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LEAPFROG STRATEGIES FOR THAILAND'S DIGITAL DEVELOPMENT

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Background

Don Tapscott first introduced the term *"digital economy"* in 1994 when the Internet was still a novelty, with his book *'The Digital Economy: Promise and Peril in the Age of Networked Intelligence'*. In a little over two decades since 1994, the digital economy now constitutes a significant and growing part of the overall economy. In a forthcoming publication, Oxford Economics estimates that the digital economy is now worth US$11.5 trillion globally, equivalent to 15.5% of global GDP. The Internet has become a pervasive phenomenon, disrupting multiple industries, creating new business models and becoming a powerful force in its own right. Digital technologies, being general purpose technologies, are transforming our economies and societies as profoundly as the steam engine in the 18th century or electricity in the 19th.

The Government of Thailand recognizes the significance of the digital economy and created a Ministry for Digital Economy and Society in 2016. It has developed a National Digital Economy Masterplan with a 20-year time horizon, divided into four phases. These include laying the digital foundations, achieving digital inclusion, moving to full transformation, and finally achieving the status of global digital leadership. It has launched initiatives like Digital Thailand, Thailand 4.0 and a special program for developing the Eastern Economic Corridor (including a digital park and a University 4.0).

Thailand's digital economy policy framework focuses on the following six strategies:

1. Build country-wide high-capacity digital infrastructure to ensure accessibility, availability, and affordability.
2. Boost the economy with digital technology i.e. driving a new S-Curve, raising competitiveness, building new businesses as well as creating values.
3. Create a knowledge-driven digital society by encouraging participation and ensuring inclusive and equal usage of digital technologies.
4. Transform into digital *'One Government'* that is open and accommodates people and businesses.
5. Develop workforce for the digital era by enhancing worker skills, creating jobs as well as building domestic strength.
6. Build trust and confidence in the use of digital technology by updating laws and regulations, encouraging investment and ensuring security in digital data and transactions.

Thailand's international rankings

Thailand's performance on various digital economy related indices and rankings has been mixed. Thailand ranked 82 out of 175 countries on ITU's ICT Development Index (IDI) 2016. The IDI adopts a triple set of rating criteria clustered around ICT access, usage, and skills. Thailand ranked 62 among 139 countries as per the World Economic Forum's (WEF's) Networked Readiness Index (NRI) 2016, which assesses the *"factors, policies, and institutions that enable a country to fully leverage ICTs for increased prosperity".* The United Nations E-Government Survey 2016, which analyzes progress in using e-government and its effectiveness in the delivery of basic economic and social services to people, ranked Thailand at 77 out of 193 countries. Waseda University's recent 2017 digital government rankings placed Thailand at rank 21 out of 65 countries covered.

On ease of doing business, Thailand has been ranked 46 out of 190 countries for 2017. The country ranked 34 out of 98 countries on the Global Competitiveness Index for 2016-17. Thailand has done relatively well on AT Kearney's Global Services Location Index (2016) ranking 6th out of 55 countries covered.

While different rankings adopt different criteria, broadly Thailand has performed better in terms of affordability and usage of mobile services, as well as financial attractiveness as an investment destination; but has not performed as well on skills and regulatory environment.

ICT status in Thailand

In 2016, according to the Household Survey on ICTs[1], computer usage among households in Thailand was 32.2%, internet 47.5% mobile phones 81.4% and smart phones 50.5%. On all these indicators, urban households did much better compared to rural areas, with computer usage at 39.6% (rural 26.2%), internet 57.4% (rural 39.5%), mobiles 86.6% (rural 77.2%) and smart phones at 60% (rural 42.8%). In terms of regions, Bangkok was the highest on all counts with the Northeastern region being the lowest.

While 73.6% of users in the age group of 25-34 years used the internet, the proportion for those over 50 years was only 13.8%. Internet usage was highest for accessing social networks (91.5%), and for downloading video, audio and gaming content (88%). There is gender equality as far as internet usage is concerned in Thailand.

According to IDC[2], IT spending in Thailand is expected to grow at a CAGR of 3.7%, reaching USUS$13.6 billion by 2019. Fifty three percent of the spending is contributed by consumer purchases of mobile devices, PCs and printers. The spending on telecom services has been growing at a CAGR of 6.9% and was estimated to be USUS$10.7 billion by the end of 2016.

According to the Alliance for Affordable Internet[3], Thailand ranked 17th out of 58 countries under the 2017 Affordability Drivers Index. Its rank was low on the Herfindahl index for market concentration with a rank of 38 out of 58 countries (rank 24 out of 37 developing countries) in 2017. This is due to the fact that one of the mobile players has close to 50% of market share for mobile. Of the three major mobile operators AIS has the largest market share of 44.4%, followed by DTAC 27.4% and True 26.2% (2016).

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[1] National Statistical Office, Ministry of Digital Economy and Society, *'The 2016 Household Survey on the Use of Information and Communication Technology'*.

[2] IDC, Thailand ICT Market Landscape Study, 2016.

[3] https://goo.gl/UTAaHH

The economy is digital

As digital technologies become ubiquitous, it is becoming difficult to determine the boundaries of the digital economy. In 2014 the European Digital Forum provocatively made the statement that *"There is no "digital economy" – the economy is digital"*[4]. In a similar vein a paper prepared by the Internet Society for OECD's 2016 Ministerial Meeting on the Digital Economy started by saying that in most OECD countries, *"the digital economy has become the economy"*[5]. According to the OECD, the digital economy *"encompasses the physical infrastructure that digital technologies are based on (broadband lines, routers), the devices that are used for access (computers, smartphones), the applications they power (Google, Salesforce) and the functionality they provide (IoT, data analytics, cloud computing)"*[6]. There is however, a blurring between the digital and the non-digital realms, which makes the task of designing and operationalizing strategies for the digital economy all the more difficult.

Importance of Focus

Recent research by AlphaBeta[7] showed that as many as 72 different government departments are involved in some countries for implementing digital economy related initiatives. This only makes more important to prioritize, coordinate and align actions across these various stakeholders.

The need for prioritization and focus brings to mind the famous case of Alcoa in the late eighties. When Paul O'Neill became the CEO of Alcoa in October 1987, the company was facing multiple challenges including worker-management tensions, low productivity and declining profits. Paul O'Neill famously set his goal not to increase profits or productivity, but to make Alcoa a *"zero worker injury company"*. One year into Paul O'Neill's taking charge, the company's profits hit a record high. By the time O'Neill left Alcoa in 2000 to become Treasury Secretary, the company's annual net income increased from US$200 million to US$1.484 billion and its market capitalization grew from US$3 billion in 1986 to US$27.53 billion. The singular focus on worker safety resulted in Alcoa putting in place one of the first global networks as part of its management information system to monitor worker injuries.

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[4] https://goo.gl/jAkX15

[5] https://goo.gl/KMDSZP

[6] OECD, *'Harnessing the Digital Economy for Developing Countries'*, page 11, December 2016, (https://goo.gl/Twcvkx).

[7] https://goo.gl/fG3Uym.

The goal of zero worker injuries was one on which workers could not fight management. Injuries often occurred when machines were not maintained or serviced properly. Thus, the maintenance of machines had to be improved, and old equipment had to be retired thereby impacting productivity. A single metric aligned different parts of Alcoa's business in a way that has now become a case study in successful management, and an example of how changing a *"keystone habit"* can have huge beneficial effects.

There are other examples of highly focused strategies. Elon Musk is widely recognized as a very successful visionary with a track record of effective execution. His company Tesla has adopted the mission to accelerate the world's transition to sustainable energy. Another of his companies, SpaceX, aims to revolutionize space technology, with the ultimate goal of enabling people to live on other planets. According to Gary Keller, if a *"company doesn't know what it's ONE Thing is, then the company's ONE Thing is to find out"*[8]. This is true as much for countries as for companies. In a speech to the US Congress in May 1961, President John F. Kennedy stated the highly aspirational goal *"of landing a man on the moon and returning him safely to Earth"* before the decade was out. This resulted in the successful landing of Apollo 11 on the moon on July 20, 1969.

In the case of promoting the digital economy in Thailand, it will be important to identify a small set of goals that can help align and center all actions and initiatives in a consistent and coherent way. For example, Singapore's Committee on the Future Economy has identified building strong digital capabilities as a key strategy, focusing on just three priorities, namely i) adoption of digital technologies by SMEs; ii) developing deep capabilities in data analytics; and iii) cyber security, and harnessing data as an asset.

Thailand's National Digital Economy Masterplan has a number of worthwhile initiatives focused on all the right things, namely development of hard infrastructure, acceleration of the digital economy, promoting digital society, digital government, workforce development and soft infrastructure (legal, regulatory and security). However, Thailand would benefit from addressing the following issues as part of its digital strategy going forward:

1. Identification of a small subset of keystone initiatives that can be game changers for the development of the digital economy.

2. Adoption of an approach that can help break existing institutional silos in the government. Rigid organizational siloes are widely recognized as a problem in Thailand.

[8] Gary Keller and Jay Papasan, The One Thing, Bard Press 2013.

3. Adopting a more forward looking and future oriented approach that scans emerging opportunities and connects them with the decision-making processes in government.
4. Placing greater emphasis on quick wins and more efficient implementation.
5. Leveraging international expertise and innovation better as part of Thailand's efforts to transform its digital economy.

Keystone initiatives

In order to identify a limited set of high impact priorities it might be good to look at digital economy trends and focus on those that are likely to have economy-wide impact. Erik Brynjolfsson, and Andrew McAfee in their recent book *'Machine, Platform, Crowd: Harnessing our Digital Future'* have identified the rapidly increasing and expanding capabilities of machines (as exemplified by AlphaGo), the rise of upstarts as platforms like Uber, Airbnb, Facebook, and Alibaba, and networks of experts and consumers (the crowd) as the three trends that will reshape the business world.

Gartner has identified the following top ten strategic technology trends for 2017:

1. Artificial Intelligence (AI) and Advanced Machine Learning (ML)
2. Intelligent Apps
3. Intelligent Things (Robots, Drones, Autonomous Vehicles)
4. Virtual Reality and Augmented Reality
5. Digital Twins
6. Blockchain and Distributed Ledger
7. Conversational Systems
8. Mesh App and Service Architecture
9. Digital Technology Platforms
10. Adaptive Security Architecture.

It will be beneficial to focus on trends that are foundational for the Digital Economy, have high potential for socio-economic impact, and present leapfrog opportunities for Thailand. We consider such opportunities in four categories: (i) digital foundations (data, networks, digital twins); (ii) transformative business models (Blockchain); (iii) digital skills; and (iv) cross-cutting institutions for the digital age.

At a fundamental level, data and high-speed networks underpin each of the top strategic technology trends. Unless Thailand gets these foundations right, systematic progress on any of these trends will be very difficult. The development of AI and Advanced ML, Intelligent Apps, Intelligent Things or Conversational Systems for example, each require access to large and diverse datasets. Data is of critical importance to other trends as well, as is the availability of hard digital infrastructure for transporting data.

Importance of Data

According to Jack Ma, the Executive Chairman of Alibaba, data is the new `natural resource'[9]. The importance of data can be seen from the fact that six of the top ten companies in the world by market capitalization are companies that are in the business of data. These include Apple (US$752 billion), Alphabet (US$579.5 billion), Microsoft (US$507.5 billion), Amazon (US$427 billion), Facebook (407.3 billion) and Tencent Holdings (US$277.1 billion)[10]. Data is becoming increasingly valuable and will have huge spillovers in other sectors. Given its sheer potential for impact across industries and sectors, we consider it to be the most important digital asset that deserves focused attention.

According to McKinsey estimates[11], the volume of data flows has multiplied by a factor of 45 since 2005. Cisco (Visual Networking Index)[12] estimates that annual global IP traffic reached 1.1 ZB per year by the end of 2016, and will grow at a compound annual growth rate (CAGR) of 22 percent till 2020. In China, close to 20 percent of imports and exports now take place on digital platforms. By 2014, cross-border data flows accounted for US$2.3 trillion in economic value (McKinsey). Given the significant value of data flows, data policies will be critical and require focused attention, particularly those relating to data generation, capture, transmission, storage, security, privacy, analytics, standardization and intelligent usage of data.

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[9] *'Alibaba's Jack Ma Just Predicted the Next 30 Years of Technological Change'*, Fortune October 13, 2016 (https://goo.gl/aztz8Y).

[10] Forbes rankings for 2017 of the World's Biggest Public Companies (https://goo.gl/pK7vXV).

[11] Digital globalization: The new era of global flows, McKinsey & Co. (https://goo.gl/hEpAQ9).

[12] Cisco Visual Networking Index, (https://goo.gl/LDw2ZE).

The 4th industrial revolution also implies that intelligent information platforms that link products and services will offer much greater value compared to standalone systems. The development of such platforms will critically depend on the access to data.

National Strategy on Data

Developing a national strategy on data would be beneficial for Thailand. Currently, Thailand's approach to data is limited to the promotion of open data in government, and integrating data for providing better services to citizens and businesses. We suggest that Thailand look at data in a broader perspective (including private sector data). For example, an increasing amount of data will be generated by machines or processes related to the Internet of Things, including factories of the future and autonomous connected devices and systems. However, no comprehensive policy frameworks exist with regard to non-personal machine generated data or to the conditions in which such data can be exploited or traded.

The European Union[13] is in the process of developing a framework for data access that could help inform Thailand's approach, revolving around the following objectives:

1. Improve access to anonymous machine-generated data.
2. Facilitate and incentivize the sharing of such data.
3. Protect investments and assets ensuring fair sharing of benefits between data holders, processors and application providers within value chains.
4. Avoid disclosure of confidential data and
5. Minimize lock-in effects especially for SMEs and startups and private individuals.

A national strategy on data could touch upon these as well as issues of i) data standardization; ii) free flow of data; iii) access to machine-generated data; iv) liability and safety issues related to data; v) establishing 311 type of data services to facilitate the location, processing and brokering of data; vi) creation of data maps; vii) providing support to data matching services; and viii) helping grow data exchanges and markets. Most of these interventions, for example, underpin Korea's recent Master Plan for the Intelligent Information

[13] European Commission, Building a European Data Economy, January 2017.

[14] Mid to Long Term Masterplan in Preparation for the Intelligent Information Society, (https://goo.gl/3x7TTt).

Society[14]. Malta, currently holding the Presidency of the European Union, is also developing a National Data Strategy[15] which could serve as a source of insights and lessons for Thailand.

Timely progress in this agenda would be aided by the appointment of a Chief Data Officer (CDO) within the Ministry of Digital Economy and Society, to lead the work on data standards, data governance, data security, data sharing, metadata management, data quality and data architecture. The position of CDO could also be considered by other government ministries, departments and agencies, given the pivotal importance of data across all sectors.

Keystone initiative on data:

A keystone initiative on data could be to transition to a requirement for insuring data assets in Thailand, which could be facilitated through a Public-Private Partnership (PPP) on cyber-risk reinsurance. This is likely to have the following cascading impacts:

1. It would require companies and government agencies to take stock of their data, assign value to their data and secure their data assets.

2. It would introduce a market mechanism to ensure data security as cyber risk insurance premiums would rise for data assets that are not secure.

3. The model would act as a check on high valuations of data as inflated valuations would result in inflated premiums.

4. It would help take stock of data on a continuing basis within government and the private sector resulting in better information on data availability, and data valuations. This would in turn help in creation of data markets, and better regulation of data flows.

5. The initiative could help develop cyber-risk assessment skills in Thailand promoted largely by the private sector.

6. Thailand would emerge as one of the most secure data locations internationally.

7. Thailand could potentially become a test bed and learning platform for global insurance companies in cyber-risk insurance.

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[15] *'Malta is establishing a holistic plan to manage data as an enterprise asset'*, Malta Information Technology Agency, June 14, 2017 (https://goo.gl/vfzxQX).

8. The initiative could also provide opportunities for the development of blockchain based insurance models that track data assets thereby lowering costs of insurance and supporting innovations in Thailand.

Network Slicing

Future ready networks: Together with data, the network infrastructure is another foundational piece of the digital economy. Thailand's current strategy on digital infrastructure is based on a nation-wide roll out of broadband, turning Thailand into an ASEAN connectivity hub, and providing broadband at a price less than 2% of GNI per capita.

Broadband networks will have to deal with the growing data demands resulting from new technologies and devices coming to the market. For example, 4K televisions, which are already in the market, have a download requirement of 100 Mbps while 8K televisions, on display at CES 2017 and soon to hit the market, will require data download speeds of 300 Mbps. Coupled with the rapid increase in Internet of Things (IoT), this means that networks will have to contend with huge demands of exponentially increasing data flows.

Thailand has made impressive gains in terms of relative broadband speeds. Akamai's Q1 report for 2017 ranks Thailand at #8 internationally with peak data speeds of 106.6 Mbps (Singapore #1 184.5 Mbps). Thailand ranked 21 in terms of average data speeds (16 Mbps) as compared to South Korea at #1 (28.6 Mbps). However, the demands on Thailand's broadband networks is only going to increase.

Leading companies are already preparing for the exploding demand for bandwidth. Google is partnering with Facebook, TE SubCom, and Pacific Light Data Communication on the Pacific Light Cable Network connecting Hong Kong to Los Angeles with a bandwidth capacity of 120 Tbps. The project is scheduled to be completed in the summer of 2018. Facebook is also building a trans-Atlantic submarine cable project Marea, from Virginia Beach in the US to Bilbao in Spain with a capacity of 160 Tbps which will be completed in October, 2017. This may be compared with Thailand's current international bandwidth of about 4 Tbps, which is a small fraction of these capacities (see Annex 2).

Broadband infrastructure in Thailand will face exploding demands of data and heterogeneous requirements of different industries e.g. automotive, healthcare, logistics, retail or utilities. The network requirements for a factory with automated and flexible production systems would differ from those of a hospital doing robotic surgeries, or from the

requirements of self-driving cars. To cater to these different requirements, networks will need to support different requirements for latency, throughput, capacity and availability. This would require a paradigm shift towards network slicing which can meet such needs. The European Commission is supporting a coalition of network operators[16] and academic institutions to focus on network slicing for 5G, and has provided US$8.9 million in funding for the initiative.

Thailand has drawn up ambitious plans for a nationwide roll out of 5G by 2020. Nonetheless it will be important for Thailand to systematically develop network slicing capabilities which will allow efficient and agile management of the network, with individual slices of the network being separately optimized for video, IoT, or critical communications depending on need. Engaging on the concept of network slicing will also help Thailand to better prepare for Industry 4.0 and other applications.

Keystone initiative on digital infrastructure:

There are a number of projects slated to begin in 2017 as part of the development of Thailand's Eastern Economic Corridor. It might be worthwhile to begin planning for 5G and network slicing to cater specifically to projects in the EEC including the Eastern Aertropolis in U-Tapao, High speed train from Bangkok to U-Tapao, Sea Ports of Laem Chabung, Map-Taput, and Sattahip, industries including electric vehicles, robotics, medical, aircraft parts, Future Cities and the Digital Park. The National Broadcasting and Telecommunications Commission is in the process of allocating bandwidth for IoT and for the Thai-Chinese high-speed railway. There seems to be some delay in the allocation of bandwidth for 5G, though this will hopefully be addressed in the near future.

A focus on the EEC may have the following cascading impacts:

1. It would help better understand the needs of potential investors who may consider investments within the EEC and have future ready infrastructure in place.
2. The EEC would become a test bed for the telecom operators for testing 5G and network slicing technologies for eventual roll out to other parts of Thailand.
3. Real life use cases would help improve the economics of 5G rollout.
4. Investors in the EEC would become aware of new opportunities to leverage 5G and network slicing and may consequently plan for more futuristic infrastructure and solutions.

[16] The Alliance includes NEC, Ericsson, Nokia, InterDigital, Orange, and Telefonica, as well as several academic institutions.

5. Thai operators will have the opportunity to collaborate with international players and better align with emerging standards and technologies on network slicing.

Merger of the physical and virtual worlds (Digital Twins)

Gartner has identified *"digital twins"* among its list of top ten strategic technology trends for 2017. According to Gartner, *"A digital twin is a dynamic software model of a physical thing or system that relies on sensor data to understand the state of the thing or system, respond to changes, improve operations, and add value"*[17]. It is estimated that by 2020 there will be more than 21 billion connected sensors and endpoints, and digital twins will exist for potentially billions of things. We see the merging of the physical and digital worlds as represented in the phenomenon of *"digital twins"* as a trend that potentially has a wide-ranging sweep cutting across different sectors and verticals, and therefore presents significant opportunities for Thailand.

We are witnessing the beginnings of a trend towards the merger of the digital and physical worlds. As part of this trend we will see a rapid growth in the digital representation of people, objects, places and processes – a phenomenon linked to the creation of digital twins[18]. The concept of digital twins is not new. Computer aided design models and process simulations have been with us for decades. However, the rapid growth in the Internet of Things including smart phones with sophisticated cameras is resulting in the creation of a higher fidelity digital representation of the real world. In parallel we are seeing rapid advances in Augmented, Virtual and Mixed Reality (AR, VR, and MR) devices and applications. It is expected that by 2020 consumers and businesses will have easy access to quality devices, systems, tools and services for AR, VR and MR.

National Strategy on Digital Twins

In this context, Thailand could consider launching a national strategy on digital twins. If it does, it will be the first country to have such a strategy. The strategy could for purposes of illustration, encompass (i) creation of digital content, (ii) development of digital skills, (iii)

[17] Gartner, Top Ten Strategic Technology T rends for 2017.

[18] According to Gartner, a digital twin is a digital representation of a physical object, person, place or process.

support to SMEs (iv) support to farmers, (v) introduction of *'Business Operating Systems'* (BOS)[19] in government, (vi) digitization of urban settlements and (vii) promotion of applications in education, health and tourism.

The creation of content could be done in close partnership with the private sector, with minimal investments by government. For example, mandating use of Building Information Modeling (BIM) for construction permits[20] (above a particular SFT threshold to begin with) would result in the digitization of building plans and create a demand for relevant skills paid for largely by the private sector. Similarly, the digitization of eco-tourism sites through use of drones, or devices like Google Street View Trekker could be done at low cost.

The development of skills could be done in partnership with leading companies like Facebook (Oculus), Microsoft (Hololens), Apple (ARKit), Samsung and Magic Leap besides others. This would help prepare Thailand for the next wave of disruptions.

The new versions of eCommerce will use AR and MR technologies as part of enhancing the buying experience. Buyers contemplating purchase of furniture will be able to visualize how new furniture would look in their homes using AR/MR applications on their smart phones. Jewelry brands are already allowing customers to see how pieces of jewelry appear on them, using their smart phones. These examples illustrate the value that could potentially be created if objects and their designs are digitized. Digitization of designs would also help Thailand's businesses to be better prepared for the emerging disruption of 3D printing. Supporting Thailand's SMEs and businesses in creating digital twins would therefore have multiple benefits: creation of a new class of jobs, a more sophisticated manufacturing and design sector, greater competitiveness and better preparedness for the future.

The Government of Andhra Pradesh in India is planning to use drones for mapping the entire state every 3 months to generate data that can be used in multiple ways, including for monitoring physical infrastructure (e.g. the condition of rural roads). Thailand could launch a major program for using drones for precision agriculture (besides tourism), thereby providing benefits to people in rural areas as part of a national strategy of digital twins. The program could be designed in a way that the private sector is incentivized to provide services to farmers, thereby creating competition in the provision of such services.

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[19] *"The term business operating system (BOS) refers to standard, enterprise-wide collection of business processes used in many diversified industrial companies. The definition has also been extended to include the common structure, principles and practices necessary to drive the organization".* (Wikipedia)

[20] See this article on BIM adoption in major countries: https://goo.gl/FrX8rk.

A program for introducing Business Operating Systems and digitizing government processes and services could prove invaluable in redesigning government services around citizen journeys and vastly improve user experience. Similarly, digitizing existing urban areas (starting perhaps with designated Smart Cities) could help in better urban planning, and better citizen engagement through visualization of future states.

Besides the examples provided above, AR/VR and MR have immediate applications in education, health and tourism. These sectors could be specifically targeted as part of a national program.

Keystone initiatives:

Examples of keystone initiatives that could be introduced for Digital Twins include Business Operating Systems for those agencies in government that figure in the Doing Business rankings (see Thailand's latest rankings in Annex 3). This could help in exploring a radical redesign of processes to improve Thailand's performance on the rankings.

Thailand proposes to develop new eco-cities within the Eastern Economic Corridor. A virtualization of each city covering the dimensions of people, places, things and processes would provide valuable experience in implementing a national program on digital twins.

1. This could be a means to attract companies engaged in cutting edge AR/VR and MR technologies.
2. The industry cluster on Immersive Content in the EEC could both contribute and benefit from the initiative.
3. The creation of digital twins for the eco-cities would allow for simulation, modeling and planning in a way which would not be possible otherwise.

Transformative Business Models: Blockchain

Distributed Ledger Technology (DLT) or Blockchain promises to be a highly disruptive technology in the years to come. The Internet has evolved from the *"Internet of Data"* based on the TCP/IP protocol, to the *"Internet of Content"* with the coming of the World Wide Web. We are now seeing the next major evolution towards the *"Internet of Value"* represented by blockchain/distributed ledger technologies, which hold the potential for massive disruption. Blockchain technology has successfully demonstrated its potential as a global scale,

peer-to-peer distributed network for the creation and the exchange of value (with Bitcoin being one example). It is now expanding to areas other than cryptocurrencies and could upend a wide range of industries and sectors.

Blockchains are likely to become an important part of the digital economy. According to the World Economic Forum[21], '80% of banks are predicted to start blockchain projects by 2017, and US$1.4 billion has already been invested into the technology over the past three years'.

Another World Economic Forum report suggests that by 2027, 10% of the world GDP will be stored on blockchain systems and by 2023, the tipping point of government applications in blockchain system could be achieved[22].

Dubai has recognized the importance of the technology and has initiated an ambitious Blockchain strategy. Dubai aims to have 100% government transactions on Blockchain by 2020. It also aims to support 1000 startups engaged on the technology, besides linking up with 27 other countries to facilitate travel using Blockchain. The Dubai government estimates that its blockchain strategy has the potential to save 25.1 million hours of economic productivity each year, and unlock 1.5 billion USD in savings annually in document processing alone[23].

Thailand may consider supporting proof of concept (POC) initiatives with respect to DLT in various sectors (in addition to Fintech where Thailand has been quite active) so that Thai companies and government agencies gain more experience and develop greater expertise.

Keystone initiative:

Thailand could identify one or more of the Doing Business Indicators and launch an international challenge for blockchain companies to develop Proof of Concept solutions. This would not only provide a clear problem to be solved for companies, but could potentially attract innovative companies from across the world to contribute to the solutions.

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[21] https://goo.gl/Ycs1tb
[22] https://goo.gl/22oiVd
[23] https://goo.gl/YF22wf
[24] https://www.42.us.org/
[25] This University has no teachers, syllabus or fees, Wired (https://goo.gl/zRPVfA).

Digital Skills

We are likely to see significant disruptions in labor markets due to the rise of artificial intelligence, robotics as well as increasing spread of Blockchain. While this is a distinct challenge, it also presents an opportunity for Thailand to prepare itself and benefit from the changes on the horizon.

Thailand would benefit from a sophisticated system for globally tracking the demand for digital skills on a continuing basis. It is important to have a global perspective since digital skills are highly portable and digital services can be delivered to any part of the world from Thailand. A Digital Skills Tracking System could leverage Big Data analytics and draw on data from companies like Burning Glass, EMSI, and others that track job postings globally. The analysis of such data can help identify the fastest growing skills/competencies, geographies, firms and hiring platforms. In addition, the system could be geared to pick up market signals on the emergent demand for skills by leveraging structured and unstructured data. These market signals would be captured from a range of sources including, but not limited to, venture capital investments, patent families' filings, leading journals, economic data and market intelligence reports.

The results of the tracking system could help Thailand to have better insights into skill requirements as well as identify promising tech companies as potential targets for outreach. The Digital Skills Tracking System could be under the Strategic Foresight Unit proposed later in this paper, and form one of the tools available to the unit for horizon scanning and risk assessment.

It will also be important to put in place a highly agile and responsive skills development program to benefit from the Skills Tracking System. This could be done by engaging with companies like Flatiron (among others) with a credible track record of responding to the market demand for skills, and also establishing innovative institutions for skills development. We present below the case of University 42 as an illustration of one such institution.

University 42

University 42 is an initiative launched by the French billionaire Xavier Niel. The University initially started in Paris and has now established a campus at Fremont in California[24]. The University has no faculty, no syllabus and no fees[25]. 42 is open to anyone between the ages of 18 and 30 whether they possess an academic degree or not. The training

lasts 3 to 5 years, with students required to work in teams of seven, on 21 levels of real world problems. 42 offers its students the very best in terms of IT resources, and depends on their resourcefulness to access cutting edge knowledge and expertise from peers and external experts, in the course of developing solutions at each level.

An advantage of the University 42 model is that the University can potentially spawn exciting technology startups, besides producing top tier IT talent.

Keystone initiatives:

1. Development of a sophisticated model for capturing global demand for digital skills tapping expertise globally.
2. Exploring innovative models for establishing University 4.0 proposed within the Eastern Economic Corridor.

Institutional design

We now turn to issues of institutional design that can be game changers for Thailand. We present below two key institutional pieces that Thailand would do well to consider, so as to better prepare itself for the future and to break organizational silos and begin introducing agile and cross-sectoral teams for designing policies and strategies for the future.

Strategic Foresight

We are witnessing today an accelerating pace of technological change and rapidly evolving business models. Systematically keeping track of these changes is important in order to benefit from the opportunities that arise and better prepare for emerging risks. The capability for Strategic Foresight has therefore become an important tool in the policy maker's toolbox. *"Strategic foresight is the ability to create and maintain a high-quality, coherent and functional forward view, and to use the insights arising in useful organizational ways. For example, to detect adverse conditions, guide policy, shape strategy, and to explore new markets, products and services. It represents a fusion of futures methods with those of strategic management"*[26]. Strategic Foresight in today's world can be a powerful tool for gaining competitive advantage.

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[26] Developing and Applying Strategic Foresight, Richard A. Slaughter (https://goo.gl/pgsQJp).

Singapore established a Center for Strategic Futures in 2009 and brought it under the Prime Minister's Office in 2015. Singapore has used Strategic Foresight with great success. For example, its exercise in Futures planning in 2012 identified Autonomous Vehicles and the Automation of Work as major areas for policy intervention. This was much before these topics had become the subject of popular discourse. As a result, Singapore gained ahead start over other countries in systematically planning for these emerging opportunities. It succeeded in attracting NuTonomy to start trials of its autonomous vehicles in the country. Singapore's Land Transport Authority (LTA) is now partnering with the company to begin trials of an autonomous mobility-on-demand transportation service to be launched in 2018. Singapore has also invested significantly in developing a Big Data Analytics based Risk Assessment and Horizon Scanning tool, which helps identify market signals in areas of emerging technologies and business models.

The role of Strategic Foresight in Thailand has traditionally been with the National Science and Technology Agency (NSTDA). Thailand could consider elevating the importance of Strategic Foresight by institutionalizing it at the highest level in government, and closely integrating it with the decision-making structures of planning and budgeting.

Many developed countries have established institutions focusing on Strategic Foresight besides Singapore. Some examples include: UK Foresight Office, Policy Horizons Canada, Center for Strategic Foresight (Korea), European Strategy and Policy Analysis System, Commonwealth Science and Industrial Research Organization - CSIRO Futures (Australia), Committee for the Future (Finland), Centre d'Analyse stratégique (France), and the Ministry of Education and Research (Germany). This list is illustrative and not exhaustive. However, with few exceptions (Singapore being one) most of these agencies are not well integrated within the decision-making structures of government.

Thailand has the opportunity to develop a model that is much more action oriented, with a capability to rapidly translate strategic insights into policy initiatives and action on ground. This could be done for example by establishing an empowered Strategic Foresight Unit situated in the Prime Minister's Office, combining Singapore's model of a Centre for Strategic Futures with the Malaysian Prime Minister's Delivery Unit. This would result in a hybrid Strategic Foresight Unit that is both future focused and implementation oriented. Moreover, a shorter cycle for conducting foresight will enable timely responses as new opportunities and threats emerge at a faster pace.

Without a well-resourced capability for Strategic Foresight, it will not be possible for Thailand to be nimble footed and future focused in identifying opportunities (and risks) for development, including for the development of its digital economy.

Agile Policy Unit

As in most countries, policy making in Thailand is siloed in various ministries. The digital economy by its very nature requires a more cross-cutting horizontal approach to policies and regulations. Regulation of electric powered autonomous cars for instance, would require coordinated approaches involving the ministries of transport, digital economy, energy and even finance (for payment systems using smart contracts for example). Therefore, institutional structures that allow for a more horizontal and more crosscutting approach to policy making and regulation would support the development of the digital economy in Thailand.

The development of Strategic Foresight as a key capability could be combined with a shift in the policy-making paradigm towards being more proactive in reaching out to companies (and academic institutions) in emerging areas of technology, and creating the conditions to attract them to Thailand. Close cooperation between the Strategic Foresight Unit and the Board of Investments will also be important in this regard.

Crosscutting policy making and regulation and translating strategic foresight into actionable initiatives could be supported by a cross-sectoral Agile Policy Unit[27]. This Unit would be empowered to proactively engage with technology companies and help establish regulatory sandboxes for example, cutting across the vertical silos of government. Agility is the ability to rapidly adapt and move in new directions. A number of large companies (e.g. Google, Netflix, Spotify, ING) have adopted agile decision making as part of their organizational design (see ING model in the Annex 1). The government can learn from these experiences.

It might be argued that government is very different from the private sector and it may be impractical to superimpose private sector structures on the complex organization of government. However, as we look into the future, governments are expected to work more closely with the private sector in any case. We will witness a blurring of boundaries between public and private in the delivery of government services. Agility in government will become a key source of competitive advantage, and there is much to learn from the private sector in this area.

[27] A Google search on *"Agile Policy Unit"* yields no results. Obviously this presents an opportunity for Thailand to develop a model that is unique and novel.

There is demonstrable evidence that small dedicated reform teams that are connected to the highest decision making levels in government and are empowered to develop reform strategies, build consensus, coordinate and mobilize resources, are more likely to succeed. Botswana, Cape Verde, Malaysia, Mauritius, and Taiwan (China) are all examples of countries that grew out of poverty in less than 30 years and successfully adopted this approach despite their varied cultural and administrative backgrounds (ranging from strong autocratic governments to weak multiparty coalitions)[28].

An advantage of the approach will be to create a cadre of policy makers who are tech-savvy, and are comfortable working in cross-sectoral settings, and in ways that emphasize speed and agility in both decision making and implementation.

In conclusion

Thailand has a huge opportunity for leapfrogging in the digital era. However, the challenge for Thailand will be to put in place structures and processes that can effectively translate ideas to action, and convert potential to reality.

[28] Reform Teams: How the Most Successful Reformers Organized Themselves, Alberto Criscuolo and Vincent Palmade, World Bank (https://goo.gl/kDnNMZ), February 2008.

Annex 1 : ING's New Agile Organizational Model (not fixed, but constantly evolving)

Tribe
(collection of squads with interconnected missions)

- includes on average 150 people
- empowers tribe lead to establish priorities, allocate budgets, and form interface with other tribes to ensure knowledge/insights are shared

Agile coach
- coaches individuals and squads to create high-performing teams

Squad
(basis of new agile organization)

- includes no more than 9 people; is self-steering and autonomous
- comprises representatives of different functions working in single location
- has end-to-end responsibility for achieving client-related objective
- can change functional composition as mission evolves
- is dismantled as soon as mission is executed

Product owner
(squad member, not its leader)
- is responsible for coordinating squad activities
- manages backlog, to-do lists, and priority setting

Chapter
(develops expertise and knowledge across squads)

Chapter lead
- is responsible for one chapter
- represents hierarchy for squad members (re: personal development, coaching, staffing, and performance management)

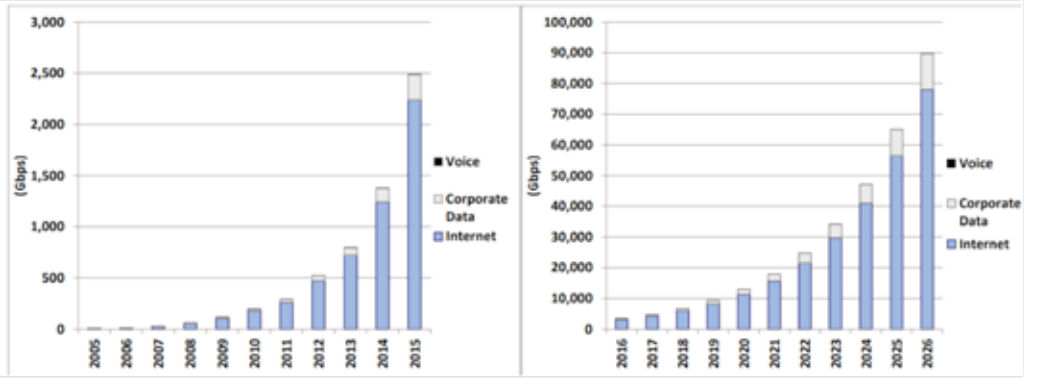
McKinsey&Company | Source: ING

Source: McKinsey & Company 'ING's Agile Transformation' (https://goo.gl/ygTTVP).

Annex 2 : Historical and Forecasted International Bandwidth in Thailand (Gbps), 2005-2026 (Source ESCAP)

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
International Internet	7	10	22	55	105	180	262	472	725	1,240	2,241
International Corporate Data	1	1	2	6	11	19	28	49	70	136	247
International Switched Voice	1	1	1	1	1	1	1	1	1	1	2
Total International Bandwidth	8	12	25	62	117	200	290	522	796	1,378	2,489
CAGR (2005-2015)	77%										

	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
International Internet	3,115	4,299	5,932	8,186	11,297	15,590	21,514	29,690	40,972	56,542	78,027
International Corporate Data	343	516	771	1,146	1,695	2,339	3,227	4,454	6,146	8,481	11,704
International Switched Voice	2	2	2	3	3	3	4	4	5	6	6
Total International Bandwidth	3,459	4,817	6,706	9,335	12,995	17,932	24,745	34,148	47,123	65,028	89,738
CAGR (2016-2026)	38%										



Annex 3 : Thailand's Ease of Doing Business Rankings 2017

THAILAND		East Asia & Pacific		GNI per capita (US$)	5,620
Ease of doing business rank (1–190)	46	Overall distance to frontier (DTF) score (0–100)	72.53	Population	67,959,359
✔ **Starting a business** (rank)	78	✔ **Getting credit** (rank)	82	**Trading across borders** (rank)	56
DTF score for starting a business (0–100)	87.01	DTF score for getting credit (0–100)	50.00	DTF score for trading across borders (0–100)	84.10
Procedures (number)	5	Strength of legal rights index (0–12)	3	Time to export	
Time (days)	25.5	Depth of credit information index (0–8)	7	Documentary compliance (hours)	11
Cost (% of income per capita)	6.6	Credit bureau coverage (% of adults)	53.0	Border compliance (hours)	51
Minimum capital (% of income per capita)	0.0	Credit registry coverage (% of adults)	0.0	Cost to export	
				Documentary compliance (US$)	97
Dealing with construction permits (rank)	42	**Protecting minority investors** (rank)	27	Border compliance (US$)	223
DTF score for dealing with construction permits (0–100)	75.65	DTF score for protecting minority investors (0–100)	66.67	Time to import	
Procedures (number)	17	Extent of disclosure index (0–10)	10	Documentary compliance (hours)	4
Time (days)	103	Extent of director liability index (0–10)	7	Border compliance (hours)	50
Cost (% of warehouse value)	0.1	Ease of shareholder suits index (0–10)	7	Cost to import	
Building quality control index (0–15)	11.0	Extent of shareholder rights index (0–10)	4	Documentary compliance (US$)	43
		Extent of ownership and control index (0–10)	5	Border compliance (US$)	233
Getting electricity (rank)	37	Extent of corporate transparency index (0–10)	7		
DTF score for getting electricity (0–100)	83.22			**Enforcing contracts** (rank)	51
Procedures (number)	5	**Paying taxes** (rank)	109	DTF score for enforcing contracts (0–100)	64.54
Time (days)	37	DTF score for paying taxes (0–100)	68.68	Time (days)	440
Cost (% of income per capita)	42.5	Payments (number per year)	21	Cost (% of claim)	19.5
Reliability of supply and transparency of tariffs index (0–8)	6	Time (hours per year)	266	Quality of judicial processes index (0–18)	7.5
		Total tax rate (% of profit)	32.6		
Registering property (rank)	68	Postfiling index (0–100)	47.32	✔ **Resolving insolvency** (rank)	23
DTF score for registering property (0–100)	68.34			DTF score for resolving insolvency (0–100)	77.08
Procedures (number)	4			Time (years)	1.5
Time (days)	6			Cost (% of estate)	18.0
Cost (% of property value)	7.4			Recovery rate (cents on the dollar)	67.7
Quality of land administration index (0–30)	15.0			Strength of insolvency framework index (0–16)	13.0