flourishing but most of interests lie on other sectors and less on agriculture

Under-utilization of data / information collected and stored in governmental databases and information systems

- Loss of opportunity to create value-added out of valuable existing agricultural datasets

Lack of game-changer ideas in agricultural field

- Agriculture is not quite an innovative sector, compared to other sectors in Thailand
- Young and smart farmers are the development focus of the Ministry of Agriculture and Cooperatives
- Startup companies can potentially bring new ideas to improve agricultural practice and help local farmers to be more self-reliant

RECOMMENDED ACTIONS

Study international best practices of agricultural startups using agricultural data provided by public sector

- Evaluate good examples of successful private companies using public-supported agricultural data and share the ideas among public agricultural organizations

Ensure readiness of the datasets potentially used by startups

- Collaborate with the owners of the datasets on NAIS to identify high-value datasets potentially can be used to foster new startup companies (e.g., meteorological data from TMD, livestock plague information from DLD, map data from LDD), additional inputs can also be learned from expert interviews, focus groups, and hackathons
- Evaluate the completeness and quality of the datasets and close identified gap, if needed
- Collaborate with EGA to prepare the datasets in API-ready format

Establish partnerships with relevant public and private organizations to seek for and foster Thai agricultural startups

- Collaborate with NIA and other private startup incubators to develop specific campaign to nurture startup companies using agricultural data provided by the government

Continuously support and promote agricultural startups under this initiative

- Ready to collaborate with new agricultural startup that would like to try make business which requires information / data from public agricultural information system or databases
- Continuously support and help the startup companies to set up robust business after tryout period

Implementation Timeline

2017 | 2018 | 2019 | 2020 | 2021

Recommended KPI

- Number of datasets open in API-ready format
- Number of agricultural start ups which regularly use public agricultural data/info

Expected Benefits

- Foster agricultural startup companies in Thailand
- Create agricultural innovations from existing public agricultural data
- Encourage young people to involve and improve Thailand's agriculture

Ongoing Projects

- Private effort to support agricultural startups
- EGA open data initiative

12 Develop local smart farmers through knowledge and information sharing as well as educational programs

ISSUES & CURRENT SITUATION

Local farmers usually stick to conventional agricultural practices, not adaptive to environmental and market changes

- Majority of Thai local farmers are traditionalist, not adjusting themselves to the surrounding dynamics

Limited availability and accessibility of fundamental agricultural information by local farmers

- Local farmers are not fully aware of the importance of public agricultural information and their online availability
- Local farmers have limited access to the information to support their agricultural practices
- Local farmers do not know whom to contact to get information needed

Under-utilization of agricultural data on governmental databases and information systems

- Stored data and information are under-used due to absence of knowledge-sharing culture

RECOMMENDED ACTIONS

Define scope and establish a clear setup of local working team by involving local administrations to focus on disseminating knowledge and educate local farmers

- Set up local working team by involving officers from MOAC and its department, local administration officer, local leaders (including local role model farmers identified in MOAC's Smart Farmers/Smart Officers project), and other relevant stakeholders
- Define objectives and scope of the local working team together along with creating work plan (e.g., design smart farmer curriculum, prepare human capital, schedule local field visits and demonstrations)

Set up training programs for the local working team to be prepared to provide proper education to local farmers

- Ensure the accessibility to knowledge resources, understanding of NAIS and the importance of agricultural data collected and stored on it, and how to use important tools and technologies (i.e. basic PA technologies, e-commerce platform) among working team members

Launch smart farmer education program locally and ensure effective communication channels to fully engage the locals

- Execute the plans by arranging training sessions on how to use data from NAIS, field-trips to witness PA technology in action, demonstration farm visits to exchange new knowledge, and consulting services in each local area by collaborative effort of the working team
- Set up various communication channels in both active (advisory services) and passive settings (local hotline and social media page) to keep in touch with local farmers

Ensure continuous implementation by local farmers

- Create robust local farmer registration to continuously keep track, monitor the progress, and follow up with the farmers

Implementation Timeline

2017 → 2018 → 2019 → 2020 → 2021

Recommended KPI

- # of local administration having smart farmer education program launched
- # of farmers registered for local training program

Expected Benefits

- Smarter local farmers, open to new knowledge and are more self-reliant
- Higher utilization of public agricultural data/ information
- Higher utilization of technologies
- Improvement in agricultural operations through the use of information to support local farmers

Ongoing Projects

- Smart Farmer & Smart Officer - MOAC

13 Roll out PA program for small farmers nationwide

ISSUES & CURRENT SITUATION

Conventional way of doing agriculture
- Relatively low yield compare to other countries
- Inefficient use of input (seeds, fertilizers, etc.)

Low level of knowledge transfer and sharing among local farmers

Low access and awareness of new technologies among local farmers

Widely scattered ownership of land
- Small farmers are not benefiting from economies of scale
- No financial capability to invest in new technologies

RECOMMENDED ACTIONS

Select key crops to be implemented in PA program
- Select high value crops (high value for Thai economy)
- Select crops with potential to implement PA – arable crops, and large scale production requirement, etc.

Identify suitable location for PA – District/ Sub-district level with high potential for PA
- Select location that are suitable (sizable area or consolidated farms) for selected crops (e.g., S1 area for rice field defined by Land Development Department)
- Select location with potential capabilities (human capital, local cooperative, etc.)

Assign project champions & key stakeholders involved to ensure successful implementation
- Identify local leaders and team (local cooperative, university research team, local farmers etc.)
- Design clear action roadmap, role & responsibility for all key stakeholders
- Ensure engagement with local farmers – the project stakeholders should teach and communicate the benefit of PA to local farmers for continuous implementation

Roll out PA technologies in phased approach
- Roll out basic PA technologies for small and medium size farmers (e.g., humidity sensor, temperature sensor)

Provide recommendation to farmers
- Analyze collected data by local administrations in each phase and offer recommendations to local farmers

Implementation Timeline

2017 → 2018 → 2019 → 2020 → 2021

Recommended KPI

- Number of roll-out PA projects
- % of farmland utilizing PA technology

Expected Benefits

- Improvement of local agricultural network
  - Best practices and knowledge sharing
  - Collaboration of local agencies
- Understanding of PA practices by local farmers
- Increase adoption in PA by farmers
- Yield improvement
- Lower cost of input

Ongoing Projects

- "Smart Agriculture" – Thailand ICT Policy Framework (2011-2020)
- "Smart Farmer & Smart Officer" – MOAC
- Pracharat (State of the People) project: Modern farming

14 Adopt large-scale PA projects in the private sector

ISSUES & CURRENT SITUATION

Private sector has high potential for PA implementation in Thailand
- Large scale production by big private players
- Financial, knowledge, and management capability
- Potential of productivity improvement & cost management

Big players have close contact with local farmers in contract farming model
- High potential to encourage and support smaller players to adopt PA

Some level of PA has been adopted by private sectors, proving practical benefit of PA implementation

RECOMMENDED ACTIONS

Promote and raise awareness of PA to private sector through marketing campaign and communication
- Ensure overall understanding of PA technologies by private players – government ensure the availability of information and access to technologies
- Demonstrate and communicate benefits of PA to the sector through successful case studies of PA in Thailand executed by big private players

Ensure the accessibility and availability of PA technologies in Thailand
- Increase government policies to ensure fair price of PA technologies (i.e. instrument/software) in the market
- Increase tax policies to encourage PA technologies adoption by private sectors

Encourage implementation of PA by big players to drive overall adoption in the market
- Close collaboration between public and private sectors (e.g. knowledge sharing, technology supply)

Promote and support small to mid-sized players to implement PA
- Promote PA to local farmers through knowledge sharing, financial support, and implementation support by big private players
- Provide government subsidizes for medium and small players

Implementation Timeline

2017 | 2018 | 2019 | 2020 | 2021

Recommended KPI

- # of new private players adopting PA
- % of farmland utilizing PA technology

Expected Benefits

- Collaboration between public and private sectors to improve agri. sector in Thailand using PA
- Increase adoption of PA in private sectors
- Increase availability and accessibility of PA technologies in Thai market

Ongoing Projects

- Pracharat (State of the People) project: Modern farming
- "Smart Agriculture" project – Thailand ICT Policy Framework (2011-2020)

15 Roll out PLF program for small farmers nationwide

ISSUES & CURRENT SITUATION

Conventional way of doing farming
- Limited use of technologies to improve production and quality of livestock
- Low management of livestock welfare

Production and quality issues of livestock farming
- Low quality of livestock production
- Unsustainable production methods

Low level of knowledge transfer and sharing among local farmers

Low access and awareness of new technologies among local farmers

Widely scattered ownership of farm

RECOMMENDED ACTIONS

Select key livestock to be implemented in PLF program
- Select livestock with potential to implement PLF – cattle, broiler, swine, fisheries, etc.

Identify location for PLF – District/ Sub-district level with high potential for PLF
- Select location that are suitable (sizable or consolidated farms) for selected livestock farming
- Select location with potential capability (human capital, etc.)

Assign project champions & key stakeholders involved to ensure successful implementation
- Identify local leaders and team (local cooperative, university research team, local farmers etc.)
- Design clear action roadmap, role & responsibility for all key stakeholders
- Ensure engagement with local farmers – the project stakeholders should teach and communicate the benefit of PLF to local farmers

Roll out PLF technologies in phased approach
- Roll out basic PLF technologies for small-mid sized farmers (e.g., basic sensors, RFID)

Provide recommendation to farmers
- Analyze collected data by local administrations in each phase and offer recommendations to local farmers

Implementation Timeline

2017 → 2018 → 2019 → 2020 → 2021

Recommended KPI

- Number of roll-out PLF projects
- % of farmland utilizing PLF technology

Expected Benefits

- Improvement of local agricultural network
- Best practices and knowledge sharing
- Collaboration of local agencies
- Understanding of PLF practices by local farmers
- Increase adoption in PLF by farmers
- Higher production and quality of livestock
- Improvement in cost of operation and input

Ongoing Projects

- "Smart Agriculture" project – Thailand ICT Policy Framework (2011-2020)
- "Smart Farmer & Smart Officer" project- MOAC
- e-Services for Livestock – Dept. of livestock

16 Adopt large-scale PLF project in the private sector

ISSUES & CURRENT SITUATION

Private sector has high potential for PLF implementation in Thailand
- Large scale production by big private players
- Financial, knowledge, and management capability
- Potential of productivity improvement & cost management

Private players account for majority of livestock production in Thailand
- Big players have close contact with local farmers as contracted suppliers
- High potential to encourage smaller players to adopt PLF

Some level of PLF has been adopted by private sectors – proving real benefit of PLF implementation

RECOMMENDED ACTIONS

Promote and raise awareness of PLF to private sector through marketing campaign and communication
- Ensure overall understanding of PLF technologies by private players
- Demonstrate and communicate benefits of PLF to private players through successful case studies of PA in Thailand executed by private players

Ensure the accessibility and availability of PLF technologies in Thailand
- Government policies to ensure fair price of PLF technologies in the market
- Tax policies to encourage PLF technologies adoption by private sectors

Encourage implementation of PLF by big players to drive overall adoption in the market
- Close collaboration between public and private sectors (e.g. knowledge sharing, technology supply)

Promote and support small to mid-sized players to implement PLF
- Promote PLF to local farmers through knowledge sharing, financial support, and implementation support by big private players
- Government subsidizes for medium and small players

Implementation Timeline

2017 | 2018 | 2019 | 2020 | 2021

Recommended KPI

- # of new private players adopting PLF

Expected Benefits

- Collaboration between public and private sectors to improve agri. sector in Thailand using PLF
- Increase adoption of PLF in private sectors
- Increase availability and accessibility of PLF technologies in Thai market

Ongoing Projects

- Pracharat (State of the People) project: Modern farming

17 Create advanced & trustworthy digital distribution platform to connect producers and entrepreneurs nationwide with end-consumers

ISSUES & CURRENT SITUATION

Middleman problem

- Most local farmers / producers rely on middlemen to bring products from farm to market
- Put pressure on local farmer / producers on agricultural product price and customers on end-product price

Not all local producers are open for changes in marketing model and distribution channels

- Average age of local farmers is relatively high; most of them stick to conventional trading means by using middlemen

Local producers lack direct contact with target customers

- Farmers / producers are not aware of customers' real needs so they cannot adjust their production accordingly

Long product distribution cycle from farm to market

- Too many intermediate trade layers lengthen the dwell-time of the products in the distribution cycle
- Less fresh agricultural product upon reaching end-customers

Local producers lack of knowledge to start own business sustainably

- Local farmers in the rural areas usually have low IT literacy and minimal marketing knowledge

RECOMMENDED ACTIONS

Consolidate existing e-platforms: Agrimart and Ortorkor.com to develop a single online marketplace

- Design scope of the consolidated e-platform which gathers effective functionalities of Agrimart and Ortorkor.com
- Work with internal relevant public agricultural agencies and external IT partner to develop the consolidated e-platform and prepare for launch
- Continuously improve the system based on international best practices of successful e-platform

Provide marketing and ICT education for local farmers and producers directly or via local administrations

- Actively approach local producers to provide education and raise awareness of marketing and ICT knowledge in order to be capable of using digital technology to help bring their products from farm to market
- Work with leaders of local administrations on the promotion of marketing and ICT literacy in the area along with planning human resource allocation

Promote the newly consolidated platform and offering financial incentives to boost utilization

- Publicize the use cases and success stories of the existing e-platform in various media as well as local administrations to encourage local farmers / producers to use this platform

Open to support startups development of alternative online marketplace business for agricultural products

- Collaborate with and support startup companies to develop more e-platforms and seek to learn new ideas from them

Implementation Timeline

2017 | 2018 | 2019 | 2020 | 2021

Recommended KPI

- Establishment of a central governmental consolidated e-platform
- Number of visitors on the consolidated e-platform

Expected Benefits

- More smaller producers can bring their products to market by themselves
- Direct contact between producers and customers
- Shorter distribution cycle leading to fresher products
- Open up opportunities for start up companies working on agricultural product e-commerce

Ongoing Projects

- MOAC Agrimart and Ortorkor.com
- Co-opclick
- Private-developed e-platforms: FolkRice, GetKaset

18 Enhance agricultural product supply chain management by using digital technology to improve traceability, quality control, and stock management

ISSUES & CURRENT SITUATION

Stringent agriculture / food product laws and regulations

- Examples include GS1 Traceability Standard, GAP/GHP/Q Mark, ISO22000:2005, ISO22005:2007, and Regulation (EC) No 178/2002

Customers' higher awareness on food quality and origins

- Global and local trend on healthier lifestyle
- Emerging of social media has made people aware of what they consume or use more than they did in the past

Small producers lack knowledge and access to resources to upgrade their supply chain management

- Lack financial capability to adopt necessary technologies
- Unaware of the regulations and lack understanding of new agricultural product standards
- Loss of opportunity to optimize production and stock management

RECOMMENDED ACTIONS

Continue to raise awareness on traceability and quality control of agricultural products

- Create campaigns to promote knowledge and importance of traceability and quality control of the entire value chain of agricultural products for local farmers / producers and entrepreneurs
- Work with local leaders to arrange seminars or training programs to educate local farmers / producers and entrepreneurs
- Promote the importance of traceability and quality of agriculture/food products via various forms of media including social and conventional communication channels

Encourage and support small- to mid-sized agribusinesses to comply with GS1 traceability standard

- Support small- to mid-sized agribusinesses to be a membership of GS1 Thailand as a first step towards adopting traceability system

Create public-private partnerships with big agribusinesses to provide necessary technology for small- to mid-sized producers to improve their supply chain management

- Collaborate with the selected private partner to disseminate knowledge and support smaller players to adopt new technology, potentially provided by the private partner, to improve traceability, quality control, or stock management
- Determine tax incentives and other benefits to attract more big players to join this effort

Implementation Timeline

2017 | 2018 | 2019 | 2020 | 2021

Recommended KPI

- Number of SMEs having e-traceability system in place
- Number of campaign to promote traceability and quality in food products

Expected Benefits

- Better compliance with food laws and regulations
- Thai SMEs are equipped with track and trace capability
- More consistent quality of agriculture/food products
- Faster to resolve food contamination problem
- Customers understand origins of the products
- Thai SMEs can optimize production and manage stock more efficiently

Ongoing Projects

- ACFS SME Traceability Program
- Traceability Technology Center Project by RFID Institute of Thailand

19 Improve National Single Window system to boost international agricultural product trade

ISSUES & CURRENT SITUATION

Thailand has NSW in place Since 2011, Thailand has had NSW in place. However, the system has not been utilized at its fullest capacity

- Public agricultural agencies have started to established connectivity with NSW but not completely linked
- There are planned initiatives at certain departments under the Ministry of Agriculture and Cooperatives to improve the connectivity to NSW
- Lack of buy-ins form relevant public agencies to use NSW as each organization has its own means to process international agricultural product trade

Thai custom lacks qualified personnel to manage and maintain NSW computer system

- Thai Customs Department is currently responsible to manage NSW, yet lack competency to operate and maintain the system efficiently
- Lack of adequate allocated budget for NSW management

Lack of a unit to continuously develop NSW in the longer term

RECOMMENDED ACTIONS

Assign responsible unit to improve and develop fully-connected NSW system

- Identify potential public and private partnerships, define scope, and select qualified committee or set up an adhoc team to be responsible for improving connectivity of ensuring its efficient use of NSW

Complete the connectivity and information exchange between related agricultural agencies and other relevant stakeholders to NSW

- Identify which sets of data necessary for agricultural product trade via NSW are missing from related agricultural agencies
- Collaborate with the agencies to obtain datasets and ensure complete connectivity (monitor and assess implemented NSW connectivity projects)

Encourage the use of NSW for agricultural product trade

- Show benefits of using NSW to the leaders of relevant public agricultural organizations to obtain buy-ins to use NSW
- Raise awareness and provide seminars / training courses on NSW for agricultural product trade to personnel of relevant public and private organizations

Implementation Timeline

2017 → 2018 → 2019 → 2020 → 2021

Recommended KPI

- Percentage of agricultural product trade activity with paperless process via NSW
- Percentage reduction in trade processing cost incurred for agricultural product trade
- Percentage reduction in processing time of agricultural product trade

Expected Benefits

- Less processing steps for agricultural product trade
- Less documentation for agricultural product trade
- Shortened processing time
- Less trade expense incurred

Ongoing Projects

- NSW system development master plan- phase 2 by Thai Customs Department

20 Develop National Tourism Information System as the central online platform providing tourism information for institutions and public

ISSUES & CURRENT SITUATION

Macro tourism-related data are collected and digitized, yet lacking efficient integration across entities

- Each national tourism entity often develops own 'tourism repository' in discrete

Limited dissemination of tourism data and analysis to stakeholders

- Local businesses/ authorities often do not receive sufficient data/ analysis to plan tourism development strategy

"Tourism Intelligence Center" (TIC) developed by MOTS to be the central, most comprehensive data warehouse for tourism industry

- Project expected to be launched in 2017 – coordination support and data provision from relevant parties are critical

RECOMMENDED ACTIONS

Integrate existing tourism-related datasets among public stakeholders

- Consolidate available data sets among entities within the Ministry and among other public entities related to tourism
- Align on data requirements/ priorities, and determine missing/ incomplete datasets to be collected

Collaborate with private stakeholders to obtain necessary information to complete/ complement tourism 'Big Data'

- Collaborate with private stakeholders for complemented data analysis, e.g., telco providers for mobile-location analysis, social media providers for online reputation analysis, financial providers for purchase analysis
- Ensure compliance on data sensitivity/ anonymity

Enhance the integrated national tourism datasets and platform

- Develop centralized platform linking all relevant tourism info/data in standard format, ensuring data automation
- Develop intelligence dashboard accessible through online portals
- Ensure continuous updates, monitoring and maintenance of platform

Promote NTIS dashboard and encourage application of tourism data/ intelligence for institutions and general public

- Publicize NTIS in various public & private channels, highlighting Open Data, key functionalities and practical use cases
- Provide regular functional trainings among key NTIS users

Apply tourism intelligence in policy planning and management

- Priority 1: Day-to-day operational application – Seating/ capacity management, resources planning, traffic/ congestion mitigation
- Priority 2: Strategic application –Tourism area zoning, Permits/ licenses allocation, Development of new attractions, Development of new routes

Implementation Timeline

2017 → 2018 → 2019 → 2020 → 2021

Recommended KPI

- Establishment of National Tourism Information System
- Number of NTIS portal visitors
- Number of stakeholders contributing data regularly
- Timeliness and comprehensiveness of data collection and release

Expected Benefits

- Improved tourism governance & strategic planning for government and businesses, improve standardization/ quality control of tourism offerings
- Improved industry & public education on tourism market insights
- Cost & time savings by eliminating duplicated data collection/publication
- Enhanced competitiveness/ digital maturity of overall industry

Ongoing Projects

- MOTS Tourism Intelligence Center
- TAT Intelligence Center
- Digital Government Master Plan (2016-2018)

21 Foster digital ecosystem for travel and tourism startups through national tourism Open Data and travel and tourism community

ISSUES & CURRENT SITUATION

Industry fragmentation and limited opportunity for local travel & tourism startups

- Thailand tourism dominated by small and medium enterprises from accom./ retail, to transport and tours
- Lack of capability development and business opportunities for travel & tourism start-ups in the country

Underutilized government database related to travel & tourism

- Tourism data repository exists yet mostly utilized for day-to-day operations or not comprehensively open to public

Limited environment conducive for building travel & tourism start-up ecosystem

- Lack of dedicated development programs for travel & tourism focus and public-private dialogues

RECOMMENDED ACTIONS

Open specific tourism datasets to public, leveraging on national tourism database

- Identify data needs and data readiness based on public/ private/ community stakeholders forum/ hackathons
- Determine missing/ incomplete datasets to be collected based on publicly available data, stakeholders needs, and int'l best practices
- Ensure data comprehensiveness, interoperability and integrity

Develop online portal for Tourism Open Data

- Design open data interface, highlighting user-friendly functionality, simple & clear messaging/ word choice, language compatibility, and easy navigation for downloading/ uploading datasets
- Promote open feedback through immediate reviews/ rating box to allow for datasets/ interface improvements
- Ensure API integration readiness and ease of request/ application

Provide technical and financial support for tourism start-ups

- Encourage private investment to incubate/ accelerate tourism and startups by providing technical assistance through knowledge sharing, training sessions, mentorship programs, and financial assistance through grants/ tax incentives
- Identify role model/ champion travel & tourism startups to promote leading by example; encourage community-grown players
- Develop challenger program and competition for travel & tourism startup to foster global excellence and competitiveness

Promote tourism public-private-community forums/ dialogues for learning, networking and exploring collaboration opportunities

- Set up network of travel & tourism players, providing regular networking/ training sessions, benefits/ incentives, market opportunities to enhance competitiveness of the overall industry
- Promote information exchange and best practices sharing among businesses for the purpose of tourism development

Implementation Timeline

2017 | 2018 | 2019 | 2020 | 2021

Recommended KPI

- Establishment of tourism Open Data
- Timeliness & comprehensiveness of tourism Open Data
- Establishment of travel & tourism networking/ dialogue sessions
- Number and growth of Thailand-registered travel & tourism startup

Expected Benefits

- Foster travel and tourism startup companies & SMEs in Thailand
- Promote travel & tourism innovations from available data
- Encourage locals to involve and improve Thailand's tourism to promote regional development

Ongoing Projects

- Digital Government Master Plan (2016-2018)
- 20-year Digital Social & Economic Development Plan
- Startup Thailand

22 Develop national trip planning platform for one-stop information gateway for tourists

ISSUES & CURRENT SITUATION

Changing consumers' expectations
towards real-time, personalized, and on-the-go services throughout the journey

Various options for travel & trip planning through web and mobile platforms
- International notable providers
- TripAdvisor, Expedia, Kayak
- Thai applications - available yet lack users due to poor content readiness and functionality

RECOMMENDED ACTIONS

Identify data needs to develop trip planning platform covering specific segments interests
- Identify data and parameters needs, e.g., directory of attractions, locations of public restrooms, transport routes by car/ boat/ air, etc.
- Incorporate data from relevant units to develop trip planning content based on identified categories, e.g., attractions, accom., transport, etc.
- Ensure flexibility in data updates by original sources through effective back-end system, e.g. change in opening hours

Enhance content and interface for personalized trip planning
- Design tour & travel offerings based on identified data and market insights, leveraging Big Data analytics to address nationality/ culture/ segment needs
- Optimize platforms to cater to nationality and cultural preferences, e.g., Chinese-version website with language support and optimized automatic suggestions based on location of user

Develop trip planning platforms, web & mobile enabled and develop a mobile application
- Develop online platforms, enabled and optimized by web & mobile to support different devices/ operating systems and user-friendly functionality
- Develop official trip planning mobile application with tour & travel offerings information and value-added functionality – enable on-site, real-time recommendations based on interests & location

Promote adoption of trip planning platforms in origin countries, at destination, and post-trip
- Develop app-installation campaigns through offline/ online marketing channels and offering benefits incentives scheme, e.g., Free wifi access at airport upon app download and first-try
- Encourage travel reviews and active engagement through social media channels and joint public-private marketing campaigns

Implementation Timeline

2017 | 2018 | **2019** | **2020** | 2021

Recommended KPI

- Establishment of official trip planning platforms: web/ mobile portal, apps
- Number of visitors to platforms
- Number of app downloads
- Users satisfaction on overall experience and quality of content
- Ranking of trip planning platforms compared to other national sites

Expected Benefits

- Improve holistic (transport-hospitality-retail) tourism management capability through integrated trip platform
- Enhance Big Data analytics for strategic planning with comprehensive consumer data from digital engagements through trip planning/ search portals
- Improve overall searching and planning experience for tourists

Ongoing Projects

- Pracharat group D3
- TAT's Amazing Thailand application
- Tourism Authority of Thailand's Enterprise Plan (2017-2021)

23 Optimize national digital marketing campaigns

ISSUES & CURRENT SITUATION

National tourism organizations show strong competencies in developing marketing campaigns to attract tourists and business partners, with several accolades and awards received

Increasing competition, especially among ASEAN players with similar natural/ cultural offerings and value propositions – Thailand needs to consistently keep pace with changing context and develop dynamic marketing strategies

Integrated efforts in marketing and branding of Thailand as a destination can be further improved – inconsistent/ unclear tourism branding and positioning especially at regional/ provincial level, e.g. multiple mottos presented at each touch point, duplicated branding for several provinces

RECOMMENDED ACTIONS

Create awareness and promote Thailand to tourists from key origin countries through digital channels, leveraging tourism Big Data

- Leverage social data and digital engagements based on tourism 'Big Data' to develop tailored marketing and advertising contents for targeted nationality and travel segment, e.g., wedding content targeting Scandinavian honeymooners based on wedding trends
- Develop specific online marketing channels targeting each nationality and travel segment, e.g., country-specific websites, YouTube channels and social media pages with customized languages, interface, and contents for each target group
- Develop rich media tourism marketing contents across segments using multi-channel digital marketing tools, e.g., Search Engine Optimization, YouTube advertising, retargeting, social media advertising, etc.

Promote advocacy and loyalty among visiting tourists through digital channels, e.g. incentivize post-trip reviews with touching message

- Promote collaboration in joint digital marketing across stakeholders, such as public and private partnership and communities involvement
- Raise awareness on digital marketing know-hows and best practices among communities, local players, and tourism authorities through online forums and social platforms to improve business exposure and promote products innovation
- Explore partnerships with leading online players to develop joint national marketing campaigns to develop holistic online identity for Thailand tourism, e.g., over-the-top chat providers (facebook, LINE), e-commerce (Amazon, Alibaba), blogs/ forums (Pantip, TripAdvisor), etc.

Actively monitor and analyze travel reviews and feedbacks on online media to develop timely action plan and response

- Use 'social listening' tools (tracking of online engagements) to monitor real-time online sentiments on the image and perception of Thailand tourism, e.g., diagnostics of search terms on Thailand, positivity/ negativity of social media conversations
- Leverage of real-time online sentiments analysis to develop responsive action plan (e.g., post natural disaster) or to enhance competitiveness (e.g., losing market share in medical tourism to neighboring countries)

Implementation Timeline

2017 | 2018 | **2019** | **2020** | 2021

Recommended KPI

- % improvement in reach & conversion
- % improvement in ROI of each country-specific and segment-specific campaign
- # world ranking in WEF's Travel & Tourism Competitiveness Index on "Effectiveness of Marketing & Branding to Attract Tourists"

Expected Benefits

- Improve Thailand's positioning and branding in tourism landscape
- Improve effectiveness and budget allocation of digital marketing campaigns
- Enhance Big Data analytics for strategic planning with comprehensive consumer data from digital engagements

Ongoing Projects

- TAT's Amazing Thailand campaigns
- TAT's 'Preferred Destination' branding

24 Develop digital solutions to promote experience enhancement at attractions

ISSUES & CURRENT SITUATION

Heavily rely on natural and cultural attractions without value added, resulting in low revenue creation and a risk of unsustainable attractions

- Cultural attractions are offer "as-is" with static story presentation such as information board at attraction
- Some digital enhancement is available in private attractions, yet lagging behind regional leaders

Concentration of tourists in key attractions heavily reviews by previous tourists

- Limitation of attraction information and lacking available portal for tourist to search and navigate have contributed to tourist concentration problem to only a few attractions already in spotlights

RECOMMENDED ACTIONS

Evaluate and design development plan for attractions with potential for digital enhancement

- Arrange workshop and focus group with owners and stakeholders of key attractions, such as temple, museum, entertainment and activity, to assess the readiness of each sector to integrate digital solution for additional value creation
- Layout development plan prioritizing attractions with high potential under close collaboration of public and private entities

Enhance the existing information and media offerings at attractions to improve the richness and attractiveness of attraction's story

- Develop Smart and IoT technologies such as smart display, smart kiosk, interactive screen and wall, etc. to deliver richer information and media for tourist
- Develop location-based audio guide tours or app with multiple languages to add flexibility to traveling experience
- Collaborate with existing mobile application or feature to better deliver personalized experience such as personalized push notification from Beacon, IoT, NFC, etc.

Develop interactive/virtual technology to deliver vivid and engaging experience

- Develop Augmented reality/Virtual reality media onto attraction such as cultural site or royal palace to better showcase the unique proposition and history of attraction
- Develop mobile application for visitor allowing visitor to easily view the Augmented reality on individual smartphone
- Integrate social media into traveling experience such as posting, liking and sharing, suggesting to friend, participating in real time activities
- Promote Thailand tourism in foreign country using Augmented or Virtual reality for immerse experience

Promote digital literacy among tourism business/ operator and travel guide to support digital experience creation among tourist

Implementation Timeline

2017 | 2018 | **2019** | **2020** | 2021

Recommended KPI

- Number of attraction with digital enhancement (Smart Display/ AR/VR)
- % Spending increase at Smart POIs
- Improvement of positive review in key attractions
- Number of mention/post/share of Thai attractions in social media

Expected Benefits

- Improve positive online positive reviews, boost attractions popularity
- Improve offline word of mouth, especially when peer referral is the main source of tourism information
- Increase value of the attraction through experiential presentation of story and history of attraction
- Enhance tourism competitiveness

Ongoing Projects

- "See Thru Thailand" AR traveling app to search and navigate to key attractions in Thailand by SIPA
- Bangkok Planetarium deployed digital semi-dome "Digistar" for unique experience of star and planet
- TAT's rare Pokemon Go character in 12 Hidden gem cities to attract tourist in second tier attractions

25 Develop digital solutions to improve and facilitate tourist mobility

ISSUES & CURRENT SITUATION

Digital service in Thailand is widely available, yet only limited in key cities

- On-demand transportation apps. (Uber, Grab) are gaining strong presence in Thailand, yet services are available only in key cities and not across cities
- Nationwide transportation service such as Train/ Bus/Van lack comprehensive schedule

Most transportation modes only offer Thai service and do not support online scheduling or pre-booking ticket

Comprehensive national transportation information is not available

RECOMMENDED ACTIONS

Develop Smart Transport web portal and app for tourists with real-time, integrated transport information, navigation and e-booking functionality for domestic travel

- Establish the infrastructure ready to service real-time transport information sharing such as GPS tracking on vehicle and Comprehensive tracking server
- Create the official online platform for transport information for tourists, integrating different modes of transportation such as bus, train, boat, etc., covering different geography (from Chiang Mai to Phuket), and operated by different operators (MRT, BTS, SRT, Transport Co. etc.)
- Collaborate with existing provider of transportation and navigation technologies and application to integrate with developed portal for seamless functionality
- Develop real-time information push notification to the platform to keep its user update of change in his travel plan such as train delay, road closed for construction, etc.

Incorporate speech to speech translation technology to assist the tourist throughout traveling experience

- Establish public and private partnership to optimize existing translation technology and to make the service integrable to various services such as transportation and emergency

Promote digital literacy among tourism officers and general citizens to become facilitator and good host

- Raise awareness and provide trainings for service staffs along tourist touch-points to be knowledgeable and digital literate in order to assist tourists when needed

Promote innovation among local SMEs and startups to facilitate the growth of Smart Tourism Destination Thailand

- Support local SMEs and startups with capability building and financial incentive to innovate digital technology that has the potential to improve Thailand tourism industry

Implementation Timeline

2017 | 2018 | 2019 | 2020 | 2021

Recommended KPI

- Number of Smart Transport app users
- Number of participating transportation companies
- Number and quality of travel advices
- Accuracy of real-time info. (delay, etc.)
- Satisfaction of tourists and residents

Expected Benefits

- Improved convenience and peace-of-mind for tourists during travels
- Increased access to and for Thai communities with reduced language barrier between locals and travelers
- Cost savings from digitalizing transport/ financial/ translation services
- Improved efficiency in tourism management and city planning/ monitoring with digitalized platform

Ongoing Projects

- MRT app shows the underground route from one location to another
- "Mang Moom" Single Ticketing of BTS, MRT, APL is expected in 2017 after the postponement from Aug'16

26 Develop digital solutions to facilitate transaction at destination

ISSUES & CURRENT SITUATION

Cashless payment is emerging primarily from collaboration between transit payment portal and telecom providers

- Transportation, telecom companies, financial institutions, financial processing services are actively developing alternative payment initiatives

Foreign providers are tapping into Thailand financial payment industry

- Chinese providers such as WeChat and Alipay are gaining presence in Thailand amidst significant growth of Chinese tourists

RECOMMENDED ACTIONS

Collaborate with local and international financial service providers to promote secure and convenient e-payment solutions for tourists

- Design collaboration model among different service providers in cashless initiative, which includes financial institutions (domestic and international), financial processing services, transit payment services, telecom provider, digital payment providers, etc.
- Closely collaborate with existing online/mobile payment providers to assess the potential to offer the service to foreign visitors
- Collaborate with local telecom providers to assess the attractiveness and the potential to develop NFC-enabled SIM card for tourist

Educate and encourage tourism business to participate in cashless society program with online POS

- Assess the readiness of the business model and providers to integrate online/mobile payment portal into operation, by determining the potential, current development status, normal business model, ICT readiness and other relevant topics
- Encourage business partnership among current online/mobile payment provider and the ready tourism businesses
- Arrange workshop for tourism business and entrepreneur regarding the structure, the benefit, the precaution and other relevant topics of cashless payment program

Encourage local startups and SMEs in the development of Fintech solution for tourist

- Support the development of Thai-based Fintech solution for tourist, with financial incentive, technical capability, supporting regulations, etc.

Actively promote the use of online/mobile payment alternative to tourist

- Launch marketing campaign to encourage more use of online/mobile payment alternatives

Implementation Timeline

2017 | 2018 | 2019 | 2020 | 2021

Recommended KPI

- Share of online/ mobile transaction
- Number of tourism POS accepting online/mobile payment
- Number of tourist applying for NFC-enabled SIM card

Expected Benefits

- Improve financial transaction convenience
- Increase security to financial transactions at destination
- Ease out currency conversion trouble
- Increase the ability for the government to obtain insights about tourist spending behaviors to further leverage in devising tourism strategy
- Improve the sales for local business who participate in cashless program

Ongoing Projects

- AIS mPay Rabbit SIM card enable user to pay BTS fare and dedicated retail store through NFC portal
- "Prompt Pay" program initiated from various commercial banks allows user to perform financial transactions through mobile

27 Develop integrated and intelligent public surveillance system with nationwide coverage

ISSUES & CURRENT SITUATION

Scattered development of surveillance system across public entity and across provinces

- Local administration is responsible for safety and security in the area, yet allocated budgets vary for each administration
- Most of the systems, which are privately owned, are not accessible by public security officers

Poor equipment quality obstructs investigation

- Low quality CCTVs prohibit license plate or face recognition
- Most installed CCTVs are for monitoring purpose on analog system without recording ability

Most equipment deployed are responsive technology without proactive detection capability

RECOMMENDED ACTIONS

Run comprehensive analysis and evaluation of existing public CCTV systems

- Evaluate as-is system to find critical point of development
- Identify damaged, depreciated, under-utilized, and unconnected CCTVs for improvement
- Evaluate the network capability, such as the readiness of coaxial cable portal, LAN line, Fiber Optic or Wi-Fi coverage

Identify Hot Spots attractions, crowded areas, and important establishment in need of constant surveillance

- Use population density, visitor counts, number of household or heat map of crime occurrence as a criteria of CCTV installation
- Prioritize areas in need of installation based on as-is evaluation and sensitive areas

Roll out CCTV surveillance installation program and VDO analytic system in prioritized areas

- Evaluate the suitable hardware and software architecture in each location that is compatible with existing establishment
- Set up Coaxial line, LAN line, wireless router, and other enabling infrastructure to accommodate the operation of CCTV system
- Develop cloud server for CCTV media centralization, of which partially is accessible by general public in real time
- Install VDO analytic system in suitable CCTV server to help detect and alert abnormality in real time

Establish and Encourage private participation

- Establish private partnership campaign in the investment of CCTV in private premise overseeing to public area which is readily available for police monitoring in real time
- Encourage private participation with financial subsidize for CCTV investment in private premise benefiting public area

Implementation Timeline

2017 | 2018 | 2019 | 2020 | 2021

Recommended KPI

- % of CCTV coverage
- Number of connected CCTVs to central security server
- Case resolved with the help of CCTV

Expected Benefits

- Reduced potential of crime and accident throughout the nation
- Early detection of suspicious objects and individual for preemptive protection
- Better capacity management and accident prevention
- Increased chance of successful investigation and execution
- Enhanced safe and secured atmosphere in tourist attractions
- Faster response and better facilitation

Ongoing Projects

- Phuket Smart City project: planned to invest in up to 2,000 CCTVs and centralized command
- CCTV installation in key attractions
- Ratchapraong comprehensive safety and security model for tourism area

28 Establish Convergent Command & Control center with intelligent capability for effective prevention, detection, response and recovery for tourist

ISSUES & CURRENT SITUATION

Emergency units often have stand alone database and command center

- Police department, Fire department, and Emergency medical unit operate on different platform and have different hotline where centralization initiative to command center of 3 emergency departments is still on-going

On-field officers are equipped only with trunked radio for voice communication

- Patrol and Responding units are equipped with trunked radio for voice and data transmission

Shortage of patrolling and on-field officer resulting in late response

- Police and Tourist police are in shortage as reflected in several volunteering initiatives in key tourist attractions

RECOMMENDED ACTIONS

Encourage and support digitization of data among emergency units to facilitate real-time info. sharing

- Establish record keeping protocol and system among emergency unit database to facilitate database centralization
- Encourage Police department, Fire department, Medical department to keep information and record in digital format on a single database within the unit

Design and layout data integration policy and architecture among emergency units

- Design the policy governing operation, cooperation, scope of responsibility, level of information share, and committee in charge of the centralized database
- Design ICT architecture by referring to the cooperative relationship of the 3 emergency units

Establish secured datacenter and cloud server dedicated for Convergent Command Center

- Develop secured API-enable cloud server for authorize emergency units
- Set up data integrating platform to collate relevant information from all emergency units
- Establish engineer team/department to maintain and improve the datacenter, cloud server and facilitating platform

Integrate analytic platform to assist surveillance and decision making process

- Set up intelligent system to help detect suspicious individual or activity by allowing the system to access media feeds from CCTV footage and the centralized database
- Improve communication portal with on-field unit using computer aided system which enable real-time communication of useful information and command from Convergent Command Center

Continuously train and develop the skill in emergency/security officers to best optimize the potential of new system

Implementation Timeline

2017 | 2018 | 2019 | 2020 | 2021

Recommended KPI

- % of local administration with centralized security command
- Time elapse of 1st responding unit
- Number of security and emergency officers trained

Expected Benefits

- Faster and more effective response to emergency and incident with centralized call center and readiness of information to assist in response and rescue task
- Tourist can rest assure of safety throughout the journey with availability of comprehensive security throughout Thailand
- Increase efficiency to emergency unit with automation system
- Limiting potential of loss with predictive system

Ongoing Projects

- "Digital Police" high-tech patrolling unit program will equip police and vehicle with camera and tablet connected to command center
- Centralized emergency call center to "911" which can direct to police department, fire department and medical department

29 Establish intelligent emergency alert system and application for warning and assisting tourists in critical situations

ISSUES & CURRENT SITUATION

Scattered emergency alert platform with National Disaster Warning

- Each entity establish different portal to report emergency e.g., Tsunami alert from meteorological, Terrorism and severe crime alert from Royal Thai Police
- Alert is distribute to local administrative to warn residents in responsible area

Warning and alert are in the form of TV broadcast, SMS and radio broadcast

- Alert is in the form of breaking news or special announcement through TV where first urgent message often come in Thai language and later in English
- Social media is often the first source of most updated information e.g., news agency twitter account, Facebook post, etc.

RECOMMENDED ACTIONS

Evaluate the readiness and effectiveness of existing emergency detection and alert system

- Evaluate the readiness of existing natural disaster detection and warning system; including flood, tsunami, land slide, fire, storm, earthquake, etc.
- Establish dedicated channel to report and warn of human-inflicting emergency such as crime, major accident, terrorism, protest, civil unrest, etc. capable of processing crowd-sourced inputs

Establish and strengthen collaboration of public and private entities for emergency management and cooperation

- Strengthen real time communication and automate alerting system between detection agencies and public warning agencies to improve time elapse from detection to action
- Establish PPP connecting private sectors with infrastructure capable of reaching large number of people for effective warning procedure; such as location-based push alert sent through cellular network which requires collaboration of telecommunication providers
- Develop inclusive warning message that take into account non-Thai speaking and people with disabilities such as English warning and Audio alert sound

Develop single warning alert app for both foreign visitor and resident

- Aggregate warning from various entities into single mobile app
- Apply real time translation functionality
- Develop location-based notification to user of the app in critical area
- Promote and encourage app installation, especially for foreign visitors such as including the app with tourist SIM card installation

Develop emergency-proof warning system leveraging on technology

- Develop wireless emergency alert system which pushes alert to phone through special cellular network which avoids signal congestion, ensures coverage of alert message during disaster time, and does not depend on internet connection

Implementation Timeline

2017 | 2018 | 2019 | 2020 | 2021

Recommended KPI

- % of disaster detected and warned
- Number of emergency app installation
- % of people in critical area receiving the alert

Expected Benefits

- Reduce loss of property and lives through early detection of threat and assistive information for evacuation and preparation process
- Reinforce safety and security atmosphere for tourists with availability of warning app and crowd reporting capability
- Enhanced and more efficient national emergency management system with timely detection and warning made available by technology

Ongoing Projects

- Scattered development of emergency warning system at some critical locations such as beaches and waterfalls
- National Disaster Warning Center under MICT offer natural disaster warning through website which relies information through public media

30 Develop preemptive immigration and border security system to foster security, facilitate arrival flows, and improve efficiency

ISSUES & CURRENT SITUATION

Thai Immigration 24/7 Center (TIC) was established in 2016

- Centralized immigration center which integrates data from Advanced Passenger Processing, Black list, Case management system and Interpol list across land, water and air border

Information about incoming visitor is not readily available at the Immigration Bureau

- Ministry of Foreign Affairs is in charge of issuing and keeping record of visa but the information is not readily connected in real time to the Immigration Bureau for validity check at border

Fairly integrated Airport Information Management System

- Large international airports are equipped with backbone system integrating 45 other systems to a single unit

RECOMMENDED ACTIONS

Evaluate the completeness and Support the completion of TIC and Advanced Passenger Processing system (APP)

- Develop Advanced Passenger Processing system in other international airports/international border additional to those already developed

Build automate immigration gate using biometric identification throughout the key airports, and later on to all international airports and borders

- Establish database of biometric traits such as face, iris, fingerprints of incoming visitors to build database
- Integrate biometric record from Visa issuance to immigration TIC for arrivals identity check
- Develop and Implement automate immigration gate for selected low-risk nations or frequent visitors at major airport to facilitate immigration process

Integrate intelligent system to the foreign visitor database and watch list to strengthen detection and pre-arrival screening

- Integrate central intelligent system that helps detect any suspicious incoming visitor through multi-dimension dataset surrounding the visitor identities
- Open partial data accessibility for Thai Royal Police and Tourist Police for swift response to any illegal or suspicious individual

Enhance security system at the airport and integrate intelligent and predictive system which links to the TIC database

- apply facial recognition application to match individuals in airport or other key areas with the watch list
- Behavioral mal-intent predictive system can be further developed once the infrastructure and capability are suitable

Strengthen international relationship and collaboration for information sharing

- Strengthen relationship with key incoming countries and outgoing destination to facilitate passenger information exchange
- Strengthen collaboration with international security entities such as Interpol to establish comprehensive and up to date international watch list

Implementation Timeline

2017 | 2018 | 2019 | 2020 | 2021

Recommended KPI

- Number of airports with pre-screen and automate immigration gate
- Time elapse at immigration

Expected Benefits

- Enhanced safety and security at the border through preemptive action in pre-screening system
- Better facilitation for welcomed tourist through availability of automated gate immigration
- Higher efficiency and accuracy in immigration procedure through the use of automate immigration gate and advanced passenger processing system
- Stronger international relationship through collaborative partnership

Ongoing Projects

- Advanced Passenger Processing System has been introduced in 7 Airports under AOT
- Biometric system has been in discussion of Thailand Immigration Bureau for immigration improvement, and of Royal Thai Police or proactive crime detection

31 Set up and meet new broadband speed and coverage targets to facilitate initiatives across the 3 sectors

ISSUES & CURRENT SITUATION

4G / LTE coverage and speeds are lacking behind other nations globally

- In 2015, coverage and speed was only at 58% and ~11 Mbps respectively
- A factor for the low adoption of 4G, only 9% of the population is connected to 4G (2016); behind neighbors Malaysia (22%) and Singapore (75%)

Low fixed broadband penetration rate (in contrast to mobile penetration)

- Penetration is only at 39% of households (2015), behind many ASEAN nations
- Due to 3 main factors in coverage, speed and affordability, penetration is highly concentrated in key municipal areas

RECOMMENDED ACTIONS

Improve overall broadband infrastructure to facilitate digitalization of the 3 sectors

- Invest in international connectivity capacity
- Continue to roll-out 4G to improve broadband speed and network quality
- Invest in fixed broadband to reach more households, especially "last mile" investment in rural areas

Develop roadmap and implementation plan based on order of priorities

- Aging society: initiate with community hospitals, general hospitals and regional hospitals
- Agriculture: areas of high agri-tech adoption
- Tourism: key areas of primary tourist cities (airports, attractions, hotels and restaurants)

Support adoption of broadband by priority sectors such as farmers, schools, hospitals

Ensure accessibility to broadband and affordability of broadband to low-income households

- Ensure availability and access to affordable devices to connect to broadband services e.g., cheaper smart phones

Engage with key stakeholders to align 4G mobile and fixed broadband roll-out strategy

- Strategize and align roll-out strategy and priority with relevant agencies and service providers

Overlook roll-out and upgrade of infrastructure

- Ensure necessary installations and upgrades are made according to plan
- Closely monitor KPIs nationwide to track progress
- Identify and provide feedback on potential areas for further improvement

Implementation Timeline

2017 → 2018 → 2019 → 2020 → 2021

Recommended KPI

- For Mobile and Fixed broadband:
  - Population coverage %
  - Avg. & max. download speed in priority areas
  - Penetration %
  - Avg. price and ARPU

Expected Benefits

- Improved internet experience in key priority areas
  - Significantly improved internet coverage and speeds
- Better affordability, thus larger penetration rates
  - Increased penetration rate (especially in city-peripheral and rural areas)
  - Decreased subscription prices and ARPU of providers

Ongoing Projects

- Thailand Internet Gateway Infrastructure Development
- National Broadband Network

32 Encourage further expansion and adoption of government cloud services (G-cloud)

ISSUES & CURRENT SITUATION

Despite being the 2nd largest economy in SEA, Thailand's cloud 'readiness' is below the median

- Thailand has only 4% of data center space with only 14 domestic data centers to leverage (12 in Bangkok)
- Majority of data centers in Thailand are private-owned; the government recently cancelled its plan to build USD 1.23 bn 'National Data center

Government has set up a government cloud service platform (G-cloud)

- all Ministries are currently using the G-cloud services for storing some of their data sets, but many information deemed confidential and high-risk are still stored in ministries own platforms

RECOMMENDED ACTIONS

Design incentives and regulation to encourage more adoption of G-cloud by government agencies

- Design incentives systems to encourage government agencies to increasingly adopt G-cloud services e.g., rewards to government agencies who use G-cloud services the most
- Consider developing regulation that requires certain government agencies to use cloud services to store certain data sets
- Consider developing regulation that requires certain government agencies to consider cloud as the first option when upgrading ICT infrastructure for data storage

Enhance quality of government cloud services through continuous infrastructure improvements and upgrades

- Benchmark quality of government cloud services with services provided in international best practice countries to identify gaps for improvement
- Upgrade technology continuously and collaborate closely with world-class cloud service providers

Engage with government agencies to understand concerns regarding G-cloud service to identify key areas of improvements

- Engage with current users to understand any pain points with current G-cloud service
- Engage with units and departments who do not use (or use very little) the G-cloud service to understand concerns and obstacles

Continue to promote awareness and understanding of benefits of G-cloud

- Build awareness and understanding of G-cloud among more government workers to encourage use
- Communicate and emphasize the benefits of using cloud to government agencies

Implementation Timeline

2017 | 2018 | 2019 | 2020 | 2021

Recommended KPI

- # of systems in G-cloud services
- Capacity of G-cloud services
- Satisfaction with G-cloud services among users

Expected Benefits

- **One consolidated cloud infrastructure for governmental institutions for ease of KM**
  - Integrated platform for:
    - Data storage
    - Systems
  - Improved accessibility to data
  - Strengthened cybersecurity
  - Reduced cost per unit for cloud storage

Ongoing Projects

- Reformation of National Research and Innovation structure 2016
- TH e-GIF project
- e-CMS project 2016

33 Design new regulation and incentives to encourage adoption of cloud services by businesses and individuals

ISSUES & CURRENT SITUATION

- **Thailand ranked 10th in Cloud Readiness Index** 2016 by Asia Cloud Computing Association (ACCA) among 14 countries in Asia Pacific, where International Connectivity and Freedom of Information are the lowest scoring elements
- **Several cloud infrastructures/services for business are offered by a collaboration of local telcos and international ICT providers** such as AIS Business Cloud under cooperation of AIS and Microsoft, True Internet Data Center partners with Google, Amazon and Huawei to offer one-stop solution of cloud service – new data center is to be built in Eastern Seaboard in cooperation with US-based Switch
- **Incomprehensive law and regulation on data security and privacy protection** hinders private investment and utilization of cloud service

RECOMMENDED ACTIONS

Enhance cybersecurity through improved law & regulation on data protection & privacy to build confidence among multinational companies in the security of cloud services offered in Thailand
- Improve law and regulation on cybersecurity to be in line with international best practices
- Enforce strictly cybersecurity law and regulation to ensure measures are taken by providers to protect security of data
- Build awareness of the improved law and regulation and focus on communicating the improved cybersecurity to multinational firms

Support businesses, especially SMEs and startups to adopt cloud services Consider providing subsidies to encourage adoption
- Offer cloud services as part of incentives given to startups and SMEs in priority sectors e.g., offer platforms for startups to develop applications on
- Offer free trials of selected products to potential users
- Provide advice to clients to support selection of suitable packages, and provide continuous assistance/advisory to users

Develop National Registry of cloud service providers for potential users to be able to easily view and select offerings

Promote cloud services in Thailand to Thai and multinational companies to encourage adoption of cloud services
- Promote awareness and understanding of cloud services to Thai private sector and the general public
- Highlight benefits of cloud services to companies in Thailand including startups and SMEs highlighting cost efficiency and flexibility
- Collect and promote successful adoption cases
- Emphasize the world-class quality and benefits of using cloud services in Thailand to multinational firms looking to expand operation in the region – use international conferences as a channel

Diversify offerings to increase relevance of cloud services
- Provide variety of SaaS, PaaS and IaaS packages
- Offer variety of packages catered for needs of different industries
- Offer packages designed for needs of SMEs and Startups

Enhance quality of cloud services through continuous infrastructure expansion, improvements and upgrades

Implementation Timeline

2017 → 2018 → 2019 → 2020 → 2021

Recommended KPI

- Number of providers of public cloud services
- Number of users of public cloud services
- Total capacity of public cloud services offered

Expected Benefits

- More cloud services offered
- More Thai companies use shared public cloud platforms
- Increase use of Thai public cloud services by multinationals
- Improved competitiveness of Thailand in cloud services
- Growth of startups and SMEs that use cloud platforms to develop new innovative applications and services

Ongoing Projects

- SUPER NAP expected to launch in Q1 2017 – biggest data center in Thailand
- NETPIE Nationwide cloud network platform for IoT connectivity by NECTEC
- AIS and TRUE cloud solutions for businesses and SME
- Several corporate-scale cloud provider e.g., NEC, Fujitsu, Microsoft

34 Develop platform to serve and strengthen the startup ecosystem

ISSUES & CURRENT SITUATION

Startup-funding in Thailand only represent 3% of ASEAN
- Given the recent 2-3X CAGR, total funding amount significantly lacks competitiveness
- The previously absent culture of VCs in Thailand is developing though number of deals is still small

Competition to become a startup hub is strong in the region
- Namely, Singapore, Malaysia, Indonesia and Vietnam are building up effort to strengthen their ecosystem, predominantly in financial incentivisation of startup enhancing structures

Lack of startup community to foster knowledge sharing and supportive business development
- Startup in Thailand often work at home or in independent premise and lack access to expert mentorship

RECOMMENDED ACTIONS

Develop grassroots activities and training program to support the growth of local startups e.g., incorporating a business, developing business model, applying ICT/ digital tools, etc.

Develop acceleration and incubation programs to support startup growth which are easily accessible for startups nationwide
- Collaborate with existing acceleration and incubation platforms to expand the platform throughout the nation
- Support establishment of new acceleration and incubation platform with financial and operational incentives

Design and develop startup nurturing platforms
- Design the structure of the program and the viable business model under collaboration with universities and private sectors
- Study international best practices and apply relevant learnings in the establishment of the program

Establish startup mentorship program to provide support for startup growth
- Encourage industry experts, IT expert, researcher, and successful startups to join the program through various incentive e.g., compensation, selective high potential audience, branding and marketing
- Integrate mentorship matching platform onto the startup platform to create accessibility for startups in the program

Develop nationwide startup nurturing facilities/incubators providing the necessary physical and operational supports for new business
- Evaluate the availability, capacity, relevancy of current offerings of startup facilities by both public and private sectors
- Enhance the capability of existing Software Park to meet the need of startup e.g., co-working space, meeting and conference room, administration assistant etc.
- Collaborate with ICT providers to offer relevant IT infrastructure/ service for startup in the incubating program e.g., Cloud and Broadband infrastructure, Datacenter

Develop and encourage private company participation in startup platform
- Develop platform for private sector to seek innovative service from startups
- Attract more private funding in startup acceleration and incubation program

Implementation Timeline

2017 → 2018 → 2019 → 2020 → 2021

Recommended KPI

- Number of new locally-developed startups
- Number of startup nurturing facilities/incubator
- Value of startup funding
- Number of mentors available in startup community

Expected Benefits

- **Solid positioning of Thailand as a startup hub in ASEAN**
  - Comprehensive and strong public support towards startups
  - Large increase in number of startups and innovations
  - Improvement of startup environment 'friendliness' by streamlined processes
  - Supports of the commercialization of new innovations

Ongoing Projects

- Pracharat SMEs Startup & Social Enterprises initiative
- Government policy support for SMEs

35 Strengthen national R&D efforts and capabilities through development of personnel, facility, and collaborative financing scheme

ISSUES & CURRENT SITUATION

Thai government GERD spending ratio is low, jeopardizing opportunity for new innovation

- GERD spending is at ~0.5% of GDP, with the majority (>70%) injected into public-driven R&D
- Funding has also been heavy on fundamental research and decentralized, causing duplicate investments

National R&D capabilities are inadequate with limited private-sector collaboration

- Many private firms have been conducting R&D work abroad
- Example factors behind the shortcoming include:
  - Limited availability of cutting-edge technology (score for 'latest technology' availability is >30% points short of developed countries)
  - Lack of post-graduate degree enrolment

RECOMMENDED ACTIONS

Build the nexus of knowledge in R&D of digital technology across the nation

- Establish researcher mobility program/grant for local researcher to transfer to different region/country research facility to cultivate and exchange knowledge
- Facilitate foreign researcher and research team to be based in Thailand with various incentives e.g., waive of personal income tax, relax of work permit and Visa, etc. to bring in new knowledge, technology, and capability to local researchers

Build infrastructure to support R&D of digital technology

- Develop research institutions under public and private collaboration where research outputs aim to solve the current challenges faced by the private sponsor
- Establish R&D facility cluster across the nation i.e. research and technology special zone, to foster knowledge sharing and convenience through proximity

Incentivize investment of private sectors in research and support high impact R&D

- Allocate public funding on R&D to key technology and industry that yield high impact to national development e.g., Datacenter and Cloud technology which are essential for startup and SMEs growth
- Support private sector involvement in public R&D initiative through effective government funding scheme e.g., public research institutions can apply for government funding with certain percentage of investment from private companies (20-30% of total research program is sponsored by private company)

Implementation Timeline

2017 → 2018 → 2019 → 2020 → 2021

Recommended KPI

- Number of research per citizen
- Capacity of nation-wide research facility
- Amount of public and private funding in R&D
- Number of foreign researchers and personnel

Expected Benefits

- **Increased rate of 'digital' innovation along areas of focus**
  - Increased number of publications, citations, patents and spin offs
- **Centralized specific 'digital' R&D topic research hubs**
  - Strengthened in-house research capacity and capability
  - Increased private-sector collaboration, and hence, improved commercialization
  - Limited duplications for R&D funding in the same topic
- **Reinforced IP/data rights**

Ongoing Projects

- Pracharat 300% R&D
- Pracharat Education Initiative

36 Develop innovation as a service by universities and research facilities for private sector

ISSUES & CURRENT SITUATION

Limited budget of public sector

- Financial limitation of each public agency hinders possibility to develop new digital solutions
- Private sectors are reluctant to invest or sponsor in R&D, most think of R&D as cost rather than investment to foster new innovation

Low impact and quality research outputs

- Research outputs are not practical to solve real-life challenges and thus missing the value to private company to fund
- Loss of opportunity to apply researched innovation to add value for business offerings and operations

RECOMMENDED ACTIONS

Design collaboration program between university/research facilities and private sectors

- Evaluate the high impact industry where R&D can have critical impact e.g., Agriculture, Healthcare, Technology, Automotive etc. for the development of collaboration program
- Study international best practices on collaboration model and potential offerings in digital technology field

Incentivize participation from universities/research institutions and private sectors

- Evaluate and select university with potential for innovation service commercialization, especially those with adequate capability and infrastructure to deliver the service
- Support universities/research facility with financial incentive and flexibility in administration procedures to encourage participation
- Support private sectors to participate in the program e.g., tax incentive from the investment to the program

Promote the program across the nation focusing on universities/ research institutions with digital technology capability and large private corporations

- Arrange workshop to showcase and match universities/research innovation service to MNCs and large Thai corporations
- Enhance universities/research institutions online channel to communicate the innovation and offerings the institution is capable of

Implementation Timeline

2017 → 2018 → 2019 → 2020 → 2021

Recommended KPI

- Number of collaboration programs
- Number of participating universities/research institutions and private companies
- Number of new innovation developed in the program (potentially measured by the number of patent granted or the number of new product/service from private sector)

Expected Benefits

- Unlock public sector's budget barrier to certain level
- Make the best use of public expertise to foster new and practical digital technology
- Expedite the development process by involving private sector

Ongoing Projects

- Pracharat initiatives
- MOUs signed between public agencies and private companies

37 Include coding lessons in primary & secondary schools, and improve interest in sciences, technology and ICT subjects among students

ISSUES & CURRENT SITUATION

Low level of programming literacy among Thai citizens
- Most are digital technology users but not developers
- Loss of opportunity to develop new domestic digital innovations

Awareness on the importance of coding knowledge
- Majority of Thai students are eager to learn about coding
- Higher qualifications required from employers including programming capability

Lack of robust central coding curriculum in Thailand

RECOMMENDED ACTIONS

Design standard coding curriculum to be used in primary and secondary schools nationwide
- Co-develop standard syllabuses of coding courses for primary and secondary education, including standardized examination
- Arrange focus groups with teachers and industry experts, and hold public hearing session to incorporate results into design of syllabus

Prepare teaching personnel for coding lessons
- Evaluate the existing capability and competency of the existing personnel in primary and secondary schools across the nation, identify needs and gaps
- Develop training program for coding and train the existing personnel for immediate use along with recruit new teachers qualified to teach coding classes per local needs (with potential incentives to attract the candidates)

Develop IT infrastructure in schools to facilitate coding and general ICT education
- Allocate budget for computer and necessary software purchase in schools nationwide
- Ensure proper operation and maintenance of IT infrastructure in schools

Set up remote learning program for coding to educate students in schools with no access to qualified coding teaching personnel
- Identify areas without adequate qualified teaching personnel
- Use remote learning to teach coding in these areas e.g., video tapes of classes

Raise awareness and understanding of coding among the general public
- Promote the importance and advantages of taking coding lessons by using various media, targeting not only students but also parents
- Arranging competitions focusing on coding to sustainably expand the talent pools

Promote continuous improvement in the quality of sciences, technology & ICT education
- Engage regularly with experts/employers to align syllabus with evolving industry requirements
- Add more practical elements and real-life examples to courses, on top of theory

Promote awareness and interests in sciences, technology and ICT-related careers among secondary school students
- Promote private sector to work with schools to promote careers related to sciences and technology e.g., special classes, visits to workplace, work experience programs

Encourage private sector to offer programs to develop talent in sciences technology and ICT from school age
- Offer various special training courses for students with strong interests in specific fields related to sciences and technology to allow skill/knowledge development beyond standard classes
- Encourage private sector to offer special projects/programs for students to explore their interests in sciences and technology e.g., funding for experiment
- Continue to offer more opportunities for scholarships and foreign exchange opportunities to outstanding students in sciences and technology

Implementation Timeline

2017 → 2018 → 2019 → 2020 → 2021

Recommended KPI

- Number of primary schools and secondary schools offering coding/programming course
- Establishment of Thailand standardized-coding program/curriculum
- Percentage of Thai students passing a standardized programming examination (to be designed)

Expected Benefits

- Higher IT literacy among Thai citizens since young age
- Emergence of new digital innovators
- Sustainable economic development in different sectors fueled by more knowledgeable younger generations
- More promising future for Thailand to develop digital economy

Ongoing Projects

- MOST considering integrating coding lessons into school syllabus

38 Improve quality of sciences and technology education in universities to produce future ready workforce

ISSUES & CURRENT SITUATION

- **Tertiary education enrollment** in Thailand is one of the highest in the Southeast Asia regions
- **Yet, quality of Higher education** still lags behind regional peers according to several rankings including the World Economic Forum Global Competitiveness Index and the Universitas ranking
- **Quality of courses related to sciences, technology and ICT still lag behind regional peers** e.g., no Thai universities are in the top 200 of QS ranking for Computer Sciences, while Singapore has 2 and Malaysia has 4
- Thai students also have relatively **poor English proficiency** – lower than Singapore, Malaysia, Vietnam, Philippines, Indonesia for IELTS/TOEFL
- Thai education systems do **not produce enough graduates who possess skills that are aligned** with industry needs
- Hence, improvement of quality of higher education is critical to produce future-ready workforce and ensure Thailand's digital ambitions are not being limited by shortage of skilled workforce

RECOMMENDED ACTIONS

Involve private sector in the design of syllabus and courses to align knowledge and skills of graduates with industry needs
- Ensure syllabus is continuously updated to align with current industry trends
- Include more practical elements in courses to equip graduates with actual skills involved with careers in the particular field
- Use more case studies and highlight real-life examples to enhance understanding of real-world application of theories
- Allow option to take less subjects in order to have more time to develop deeper specialist knowledge and acquire relevant skills for specific fields

Promote awareness and interest of different careers in sciences, technology and ICT
- Have more guest/special lecturers from private sector to teach specific courses
- Invite famous, inspirational, successful people, including alumni, from variety of career paths (e.g., researchers, large corporate, startups) to give talks to students
- Partner with private sector to develop projects and competitions to allow students to explore interests outside of class e.g., digital startup business plan competition
- Partner with private sector to offer more internship opportunities
- Encourage more variety of employers to participate in career fairs to broaden understanding of the possible career paths

Provide more opportunities for students in sciences, technology and ICT related courses to enhance core skill beyond major subject e.g., language, business skills
- Provide language lessons for students in sciences, technology and ICT related courses
- Allow students in sciences, technology and ICT related courses to take more-classes in business, management, accounting, finance and other disciplines that help improve their hire-ability and ability to start own businesses

Promote collaboration with international institutions
- Encourage Thai students to have exchange terms/years abroad in regional and global leading universities in particular fields
- Promote Thai universities to international students to have exchange terms/years in Thailand, including both students from within the Asia Pacific and beyond
- Encourage foreign exchange & training programs for researchers and lecturers, allowing Thais to acquire international experience & knowledge and encouraging foreigners to come to Thailand to promote knowledge exchange
- Encourage research collaboration with overseas universities

Continuously enhance quality of lecturers
- Encourage universities to develop quality rating system for lecturers
- Encourage exchange of staff between universities for knowledge-sharing
- Allow more opportunities for students to take lessons in teaching skills, especially for those looking to join the universities as teaching staff

Ensure higher education institutes are equipped with adequate infrastructure to teach sciences, technology and ICT subjects e.g., laboratories, computers, teaching materials

Implementation Timeline

2017 → 2018 → 2019 → 2020 → 2021

Recommended KPI

- Number of Thai universities in the top 200 based on QS University Rating – overall and for Computer Sciences, Engineering and Mathematics
- World Economic Forum's Index for Quality of Maths and Science Education
- Universitas's score for Quality of Higher Education
- Universitas's score on rating of knowledge transfer between universities and companies

Expected Benefits

- **Enriched IT-readiness of the economically-active and retirees (elderlies)**
  - Improved digital literacy
  - Enhanced awareness and understanding of digital technology
- **Improved penetration rate of IT users in Thailand** (significant increase expected amongst the economically-active segment)

Ongoing Projects

N/A

39 Encourage training and development of workforce, including in ICT capabilities

ISSUES & CURRENT SITUATION

Thai education systems do not produce enough graduates who possess skills that are aligned with industry needs

Thai companies are investing less in training and staff development than regional peers based on the World Economic Forum's Global Competitiveness Index

While education system improvement will help to produce future-ready workforce in the future, it is also important to enhance the capabilities of exiting workers including in digital capabilities

RECOMMENDED ACTIONS

Design and launch government-led training program on ICT capabilities
- Collaborate with academics and private sector to design training syllabus based on current challenges and industry needs
- Set up training centers in different provinces
- Recruit the training staff at each training center, involving local academia as well as business owners
- Allow training conducted at training centers to be taped and used for training at district and sub-district levels
- Focus on "training the trainers" e.g., train SMEs owners and company representatives for them to train the rest of employees

Encourage businesses to invest more in training and development of employees including in ICT capabilities
- Design tax and other financial incentives that can encourage training of local workers e.g., make training expenses tax deductible , special incentives for multinationals investing in training of local workers
- Set minimum requirements on the percentage of Thai workers in professions in priority sectors , e.g., digital to encourage recruitment and training of Thai workers
- Design incentives to encourage knowledge transfer from foreign workers to Thai workers e.g., require certain number of hours of training to be provided to local Thai workers
- Develop regulations to define a minimum number of training provided by employers
- Emphasize benefits of digital literacy to businesses

Support SMEs and startups in training their employees on ICT skills
- Provide training materials
- Train the SMEs/startups owners on how to train their employees
- Consider providing subsidies or setting up funds to support training among SMEs

Develop and make widely accessible the self-learning tools to allow people to learn and develop digital skills
- Collaborate with academics and private sector to design self-learning syllabus
- Develop e-learning tools, and booklets for self-training
- Promote awareness of self-learning tools

Raise awareness of 'benefits of digital literacy and skills' to entire population
- Conduct mass public communication and campaigns to raise awareness and create culture of 'strong digital literacy'

Implementation Timeline

2017 → 2018 → 2019 → 2020 → 2021

Recommended KPI

- World Economic Forum's Index on Extent of Staff Training by employers
- Satisfaction of employers with employees' skilled (whether their skills are required with industry requirements)

Expected Benefits

New workforces with improved digital literacy and IT skills
- Introduction of new IT-related subjects and course (into curriculum)
- Additional IT-components in existing courses

Ongoing Projects

N/A

Insights on Digitalization of Thailand Industry

Digital Roadmap for Aging Society,
Agriculture, and Tourism

White Paper
February 2017

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