Understanding the dynamic of digital economy in the context of digital literacy of Thai households

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31 August 2020

Abstract

Digital economy has led to new business opportunities and growth potential especially for developing countries such as Thailand. However, one crucial factor that could create challenges is the readiness of households in adapting to the digital environment. This research proposes that digital literacy of households is the key indicator that helps policy makers to understand the digital divide situation. Digital literacy should be measured by 4 sub-dimensions, namely, 1) the access to digital technologies 2) the level of digital skills 3) the level of digital knowledge and 4) the digital information awareness. After using the principal component analysis (PCA) to develop the scoring system of digital literacy and using the cluster analysis to classify the sample into 3 levels of digital literacy, it is found that households in the illiterate group are mostly unemployed or work in the labor-intensive sector. When looking at how they use financial services, they appear to significantly use fewer banking services and have lower preference on the personalization of services than the digital fluency group. This evidence suggests that populations in the digital illiterate group may have already suffered from the digital divide which could intensify the problem of wealth inequality in the digital era. Consequently, policies that guarantee all households to have certain levels of digital literacy are needed.

JEL Codes: G21, O10, O30

Keywords: Digital literacy, Financial services industry, Digital economy

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The author can be contacted at roongkiat@cbs.chula.ac.th. The opinions expressed in this study are those of the authors and should not be attributed to any organizations. This paper is part of the research project granted by the Integrated Strategic Research Program on Social Sciences: Khonthai 4.0 or commonly known as “Khonthai 4.0 Spearhead Program”. The author would like to thank Professor Mingsan Kaosa-Ard for all valuable opportunities and feedbacks.

1. Introduction

Over the past decades, the economy has greatly transformed from the traditional way of doing business into a digital (or electronic) format. This new economy has normally been named as "Digital Economy". This new economy is believed to generate a new path of growth for many countries, especially developing countries such as Thailand. This is because digital technology leads to new kinds of business models which transforms the economic relationship between consumers, micro and small enterprises, and large corporations.

The prime minister of Singapore, Li Sian Lung, addressed in the World Economic Forum in 2018 that the size of Southeast Asia (SEA) economy could become the world's fourth largest economy by 2030 (Loong, 2018). He suggested that the growth potential of the region results from many factors such as young demographic structure, urbanization trends and the development of digital infrastructure. Moreover, the current size of digital economy in the SEA region is currently low at only 7% of GDP, compared to 16% in China and 35% in the US (Bain & Company, 2018)

The data compiled by OECD (2019) also shows that the real growth rate of GDP at around 5% per annum experienced over the past 4 years in ASEAN is largely a result of the traditional way of doing business such as seasonal farming, labor-intensive manufacturing process and the production of low value-added products. With the globalization trend and intense competition, this level of growth may no longer be sustainable in the next decades.

Digital economy is, therefore, the only new path for ASEAN to retain the same growth rate as in the past. However, it does not mean that all individuals and enterprises will reap similar benefits from the transformation into the new economy. The situation of digital divide, where some groups of households lack behind in terms of accessing and using digital technology, could intensify the challenge of wealth inequality in the economy.

This research paper proposes that the measurement of digital literacy is needed in order to estimate how effective individuals can use the digital technology for economic activities. As digital literacy is a new concept, there is no consensus regarding the questionnaire used to measure the level of digital literacy. This paper proposes a set of questions to measure the digital literacy and applies statistical techniques to create a scoring system of the digital literacy for Thai households. It will also use a financial services industry as a case study to investigate how different levels of digital literacy could have an impact on the behavior of households in accessing and using banking services.

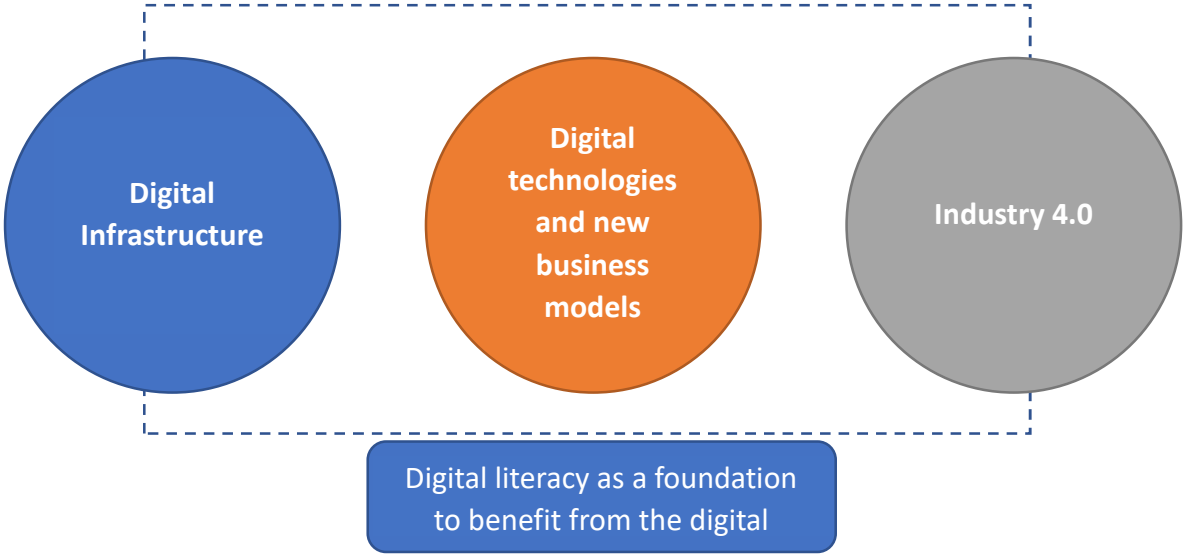
The outline of this paper are as follows. It will begin in Section 2 with the discussion on the characteristics of digital economy and how it leads to new business models and new economic relationships. This will be followed by the analysis on the aggregate statistics showing the current stage of digital economy in Thailand and across SEA countries in Section 3. The purpose of this analysis is to understand how well Thailand performs in terms of the inclusion of digital infrastructure and the ability of Thai households and enterprises in using the digital technology.

Section 4 will discuss the previous literature that attempts to study digital literacy. The insights gleaned from this literature review will be used to develop the measurement of digital literacy for Thai households. Research methodology and data sampling techniques are explored in Section 5 while the results of digital literacy and its relationship with socioeconomic status are discussed in Section 6. It will be followed by the analysis on the behavior of households in using banking products and financial services in section 7. The paper will end with some policy recommendations to improve the digital literacy of Thai households which can be considered as a key factor in determining the growth potential of Thailand in the digital era.

2. Digital economy and the emergence of new business models

The characteristics of digital economy can be defined as the economy that consists of three main components as shown in Figure 1.

Figure 1 Framework of the digital economy



The traditional infrastructure such as rail, road, water system and electrical grid is still important in the economy but digital infrastructure that includes telecommunication network, the availability of digital technology (hardware and software), and the affordability to access the internet will act as the new backbone in the digital economy.

Apart from the availability of digital infrastructure, the economy needs to utilize those digital technologies to create new business models such as the emergence of sharing platforms, e-commerce platforms and the concept of everything as a service (XaaS) models. These new business models normally lie on the concept that consumers and producers can directly meet each other at low costs through online platform. This new model makes financial intermediaries become less important.

Not just about the new business models that change relationship between economic agents in the economy, the manufacturing process of all products and services should also be

done in an innovative way by incorporating new digital technologies such as artificial intelligence (AI), robotics, big data analytics and the Internet of Things (IoTs). All these new production techniques are normally called Industry 4.0.

If the transformation to the digital economy is successful, it is forecasted that ASEAN's GDP could increase from just USD 2,670 billion in 2017 to around USD 5,000 billion in 2025 (Bain & Company, 2018). The additional growth of around USD 1 trillion is estimated to be a result of the adoption of Industry 4.0, the new opportunities from platform business models and the rise of enabling sectors such as the ICT and logistics industries which help to reduce operating costs of other sectors in the economy.

It is also expected that those additional growths in ASEAN's GDP will largely come from economic activities of micro and small enterprises. This is because the data compiled by ADB (2014) only shows that the share of gross value added of small enterprises was only at 42.2%. although the employment share was around 66.3% of total employment (based on the median figure). Moreover, in terms of export figures, small enterprises in SEA countries contribute only around 10-30% (ERIA-OECD, 2014) even though the research by López-González (2016) shows that they appear to be exporters in the global value chain more than acting as importers of foreign inputs.

The potential growth prospects for small enterprises in the digital economy is based on the assumption that they can leverage their business by the use of digital technologies. It is not only about the ability to access vast amount of information online but also the ability to enhance the use of digital applications and services and to be part of the new digital ecosystem where every transaction is taking place digitally.

Yokoi et al. (2019) shows that the top 5 industries that will mostly be disrupted in the next 5 years are 1) Media & Entertainment 2) Tech products & Services 3) Telecommunications 4) Retail and 5) Financial services. As most small enterprises appear to be involved in the retail industry, this creates new growth opportunities for them who can effectively utilize new technologies to compete with large incumbents. The new business models that emerge from the digital economy can be categorized as 1) the platform business 2) the everything as a service model and 3) the omnichannel retailing strategy.

The emergence of platform business greatly empowers small enterprises in the aspect that they can distribute their products and services both domestically and internationally at much cheaper costs. The e-commerce platform does not only provide an online presence for small enterprises, but the platforms normally offer other enabling solutions across the value chain such as marketing strategies, payment technologies, logistics, accounting management, and inventory management.

These services are provided as an entire integrated ecosystem for small enterprises to grow their business. This means that enterprises can significantly reduce costs in distributing their products and services and can use advanced digital technologies without having to invest in those technologies by themselves.

The data compiled by Competition and Consumer Commission Singapore (CCCS) shows that the top 5 industries that will be disrupted by the emergence of e-commerce are 1) Accommodation booking, 2) Flight booking, 3) Land transport, 4) Cosmetics and beauty products and 5) Fashion (CCCS, 2019). Even though this disruption creates significant impacts on existing traditional enterprises, it also creates new business opportunities for ASEAN small enterprises and startups.

As platform providers normally offer other enabling services to users, it can be considered that those services are part of a new business model called the everything-as-a-service (XaaS). This new service economy provides great opportunities for individuals and small enterprises to access certain digital technologies online through the cloud computing technologies.

XaaS can be defined as what Gartner, a research firm, provides a definition for software as a service (SaaS) with the only difference that the term "software" can be replaced by "Everything". According to Garner (2020), SaaS is "software that is owned, delivered and managed remotely by one or more providers. The provider delivers software based on one set of common code and data definitions that is consumed in a one-to-many model by all contracted customers at anytime on a pay-for-use basis or as a subscription based on use metrics."

Apart from SaaS, there are also "platform" as a service for the ability to use certain applications or digital tools, "infrastructure" as a service for the ability to use certain backbone computing hardware, or "device" as a Service for the ability to use particular devices over certain time periods. Therefore, XaaS is the new business model that allows enterprises to access digital apps or some forms of services without having to purchase a lifetime license.

XaaS is the new strategy that can be used to reduce costs related to internal support services and transform enterprises to be a "light" or "agile" organization. Large capital expenditure (CAPEX) that most organizations normally incurred in the past will now be replaced with manageable operating costs. The data compiled by S&P Capital IQ and Deloitte shows that the net value of property, plant and equipment (often known as CAPEX) as a percentage of total assets has been declining from 31% in 2001 to only 23% in 2017 for S&P Asia 50 companies (Deloitte, 2018). The maximum percentage of PPE to total assets also dropped from over 80% to just under 70%.

Without having to invest heavily in fixed assets, enterprises can move fast, have more agility and streamline workflows. If some products or services they partner with are outdated or become ineffective, enterprises can easily replace those services with newer versions.

Due to this new business paradigm, many high-profile firms that have already developed superior software or platforms for their internal operations are also finding new ways to deliver their own legacy assets to support other enterprises. This can be done by a few technical upgrades and strategically deployed APIs. For instance, Amazon provides its own internal services such as customer service systems, financial service platforms and

warehouse systems for other enterprises to use in their businesses (Deloitte, 2017). From the Amazon's perspective, this strategy monetizes its current work process for subscription fees.

Another possibility of XaaS is financial institutions providing core banking infrastructure for other enterprises to use. Currently, most financial institutions have developed credit approval process, payment process, authentication process or data analytics system for their own operations. These infrastructures could be adapted and provided as XaaS to their existing customers. This would enable small enterprises or large corporations to use "authentication-as-a-service", "data validation-as-a-service", "credit scoring-as-a-service", or "payment process-as-a-service" capabilities.

However, there are also some drawbacks of using XaaS. Enterprises may not have a full control on services they purchase. Some interruptions in the services may be fixed faster if done in-house rather than remotely by the managed service providers (MSPs). Lastly, XaaS can create concerns about data privacy and cyber security as some processes are done through cloud computing technology.

Those e-commerce platforms and everything-as-a-service models also allow enterprises to have new strategies in marketing. Enterprises are required to integrate offline and online sales in a seamless way. In the past, enterprises normally apply only one single channel when reaching out to consumers. Then, multi-channel retailing has emerged with the concept that consumers can have different shopping experience from each channel. However, enterprises still do not integrate different shopping channels together to create seamless experience. In order to integrate all sale channels in a more effective way, the concept of omnichannel retailing is emerged which combines multi-channel and cross-channel together.

The omnichannel retailing is essentially a result of digital economy with high-speed connection network, smart devices, and social networks. With these three factors, customers can experience new behavior in researching, browsing and purchasing. The shopping journey may not be as straightforward as browsing the products online and then buy from the brick-and-mortar store. It can be any combinations such as researching online, browsing offline and buying online.

Omnichannel is not about having multiple channels such as a website, a mobile app, and a physical store. But it is more about integrating those multichannel by utilizing digital apps and services that can link data about inventory, sales, and customer data together. This linkage of data can be done solely by one single digital platform or done separately between different platforms through APIs.

An interesting use case of O2O strategy is "Miaojie" app created by Alibaba in 2015. This application acts as a third-party shopping app which many enterprises can use to enhance shopping experience in their physical stores. The app used to launch a "walking campaign" where users can earn "miles" during their shopping in physical stores. Miles can be redeemed for some rewards. This strategy lengthens the time consumers spend in physical stores and increase more visits (Fung Business Intelligence Center, 2015).

Miaojie app is an example of a digital tool that enterprises can subscribe to get services and enhance their omnichannel retailing strategy. Other examples of famous omnichannel strategies include in-store interaction (i.e. ShopKick), price relation (i.e. ShopSavvy) and offline surveying to online shopping (i.e. Taobao).

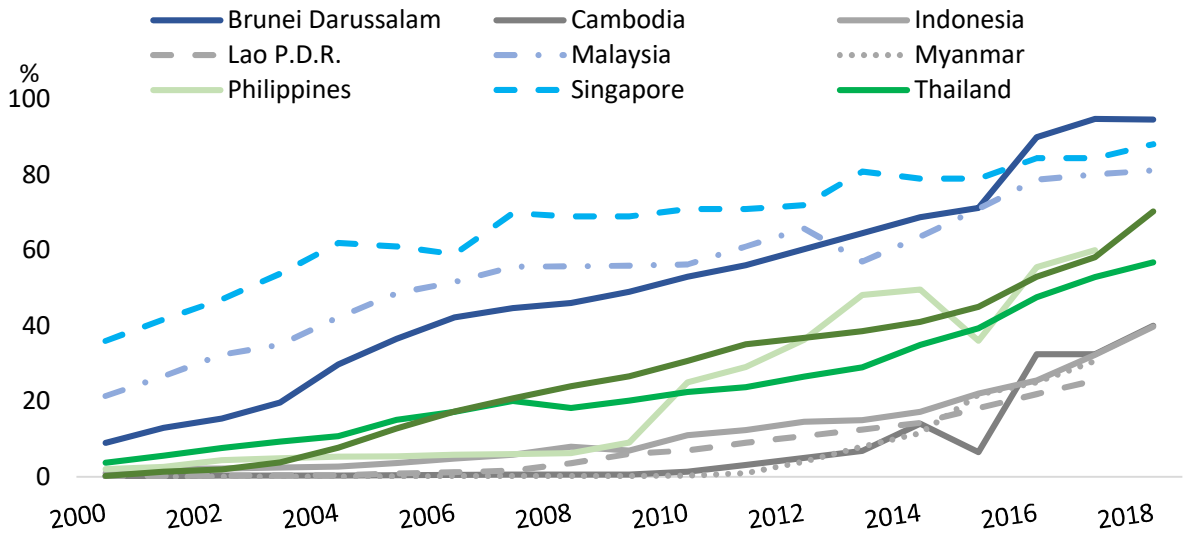
To sum up, digital economy is not only about doing all transactions online or selling products and services through e-commerce platforms. It is more about the availability of digital infrastructure and the ability of enterprises and households to leverage on the digital technologies for new opportunities. In order to reap all the growth potential arising from new business models and industry 4.0, it is required that populations should equally have access to digital technologies and possess a certain level of digital skills. The next section will review and discuss the current stage of digital economy in Thailand.

3. Current stage of digital Economy in Thailand

The stage of digital economy can be understood by the measurement of its inclusiveness of digital infrastructure. The aspects of inclusiveness normally fall under two main categories which are 1) the degree of access and 2) the quality of internet connections.

Regarding the degree of access, Figure 2 shows that even though there were high growth rates in the percentage of individuals using the internet in Thailand, the level of internet penetration is only around 60% which is still lower than Brunei Darussalam, Singapore and Malaysia where the penetration rate stands at around 80%. The low internet usage can come from many factors such as insufficient bandwidths, high price, low speeds and under coverage of fixed and mobile broadband.

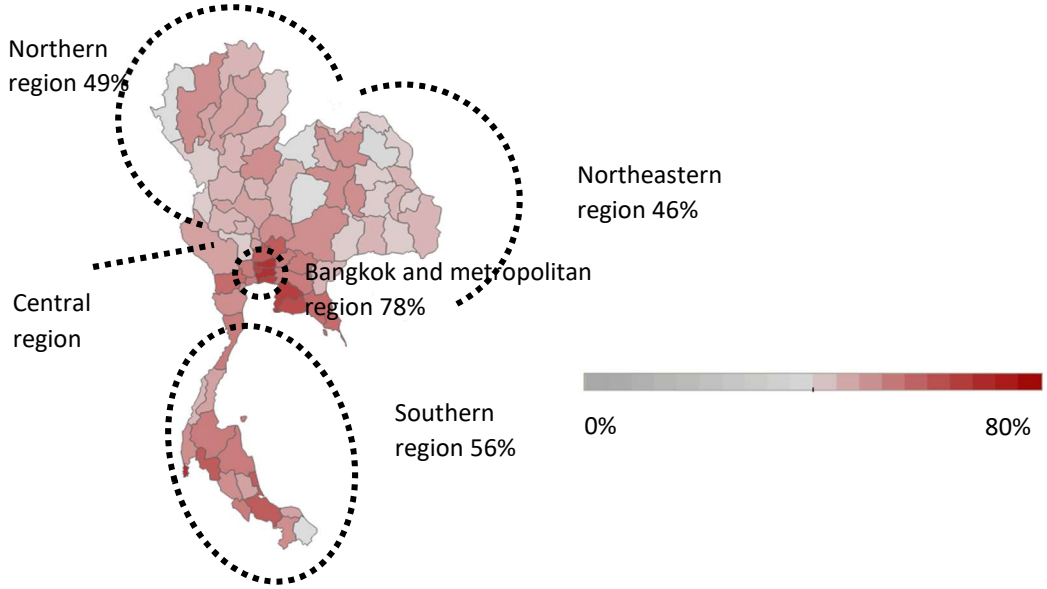
Figure 2 Percentage of individuals using the internet in ASEAN



Sources: ITU (2019), ITU World Telecommunication/ ICT Indicators (database), http://www.itu.int/en/ITU-D/Statistics/Pages/default.aspx

When analyzing the internet access across different regions in Thailand, Figure 3 shows that there is a large variation of internet access from as low as 34.7% in Sakon Nakhon to as high as 79.27% in Phuket. The regions of concerns are the Northeastern and Northern region where the rates of internet access are only at 46% and 49% respectively. This level of internet access is still not impressive when comparing with other key developed countries such as 96% in the Republic of Korea, 91% in Japan, 88% in Singapore and 87% in the US (based on ITU database).

Figure 3 Internet penetration rates in Thailand (2018)

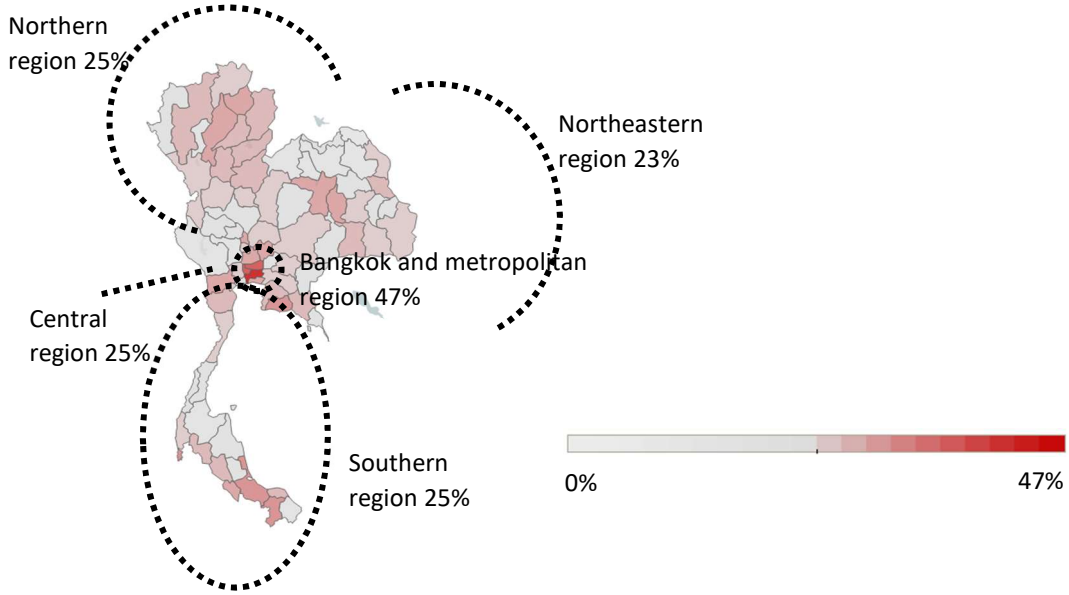


Sources: National Statistics Office

Another aspect used to measure the degree of access is the penetration rate of computer which stands at only 28% in Thailand (Figure 4). If Bangkok is excluded, the average penetration rate of computer will drop to as low as 25%. This level of penetration rate is quite low compared to the average of around 77% for the European countries and around 52% for the Asia-Pacific region (estimated from the countries with available data in ITU database).

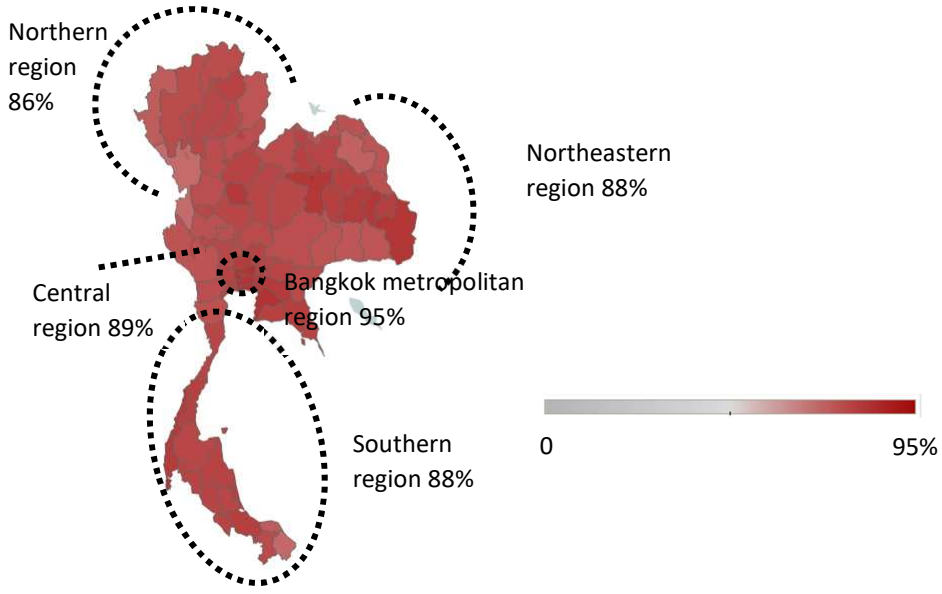
The only impressive indicator of digital access in Thailand is the penetration rate of mobile phone as shown in Figure 5. The high penetration rate at 89% is similar to the levels seen in Denmark, Sweden, and Singapore. In addition, at least 70% of the populations in every province can access mobile phones, by either having their own device or using the device of other members in a household.

Figure 4 Computer penetration rates in Thailand (2018)



Sources: National Statistics Office

Figure 5 Mobile phone penetration rates in Thailand (2018)



Sources: National Statistics Office

The data compiled by the National Statistics Office also shows that there are some variations of digital technology access when considering across different age groups, education levels and occupation types as shown in Table 1. The use of digital technology appears to largely be concentrated in individuals with the bachelor's degree or above. Some occupation types such as agricultural workers, elementary workers, and blue-collar workers have significantly low access to computers and the internet.

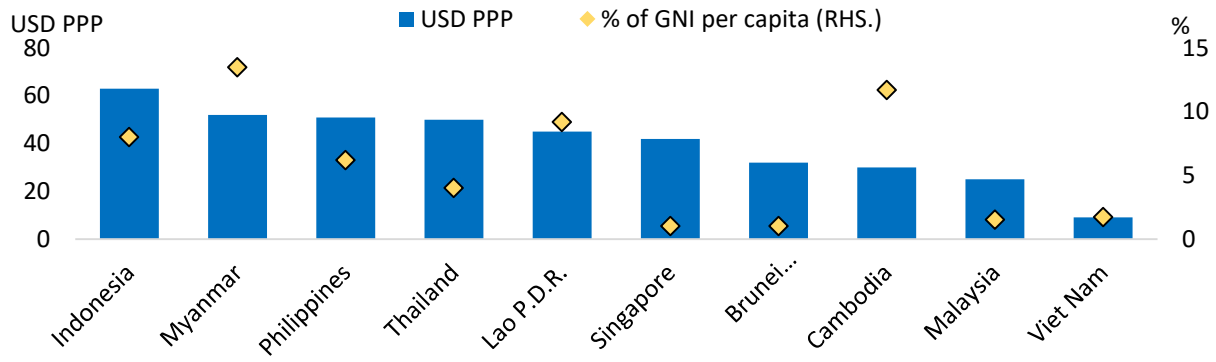
Table 1 Penetration rates of computer, internet and mobile phone across gender, education and occupation

		Computer	Internet	Mobile phone
Gender	Male	27.54%	57.78%	89.95%
	Female	29.01%	55.90%	89.16%
Education	No education	2.80%	15.17%	60.53%
	Less than primary education	17.52%	22.57%	76.85%
	Primary education	22.27%	52.42%	93.70%
	Secondary education	27.76%	77.17%	97.59%
	High school	29.43%	81.48%	98.26%
	Diploma	40.26%	89.18%	98.95%
	University level	71.71%	95.12%	99.46%
Occupation	Managers	58.02%	87.59%	99.56%
	Professionals	90.87%	98.52%	99.67%
	Technicians and Associate professionals	76.70%	95.71%	99.67%
	Clerical support workers	80.56%	96.80%	99.65%
	Services and sales workers	16.62%	68.77%	97.84%
	Skilled agricultural, forestry and fishery workers	1.95%	28.90%	93.65%
	Craft and related trades workers	11.03%	61.63%	96.35%
	Plant and machine operators and assemblers	7.58%	74.33%	98.26%
	Elementary occupations	3.09%	45.20%	93.81%
	Armed forces occupations	73.53%	94.97%	100.00%

Sources: National Statistics Office

One main factor that could explain the low penetration rates of digital technologies is the price level of communication services. Broadband Commission for Sustainable Development (2017) proposed that the reasonable price level of communication services in each country should be around 5% of monthly gross national income (GNI) per capita. The data compiled by the International Telecommunications Union (ITU) shows that the price of fixed broadband in Thailand is around $50 (measured under the Purchasing Power Parity metric) which equals to around 4% of GNI per capita (Figure 6).

Figure 6 Price of fixed broadband monthly subscriptions in ASEAN (2017)



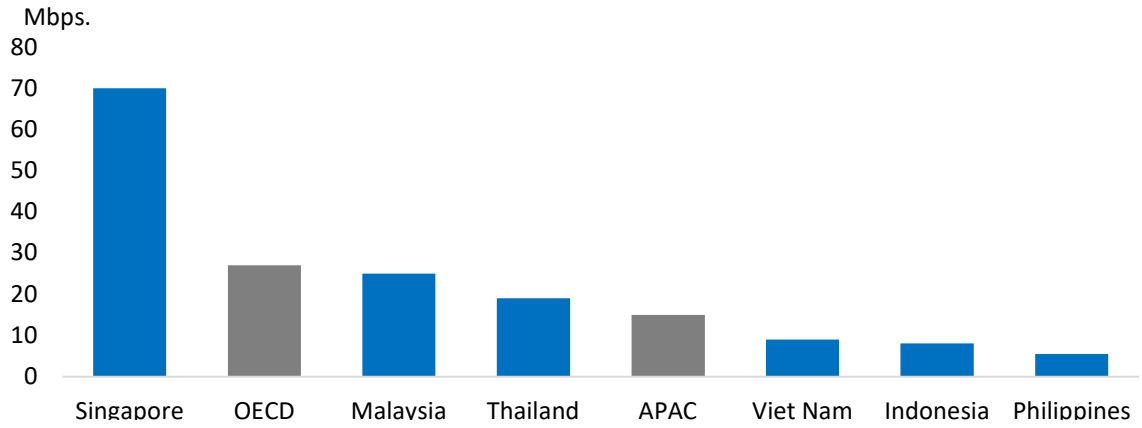
Source: ITU(2019), ITU World Telecommunication/ICT Indicators (database),https://www.itu.int/en/ITU-D/Statistics/Pages/stat/default.aspx

Even though the price of communication services is within the reasonable level, Thailand could do better because the price of fixed broadband subscription can be reduced to as low as 1-1.5% of GNI per capita in Brunei Darussalam, Singapore and Malaysia. This low cost in accessing the internet could be one of the reasons explaining the high penetration rate of internet at 80% in those countries.

Although the penetration rate of mobile subscriptions approaches 80% in most ASEAN countries (OECD, 2019), this does not suggest that mobile broadband can solve the problem of low internet accessibility in the region. The heavy reliance on mobile broadband can lead to the situation where the average speeds of mobile connections are relatively low due to insufficient bandwidth. Fixed and mobile networks are not a substitute but rather a complementary as Wi-Fi technology can offload mobile traffic.

Regarding the quality of internet access, the speed of connection experienced by users is the key indicator commonly used. The M-Lab data shows that the average download speeds of data in Thailand is around 19 Mbps which is slightly higher than the average speed of the Asia-Pacific countries. However, this level of speed is only 60% of those in the OECD countries (Figure 7).

Figure 7 Measurement of mean download speeds (fixed broadband) - 2019

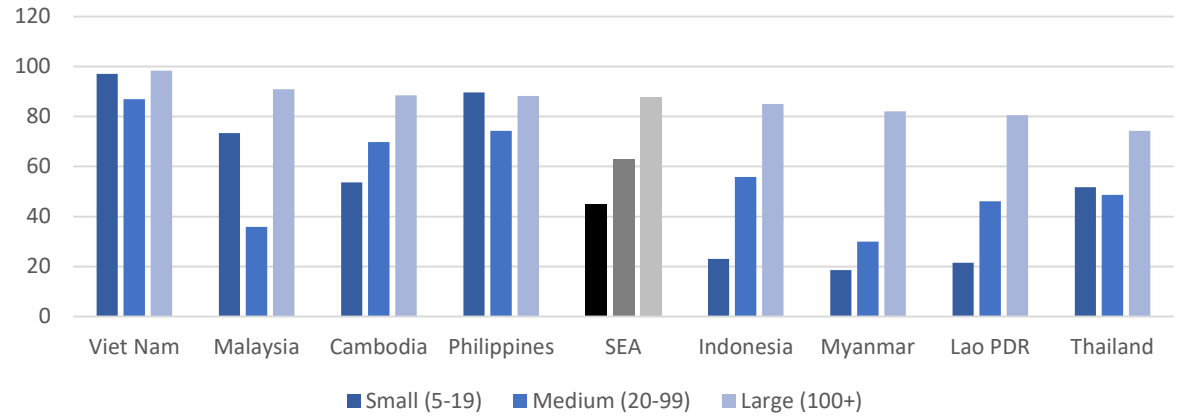


Soure: Cable (2019), Worldwide Broadband Speed League 2019 (database)
http://www.cable.co.uk/broadband/speed/worldwide-speed-league

Apart from those statistics representing the stage of digital infrastructure in Thailand, the other statistics that can be used to measure how well the economy can perform in the digital economy is the usage and access of digital technology by enterprises. Bain & Company (2018) estimates that 65% of rural SMEs in the SEA region still face weak internet connections. Moreover, seamless cross-border payment options are still limited as financial institutions in some SEA countries have not developed and provided these services to SMEs. Although SMEs can sell their products oversea through cross-border e-commerce, 50% of SMEs express concerns about the cross-border trade processes and logistics infrastructure which make it difficult for seamless digital trade to occur.

Owing to those barriers, the data surveyed by ERIA (2019) shows that only 10% of small enterprises use advanced digital tools such as Enterprise Resource Planning (ERP), Customer Relationship Management (CRM), Big data analytic and automation in their operations. When looking at the use of basic software, World Bank database and Enterprise surveys show that only 50% of small firms in Thailand use email to communicate with clients and suppliers. This figure is slightly more than the average figure of the SEA region but the proportion of large firms using email to communicate with clients/suppliers in Thailand still lack behind at only 72% compared to the average value at 85% as shown in Figure 8.

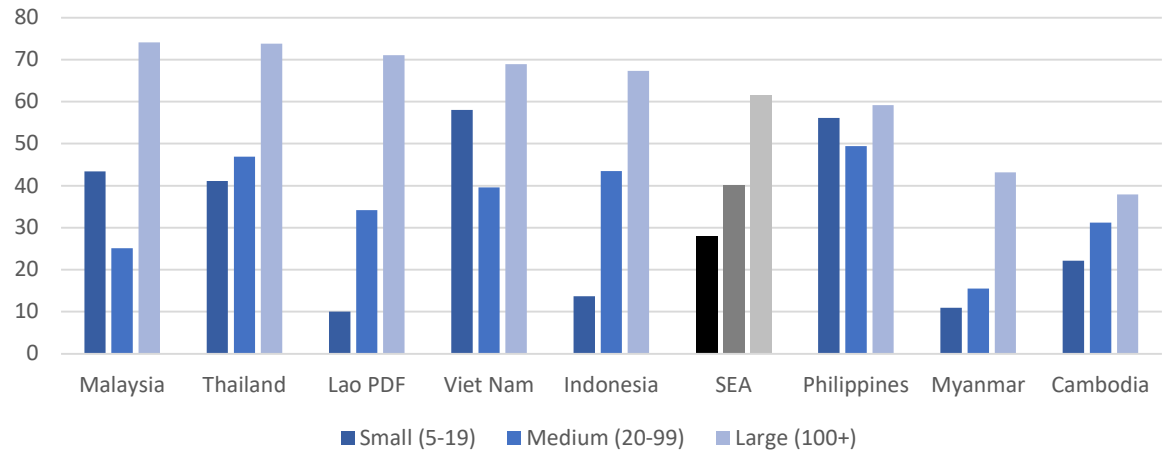
Figure 8 Firms using email to interact with clients/suppliers (2015 and 2016)



Source: World Bank (2019), Enterprise Surveys (database), www.enterprisesurveys.org

Even though the number of social media accounts in Thailand is as high as 75% of the total population (We are Social, 2019) and around 70-77% of firms having a Facebook fan page (Facebook/OECD/World Bank, 2019), the enterprise survey by World Bank only shows that 40% of small firms in Thailand have their own website. Large firms in Thailand appear to do much better with more than 70% having their own website (Figure 9).

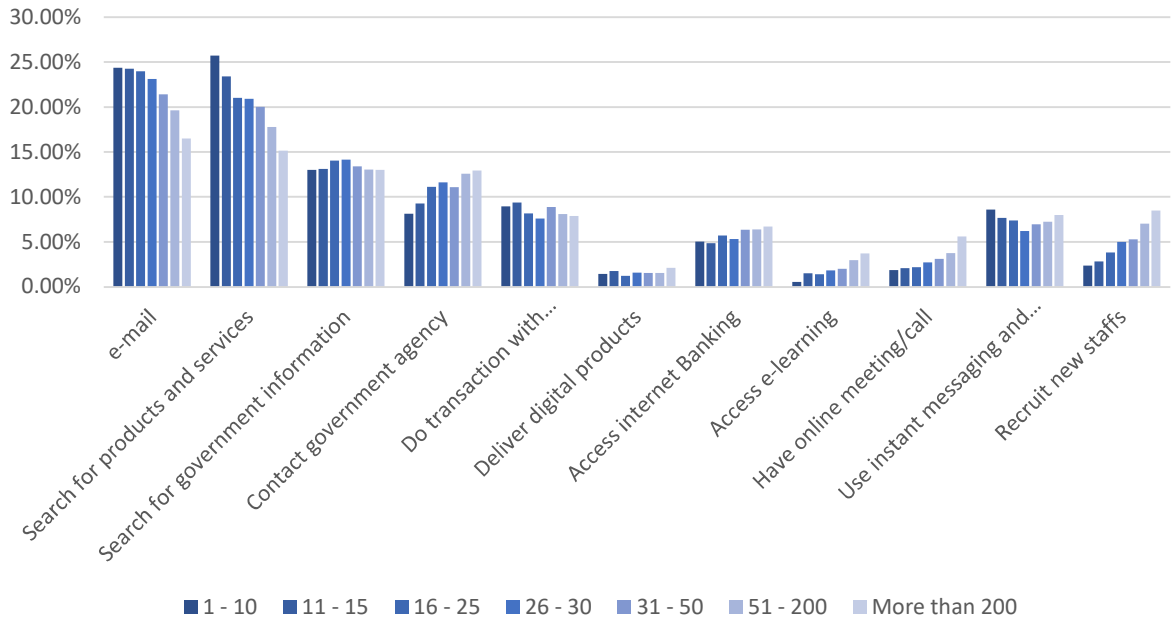
Figure 9 Firms with their own website (2015 and 2016)



Source: World Bank (2019), Enterprise Surveys (database), www.enterprisesurveys.org

When looking in detail about how firms in Thailand use the internet, the survey by National Statistics Office shows that small firms appear to particularly use the internet only for e-mail and searching for products and services while large firms tend to use the internet across different activities (Figure 10). This suggests that small firms only use basic activities while large firms use more advanced applications for different tasks.

Figure 10 Internet usage activities of enterprises in Thailand across firms with different number of staffs



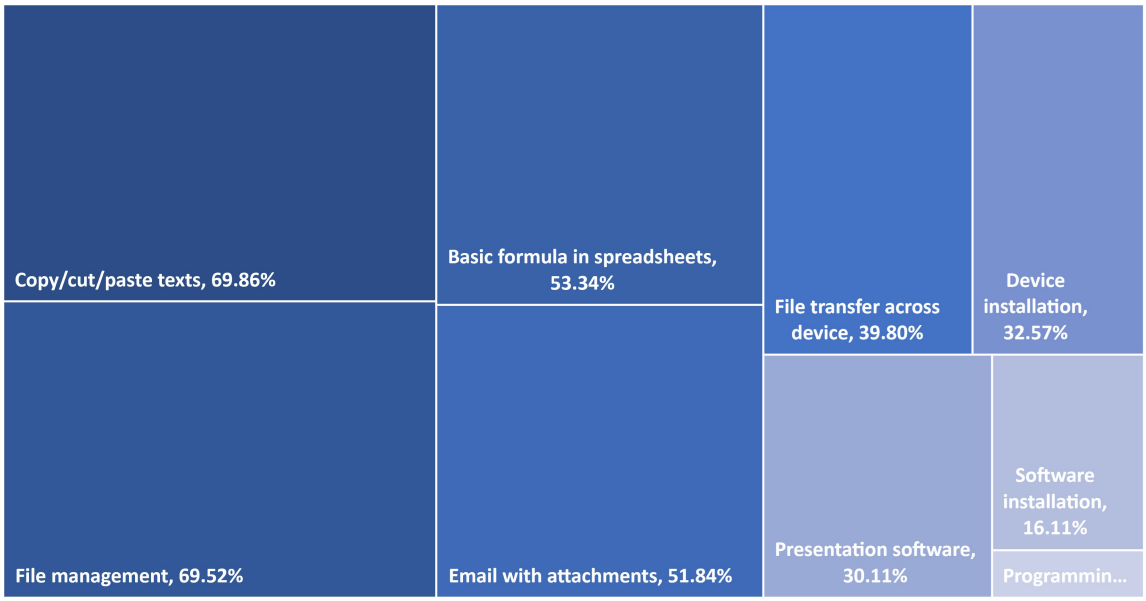
Source: National Statistics Office

When looking at the adoption level of e-commerce in ASEAN, the UNCTAD B2C e-commerce index 2019 shows that Thailand ranked only at 48th globally compared to Singapore at 3rd, Malaysia at 34th, Vietnam at 64th and the Philippines at 89th (UN, 2019). Key limitations that prevent small enterprises from reaping the full benefits of e-commerce are the lack of digital payment options and physical infrastructure.

Although small enterprises in ASEAN lack behind in terms of the digital technology utilization, the survey by EY (2019) demonstrates that 81% of SMEs in ASEAN would like to leverage its business with digital technologies in the future. The top priority of SMEs' investment in the next 3 years is the investment in the payment technologies (68.2%), big data and machine learning (66.0%) and process optimization through blockchain (53.3%).

The limited skills of using digital technology does not only exist at the enterprise level. The survey by the National Statistics Office also shows that most Thai households can only do basic functions such as copy/cut/paste texts and file management. Only half of them can do basic calculation in Excel and send email with file attachments. In addition, more than 70% of Thai households could not use complicated software (i.e. graphic, presentation and excel) or could not install software in a device as shown in Figure 11.

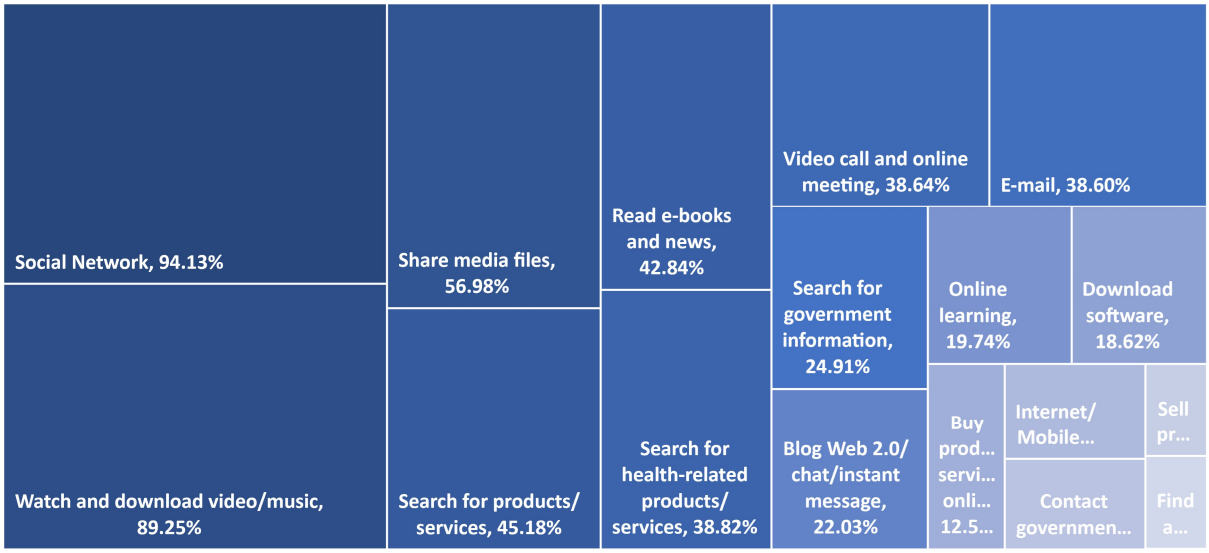
Figure 11 Percentage of households having the abilities to do certain digital tasks



Source: National Statistics Office

When Thai households use the internet, online activities appear to be concentrated in only leisure and low productive activities such as using social network, uploading/downloading media file and making calls as illustrated in Figure 12. They hardly use the internet for e-commerce transactions, internet/mobile banking, search for a job or start a business.

Figure 12 Percentage of households using the internet across different activities



Source: National Statistics Office

As most SEA countries including Thailand still have lots of gaps to improve, many countries have decided to outline a roadmap to facilitate the transformation into the digital economy. For example, Singapore is gearing for the Smart Nation by setting Committee for the Future Economy initiatives (IMDA, 2014). Malaysia laid out the Industry 4.0 transformation by launching the world's first digital free trade zone with Alibaba (Sue-Ann, 2017). The country also allocated RM250 million for fiber backhaul projects in rural areas such as Sabah, Sarawak and parts of Peninsula Malaysia (Sharon, 2020).

In Thailand, the Ministry for Digital Economy and Society was established in 2016 to support policies for the digital economy. The 20-year Masterplan to develop the National Digital Economy has also been drafted which includes 4 phases of development, namely, 1) building the digital infrastructure 2) increasing the digital inclusion throughout the country 3) transforming the government work process and 4) achieving the leading role in the global arena (Heeks & Bukht, 2018). This masterplan is summarized as the "Thailand 4.0" initiatives for campaigning the policy to wider public.

Apart from the policy in each country, there are also some collaborations in the regional level to encourage digital developments. The blueprint for the ASEAN Economic Community (AEC) 2025, the ASEAN ICT Master Plan 2020 and the Master Plan on ASEAN Connectivity 2025 are a few documents outlining the digital development plans of ASEAN (Internet Society/TRPC, 2015). The main policy objectives are to expand broadband connectivity and promote the diffusion of ICT technologies such that the logistics, e-commerce, banking, and manufacturing industry can prosper in the digital era (Mitra, 2019).

However, one last key point that policy makers should not overlook is the variation of digital inclusion between rural VS urban areas and between old VS young populations. The digital divide, if exist in the society, could create new challenges such as cyber security issue, the comparative disadvantages of small enterprises in rural areas compared to those in urban areas, and the ageing population being left behind in the digital economy.

This research proposes that the measurement of digital literacy could be a key policy variable that policy makers should focus on in the next decades. The investigation about digital literacy and socioeconomic factors would allow policy makers to understand the problem of digital divide and prepare some preemptive actions to mitigate any challenges that may arise. As a consequence, the next section will discuss previous literature that attempts to understand the mechanic of digital literacy.

4. Literature review on digital literacy

Digital transformation has led to significant shifts in the relationship among economic agents in the economy. Even though this transformation is aimed to improve the efficiency of business operations and the satisfaction of customers, it does not mean that every group of populations will equally benefit from the digital economy. This section will propose the idea that "digital literacy" can be an important indicator in understanding the dynamic of digital

economy. The measurement of digital literacy can be a new policy tool to measure the ability of households to access and use digital technologies.

This section will begin with the discussion of why digital literacy is an important indicator. It will be followed by a review of literature that attempts to investigate the relationship between the level of digital literacy and key socioeconomic characteristics. The main goal of this research is to understand the digital divide situation which would allow policy makers to design policies to mitigate the problems of inequality in the digital era.

4.1 Definition of digital literacy and its importance

The rate of technology developments has increased tremendously in the past few years compared to the rate of changes over the past 200 years. In the era of baby boomers, the wireless technology with radio wave connections has just occurred. Then, during the period of generation X, the television technology has emerged which followed by the period of personal computers and desktops in the 1980s. This is the beginning of the digital era which starts to grow in an exponential rate until fast wireless connections, smartphones, tablets, and IoT devices are widely used in the market nowadays.

This rapid digital transformation does not only occur within the Information and Communication Technology (ICT) industry, but it also leads to new kinds of business models across various industries. The financial sector which appears to be conservative and hardly be disrupted by any technological changes in the past is also under pressure by the new digital technology that transforms how banking products and financial services are delivered.

For example, they were pushed to offer zero transaction fees for most of the digital and mobile transactions. The deposits and lending business also face with new competing products such as the emergence of P2P lending platform, crowdfunding platforms and market place lending. The popularity of cryptocurrency with the use of distributed ledger technology provides the possibilities for low-cost and real-time cross border transfers.

All these examples are just a few examples that could change the way commercial banks deliver financial services. On one hand, this transformation could improve the efficiency of banking process. However, on the other hand, it could inhibit the progress of financial inclusions if some groups of populations are unable to adapt to all those digital transformations.

Many academics found that the gap in accessing digital technology in the 21st century may be the widest of our mankind history. The existence of digital divide does not only affect the ability of households in accessing products and services but also affect social norms, value, culture and political views. For instance, young generations tend to use short sentences with keywords instead of long and complete sentences so as to make it faster when sending messages through chat messaging apps.

Digital divide is, therefore, the main challenge of policy makers when designing certain policies to increase digitalization. In the developed countries such as the US, the UK, and Canada where many believe that the digital divide may be limited, but the research by Jones and Fox (2009) and Zhang, Callegaro, and Thomas (2008) show that some populations still

cannot access the internet. In order to identify the level of digital divide, it is necessary to define some indicators used to measure the ability of populations in accessing and using digital technologies. This research proposes the measurement of digital literacy as the key policy variable to monitor.

Digital literacy is the new term that academics still have some debates about its definition. In the past, it is sometimes used interchangeably with ICT fluency, digital competence, digital citizenship, technological literacy or e-literacy. However, it may be too narrow to limit the definition of digital literacy to only the skills and ability to use digital technology.

Initially, the term called "computer literacy" was used in the 1970s to measure the ability to code computer commands and to create software for computer processing. When there was a widespread use of internet connection, a new term called "information literacy" and "network literacy" was created in the 1980s and 1990s respectively. However, those terms appear to focus only on certain aspects of using digital technology. Then, there was an idea in 1999 to combine critical thinking skills with the behavior in using digital technology. This is the first time that digital literacy has been mentioned (Eshet-Alkalai, 2004).

The difficulty in measuring digital literacy is, therefore, related to the fact that this term involves various skills across different disciplines. A few examples of digital literacy definitions are shown in Table 2. It can be seen that digital literacy is not only about the ability to use digital technology, but it will cover the ability in searching, evaluating, synthesizing the digital information received from the digital world.

Table 2 Examples of digital literacy definitions

Literature	Definitions
European Information Society stated in Martin (2005)	"Digital literacy is the awareness, attitude and ability of individuals to appropriately use digital tools and facilities to identify, access, manage, integrate, evaluate, analyse, and synthesize digital resources, construct new knowledge, create media expressions and communicate with others, in the context of specific life situation, in order to enable constructive social action and to reflect upon this process."
British Future lab's handbook on digital literacy across the curriculum stated in Hague and Payton (2010)	"To be digitally literate is to have access to a broad range of practices and cultural resources that you are able to apply to digital tools. It is the ability to make and share meaning in different modes and formats: to create, collaborate and communicate effectively and to understand how and when digital technologies can best be used to support these processes."
Stordy (2015)	"The abilities a person or social group draws upon when interacting with digital technologies to derive or produce meaning, and the social, learning and work-related practices that these abilities are applied to".

These conceptual frameworks have led Eshet-Alkalai (2004) to propose that digital literacy need to cover 5 dimensions, namely 1) Photo-visual literacy 2) Reproduction literacy 3) Branching literacy 4) Information literacy and 5) Socio-emotional literacy. The recent study by Ng (2012) also proposes a framework of digital literacy which includes 3 important skills, namely 1) Technical skills 2) Cognitive skills and 3) Social-emotional skills.

Spengler (2015) proposes similar concepts as Ng (2012) but use different terminologies by stating that digital literacy should cover 3 literacy, namely 1) computer literacy, 2) media literacy and 3) information literacy. Gui and Argentin (2011) further state that digital literacy should not only cover skills in certain dimensions, but it should also include the ability to continually adapt skills in an extremely dynamic environment. Hinrichsen and Coombs (2013) emphasize that digital literacy needs to cover the ability to understand information, seek for meaning, and evaluate the risk of personal data in an online world.

Because digital literacy involves many disciplines, some academics (Kalantzis & Cope, 2006) may use the term called 'Multiliteracies' and 'New literacy' to represent skillsets that populations should possess in the digital era. The term "New literacy" extends to cover the ability to use letters, symbols, colors, sound, image and graphic for online communication. Lankshear and Knobel (2003) elaborate that "New Literacy" is the knowledge that leads to new digitally saturated social practices. These skills go beyond the ability to write because it covers the ability to create hyperlinks to connect different media such as documents, image, video, and sound together.

Based on the review on digital literacy definitions, this research proposes that the digital literacy should be measured by 4 sub-dimensions, namely 1) the access to digital technologies, 2) the skills to use digital technologies, 3) the knowledge to understand digital technologies and 4) the awareness about privacy, safety and risk of using digital information.

These measurements of digital literacy, if used with other basic skills in life, can assure that persons with a high level of digital literacy would possess following characteristics.

- The ability to use and conduct computer-based operations in daily life
- The ability to search, identify and evaluate online information
- The ability to choose technology and devices for solving problems or for generating innovation.
- The ability to behave ethically in an online world.

4.2 Understanding digital divide

In the past, the term called "digital divide" only refers to the inequality in accessing digital technology and using the internet. For example, the research by Jones and Fox (2009) and Zhang, Callegaro, and Thomas (2008) show that there are some degrees of internet inequality in the U.S. Because of this narrow definition, policy makers mostly paid attention on only the inclusiveness of digital infrastructure.

However, the definition of digital divide should be extended and include the fact that populations in different ages or in different occupations may possess different levels of digital literacy. One factor that most researchers assume to be the significant cause of digital divide is generation. For example, the new generation who born after 1980 is assumed by Prensky (2001) to possess digital literacy since they were born because they are surrounded with digital technologies. This assumption has led to a new generation called "Digital natives" or "Net generation" (Tapscott, 1998).

This concept of digital natives come from the analogy with language development that when a person born with parents using certain language, he would be able to use that language very fluently and that language is considered as his mother tongue. Thus, a person born with digital technology may be a native speaker of digital skills. Prensky (2001) posits that digital natives will have a culture of linking, creating and sharing information online such as blogging, playing video games, downloading music, buying products online and using social network. Another characteristic of digital natives is the ability to manage visual information and use digital technology with ease of performance by multitasking.

Based on the idea of Prensky (2001), Helsper and Eynon (2010) suggest further that the development of Web 2.0 could separate digital natives into 2 subgroups, namely the second-generation digital natives for those born after 1990 and the first generation digital natives for those born between 1983 – 1990. The concept of digital natives also leads to the concern in education system that teachers who teach new generations is “non-digital natives” that use “pre-digital language”. Therefore, they may not have the capability to teach “digital natives” who use “digital language” as their mother tongue (Cornu, 2011).

Because digital divide is initially assumed to arise from generation-related factors, most research in the past attempt to find relationship between age and the use of digital devices. However, the research by Dimaggio et al. (2004) and Hargittai (2008) find that age and generation factors are not the only two important factors explaining digital divide. Other socioeconomics factors such as ethnicity, education levels, income, occupation types and postal address are also significant in explaining digital divide (Bimber, 2000; Hoffman & Novak, 1998; Loges & Jung, 2001).

Although gender appears to have low relationship with digital divide when measured through the aspect of internet access (Ono & Zavodny, 2003) and digital device access (Nasah et al., 2010), education levels appear to have significant impacts on digital divide. Howard, Rainie, and Jones (2001) find that those graduated at the bachelor’s degree or higher tend to have more usage of the internet for productive activities such as accessing banking services and reading news than those graduated from lower levels. This means that the “capital-enhancing activities” are more prevalent among those graduated at the bachelor’s degree or higher. Moreover, Hargittai and Hinnant (2008) find that the level of education is negatively related with recreational activities such as playing video games, consuming digital media or gambling. The research by Dimaggio et al. (2004) also discover similar results as Howard, Rainie and Jones (2001).

In addition, Kennedy et al. (2008), Kvavik, Caruso, and Morgan (2004) and Livingstone and Bober (2004) find that internet usage patterns are significantly different among ethnic groups. Students from low socioeconomic status and females with Hispanic and African American racial appears to have less knowledge in using the internet compared to others (Hargittai, 2010). It is often argued that the difference in the behavior of using the internet is a result of different web experience of parents and the level of autonomy allowed in the family.

Perez-Escoda, Castro-Zubizarreta, and Fandos-Igado (2016) who investigate the digital literacy of students at primary schools suggest that digital literacy requires proper education systems to help young generations to develop digital skills. The research by Bullen et al. (2008) also find that students in Canada may know how to use digital devices but they still lack the knowledge of understanding the mechanism inside most digital technologies.

Kvavik (2005) also find that even though students at the bachelor's degree know how to use Microsoft offices, they only know basic functions and they still could not manage to find solutions to do new tasks. Lorenzo and Dziuban (2006) who investigate the behavior of students in searching and analyzing information online conclude that "students aren't as net savvy as we might have assumed". This has led Helsper adn Eyno (2010) to conclude that digital divide will significantly be determined by 4 main factors namely, 1) Breadth of use, 2) Experience, 3) Gender and 4) Education.

Those empirical evidences about digital divide appear to contradict with the assumption of "digital natives". It means that the policy attempting to increase the inclusion of internet may not be a perfect solution to solve digital divide as it only mitigates one aspect of digital literacy. Socio-familiar context that has negative impacts on the use of digital technology should also be addressed by policy makers to reduce the large gaps of digital divide. As the concept of digital natives lacks research findings to prove it empirically, a better way to understand the dynamic of digital divide is to measure the level of digital literacy that combines many important sub-dimensions altogether.

5. Research methodology and data sampling

Based on the literature discussed above, there appear to be some relationships between the behavior of using and accessing digital technologies and socioeconomic variables such as age, generations and family contexts. The samples used for this research are, therefore, required to cover populations across different ages and socioeconomic status. In order to achieve that outcome, the stratified sampling technique that partitions the samples across age groups is used. This sampling procedure could ensure that the distribution of the sample will closely be similar to the age distribution of populations in Thailand.

The definition of generations used in this research is derived from Pew Research center (2019) who classifies Baby boomers as those born during 1946-1964, Gen-Xs as those born during 1965-1980, Millennials (Gen-Ys) as those born during 1981-1996 and Gen-Zs as those born during 1997-2012. According to the National Statistics Office, the actual distribution of Thai population in different generations is shown in Table 3. Therefore, the sampling in this research will include the proportion of individuals in different age groups according to this distribution.

Table 3 Proportion of Thailand population across different generations

Generation	Birth years	Demographic structure in Thailand
Baby boomers	1946-1964	22.18%
Gen-X	1965-1980	28.81%
Millennials	1981-1996	26.43%
Gen-Z	1997-2012	22.58%

Note: Demographic structure in Thailand is based on the figures in 2018.
Source: National Statistics Office

Regarding the number of samples, this research uses the Cochran (1963) technique to estimate the minimum number of samples that can meet certain levels of precisions (*e*), degree of variability (*p*) and the significant level (α). After assuming the level of precision at 5%, the degree of variability at 50% and the significant level at 5%, it can be estimated that the number of samples should be at least 385 for the total number of populations in Thailand at around 65 million. Consequently, the total number of samples in this research is set at 500.

However, due to time and budget constraints, the samples are randomly drawn only from the populations living in the Bangkok Metropolitan Region. In order to have samples living across different districts within the region, the number of samples in each district will be fixed as shown in Table 4. This sample drawing procedure is designed to make the samples in this research accurately represent the populations in the Bangkok Metropolitan Region.

Table 4 The classification of sampling across different areas of Bangkok Metropolitan region

Age group / Area	55-73 (Baby boomers)	39-54 (Gen-X)	23-38 (Millennials)	7-22 (Gen-Z)	Total
Nonthaburi	7	10	9	7	**33**
Samut Sakhon	7	10	9	8	**34**
Samut Prakan	7	10	9	7	**33**
Phra Nakhon	6	8	7	6	**27**
Dusit	6	8	7	6	**27**
Bang Khen	6	8	7	6	**27**
Lak si	6	8	7	6	**27**
Bang Kapi	6	8	7	6	**27**
Phra Khanong	6	8	7	6	**27**
Lat Krabang	6	8	7	6	**27**
Din Daeng	6	8	7	6	**27**
Chatuchak	6	8	7	6	**27**
Khlong Toei	6	7	7	6	**26**
Lat Phrao	6	7	7	6	**26**
Don Mueang	6	7	7	6	**26**
Rat Burana	6	7	7	6	**26**
Bangkok Noi	6	7	7	6	**26**
Bang Bon	6	7	7	7	**27**
Total	**111**	**144**	**132**	**113**	**500**

The methodology used to obtain the samples living in certain districts is by visiting the district offices and randomly ask individuals who visit the offices until the total number of samples in each age group is attained. According to this sampling technique, the final

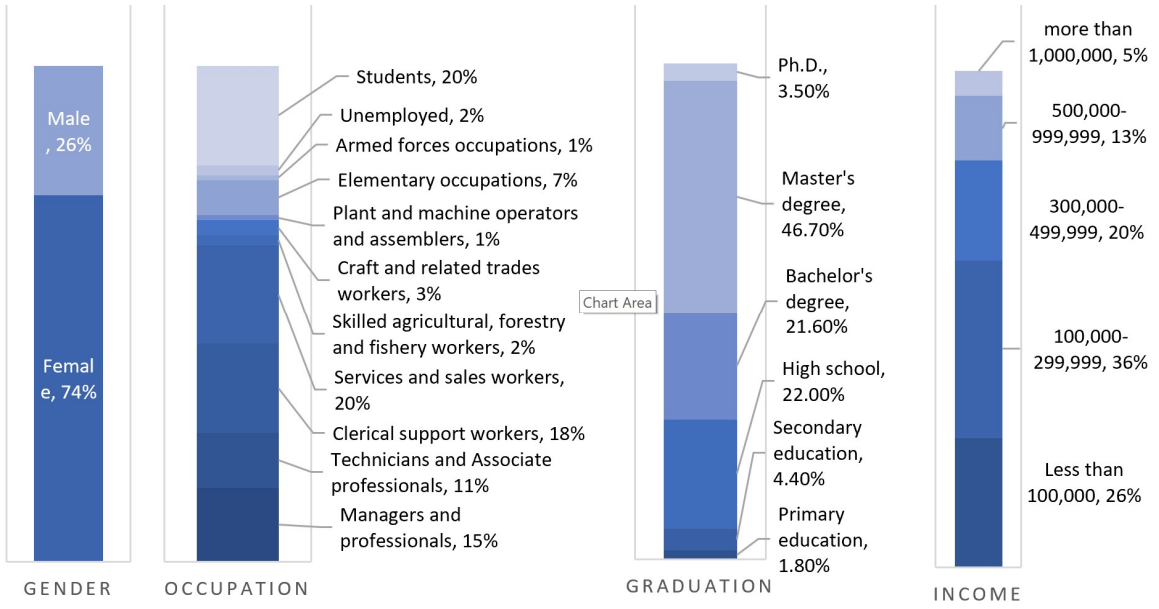
characteristics of the samples in this research are shown in Table 5 with the highest age at 71 and the lowest age at 12.

Table 5 Descriptive statistics of age of the samples

Generations	Birth years	Age			
		Minimum	Maximum	Average	S.D.
Baby boomers	1946 – 1964	55	71	59.66	3.48
Generation X	1965 – 1980	39	54	45.62	4.64
Millennials	1981 – 1996	23	38	28.63	3.89
Generation Z	1997 – 2012	12	22	17.89	2.78

Because the stratified sampling technique used in this research only partitions the samples according to the generation groups, the characteristics of the samples in the aspects of genders, occupation, education and income are random as illustrated in Figure 13. It can be seen that the samples are composed of female at 74% and male at 26%. Around 20% of the samples work in the services and sales function, followed by clerical support function at 18%, and manager levels at 15%. These occupation types are classified according to the International Standard Classification of Occupations (ISCO-88). There are around 20% of the samples who are still studying. Most of the samples are at the master's degree followed by the high school level and the bachelor's degree. Regarding the level of income, around 62% of the sample have income less than 300,000 baht per year and around 5% having income of at least 1,000,000 baht per year.

Figure 13 Descriptive statistics of socioeconomic status of the samples



Although the samples that have a bachelor's degree or above is expected to have more experience, knowledge and maturity than the sample studying at school levels, most questions in the questionnaire developed to measure digital literacy are basic questions about the usage of digital technology. In addition, some English words in the questionnaire are only transliteration of the words commonly used in daily life such as Microsoft word,

smartphones or Web browser. In order to further limit the bias that may occur due to the misunderstanding of questions, the questionnaire is not distributed directly to the samples. The technique in collecting the information from the samples is by having interviewers explaining each question one by one.

The questionnaire developed to measure the digital literacy is separated into 3 sections. The first section includes information about socioeconomic status. The second section includes questions that attempt to measure 4 sub-dimensions of the digital literacy and the last section includes questions about behavior and preferences on banking services. The details of the digital literacy questionnaire are shown in Appendix I.

The last section about banking preferences is added into the questionnaire because financial services are considered as the key foundations supporting the growth of the digital economy. With the ongoing transformation of banking services from branch banking with face-to-face communication into mobile banking with digital relationship, it is interesting to estimate whether some groups of populations would be disadvantageous and finally be excluded from the financial services industry. The banking industry is, therefore, chosen as a case study in this research.

Furthermore, in order to understand how financial institutions in Thailand transform themselves in the digital era, this research also develops another questionnaire to ask top management teams of Thai financial institutions about their views on competitions and key technologies in the next decades. The information obtained from this part will also be compared with what the populations expect to see from the financial institutions. This would provide some insight whether the digital transformation strategies implemented by financial institutions are in line with customers' expectations. The details of the executive questionnaire are shown in Appendix II.

As can be seen in the digital literacy questionnaire, there are many questions used to measure certain sub-dimensions of digital literacy. For example, the measurement of digital skills is composed of self-assessment questions on the 5 Likert scales across 17 different tasks. After obtaining the Likert scores of those tasks, it is not appropriate to directly combine the scores in a simple way such as averaging the scores with equal weights. This is because it may not accurately reflect the variation and variability of the information contained in each observed question. This problem can be mitigated and solved by the statistical technique called Principal Component Analysis (PCA) which is the technique used to create a linear function that can best contain all the information obtained in each observed variable.

The outcome from this linear function is considered as a measurement of certain key factors that cannot be observed directly. These unobserved qualitative factors are normally called latent variables. PCA is therefore a mathematical technique that attempts to adjust the coefficients of each observed variables until the variation of the outcome from the linear combination can mostly explain the total variation of all observed variables.

When estimating the solutions of linear combinations, PCA does not only provide one set of the coefficients but the number of solutions derived from the PCA's algorithm will be equal to the total number of observed variables used in the PCA. For example, if there are 4

observed variables, PCA will estimate 4 different sets of coefficients and each of the set (or linear combinations) is estimated under the assumption that they are orthogonal to each other. Each linear combination will create the outcome called Principal Component (PC) which represents the latent variable of interest.

For example, Table 6 shows the PCA analysis for the measurement of the digital access sub-dimension. Because there are 4 observed variables, PCA can generate 4 different components. The criterion in choosing which PC is the best outcome of the latent variable is normally based on the eigenvalue that needs to be greater than 1 (Kaiser, 1960). Because the first component can explain around 61.37% of the total variance with the eigenvalue at 2.455, this component is chosen to represent the digital access sub-dimension.

Table 6 Principle Component Analysis (PCA) of the digital access sub-dimension

Component	Eigenvalues	% of Variance	Variables	Factor loading
1	2.455	61.372	Desktop/laptop	0.756
2	0.780	19.512	Smartphone/Tablet	0.895
3	0.530	13.246	SmartTV/Smartwatch	0.784
4	0.235	5.870	Others	0.684

Notes: Measurements of the digital access sub-dimension is the number of devices owned by households.

The linear combination (factor loadings) of all observed variables obtained from the PCA technique can be used as a scoring model to measure certain aspects of digital literacy. When using this scoring system, the values of each observed variables will have to be converted into a standardized variable (Z-variables) before using the linear combination of PCA. This means that the final score from the PCA technique will be a standardized score with the mean at 0 and the standard deviation at 1.

After obtaining the standard score of each sub-dimension of digital literacy, the statistical technique called the cluster analysis is used to separate the samples into groups with different levels of digital literacy. Cluster analysis is the statistical technique that does not require an identification of thresholds to separate the samples into groups. It is different from the discriminant analysis and ANOVA because those statistical techniques require a classification of sample into groups before testing whether certain variables can significantly determine the separation of groups.

In the case of cluster analysis, there is no need of having any prior criteria, such as gender or income ranges, to separate the samples into groups. It requires only an identification of variables that will be used as a benchmark to separate the samples. Cluster analysis will attempt to find the boundaries of those variables that can ensure the average values of those variables within each group to be largely different from other groups. Cluster analysis is sometimes referred to as an unsupervised classification without pre-defined classes.

The mathematical techniques of cluster analysis are distinguished into two main algorithms, namely 1) k-means clustering and 2) hierarchical clustering. In this research, k-means clustering is chosen as it is the technique that can test the appropriate number of groups (k) that best fit with the samples while the hierarchical clustering is the method that

attempts to separate all the samples until the number of groups equal the number of samples and researchers will need to decide about the number of groups that should be used for clustering later.

The process of k-means clustering starts with randomly assigning samples into a separate group until the variables used as the benchmark for separation is largely different between groups and the value of those variables within the same groups are not significantly different from each other. The variables used for the grouping do not need to be a single variable but can be a range of variables that researchers would like to use as the criteria for classification. It can be concluded that k-means clustering attempts to measure the heterogeneity between group and the similarity within groups for a certain number of k.

However, the cluster analysis does not guarantee that the groups being classified can be explained by certain causal relationships because the clustering process is purely a mathematical process. Thus, after separating the samples into groups, other statistical techniques such as multinomial regression or ANOVA are normally conducted to test and identify the key determinants that significantly explain characteristics of each group. The coefficients from multinomial regression can be considered as the measurement of probability that certain samples will belong to a particular group.

The ANOVA technique used in this research is the Duncan's New multiple range test. The Duncan's method is appropriate because its algorithm was designed to reduce Type II error, which is the error that the test rejects the null hypothesis even though the null should not be rejected. The test starts by finding the mean and standard error of a certain variable in each group (m_1, m_2, …, m_n) and then comparing the means between the highest mean group and the lowest mean group before comparing the highest mean group with the second lowest group. The standard error of each group is used to test whether the value of that variable in each group is significantly different from each other.

Regarding the test on the significant differences of categorical variables such as age, occupation types, or income ranges, the Pearson's Chi-square test is used.

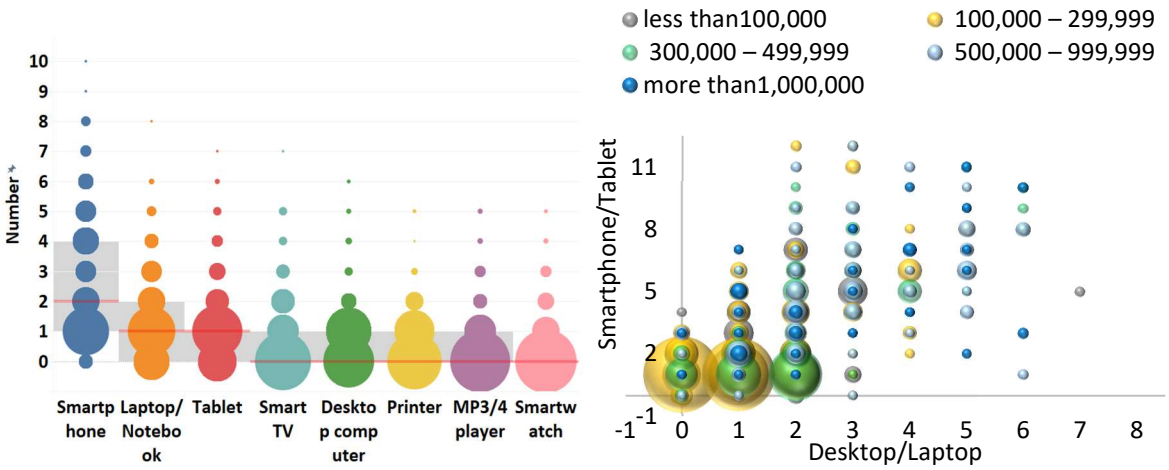
6. Empirical results of the digital literacy of Thai households

The first part of this section will demonstrate key descriptive statistics of the data obtained from the digital literacy questionnaire. It will be followed by the results of the standard scores of each sub-dimension of digital literacy. The final part of this section will discuss the results from the cluster analysis that separates the samples into 3 groups namely, 1) the digital fluency group 2) the digital neutral group and 3) the digital illiterate group. It will also attempt to test which socioeconomic status can significantly classify the samples into groups.

Regarding the degree of digital technology access, Figure 14 shows that smartphones are the digital device that households in Thailand have the highest degree of access with 2 devices per household, followed by laptops and tablets at 1 device. When looking at the relationship between the number of smartphone/tablet and the number of desktop/laptop,

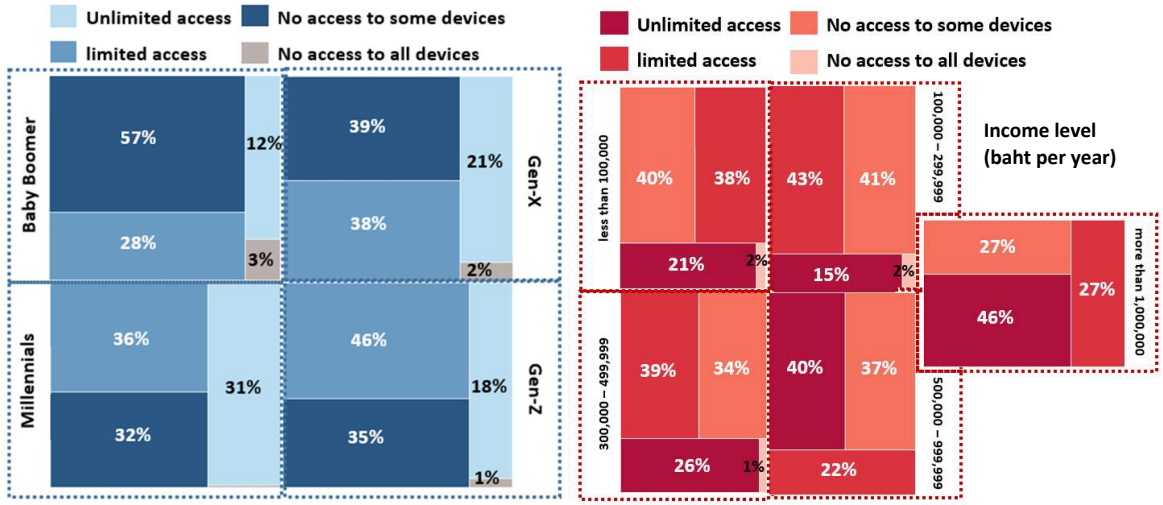
it can be seen that households in Thailand appear to have 2 smart devices per one computer device. There is also a positive relationship between income level and the degree of digital technology access. The gap in the number of digital technology devices across different income groups appear to be highest for smart TVs and smart watches.

Figure 14 Number of devices accessed by the samples



When measuring the degree of digital technology access by the frequency and the ability to access those technologies, Figure 15 shows that Millennials is the generation with the highest proportion of unlimited access to all digital technologies, followed by Gen-X and Gen-Z. Regarding the income level, around 40% of the samples with income less than 300,000 baht per year have either a limited access to digital technologies or no access to some technologies. In contrast, 40% of the samples with income greater than 500,000 baht per year have unlimited access.

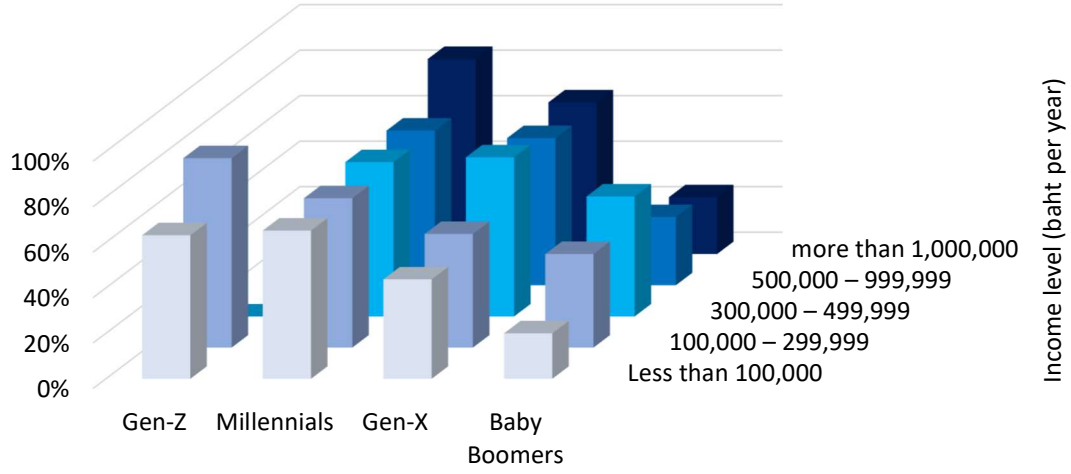
Figure 15 The ability to access digital technologies across different generations and income



Note: Unlimited access is the ability of households to access all digital technologies without any obstacles. Limited access means that households can access all digital technologies but with limited abilities. No access to some devices represents the inability of households in accessing some digital technologies. No access to all devices means that households cannot access any digital technologies.

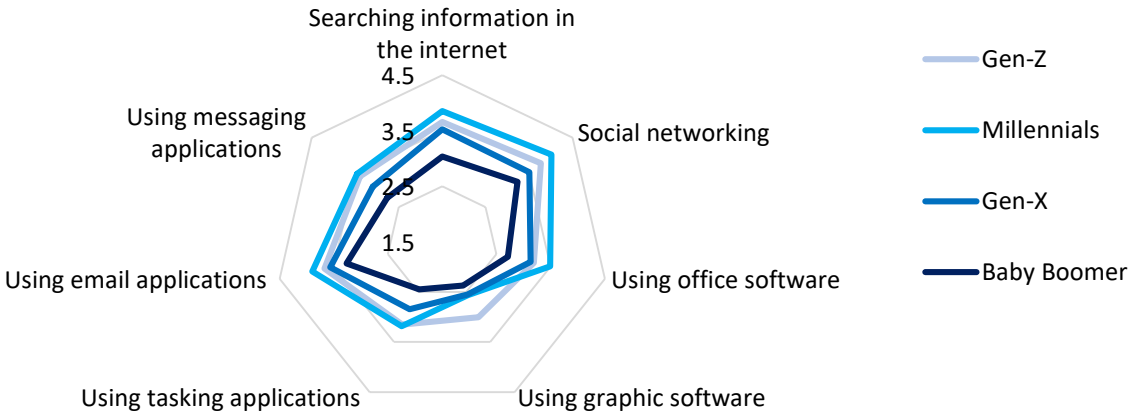
When grouping the samples according to income levels and generations, Figure 16 demonstrates that there are large variations of digital technology access in the aspect of income levels especially for the samples in Gen-X and Baby boomers. However, the samples in Gen-Z and Millennials appear to have similar abilities to access digital technologies across different income level.

Figure 16 Proportions of individuals accessing at least one type of digital technologies



Even though there are 17 types of activities used to measure the level of digital skills, these activities can be grouped into 7 broad categories namely, 1) searching information in the internet 2) social networking 3) using office software 4) using graphic software 5) using tasking applications 6) using email applications and 7) using messaging applications. Based on the Likert scores (1-5), Figure 17 shows that most of the samples have high levels of skills in using the internet, email apps and social network. An interesting finding is the skills in using graphic software which are highest for Gen-Z. Baby boomers appear to consider themselves being unable to use most of these activities with the average score of only 2.77 out of 5.

Figure 17 Digital skills of the samples across different generations



When looking at the digital skills across different income levels, Figure 18 illustrates that low-income groups have significantly lower scores compared to those with income over 1 million baht per year. This evidence suggests that low-income groups may lack appropriate digital skills to improve their working status. Figure 19 also shows that the unemployed group and those working in support and basic functions possess significantly lower levels of digital skills than other occupation types.

Figure 18 Digital skills of the samples across different income groups

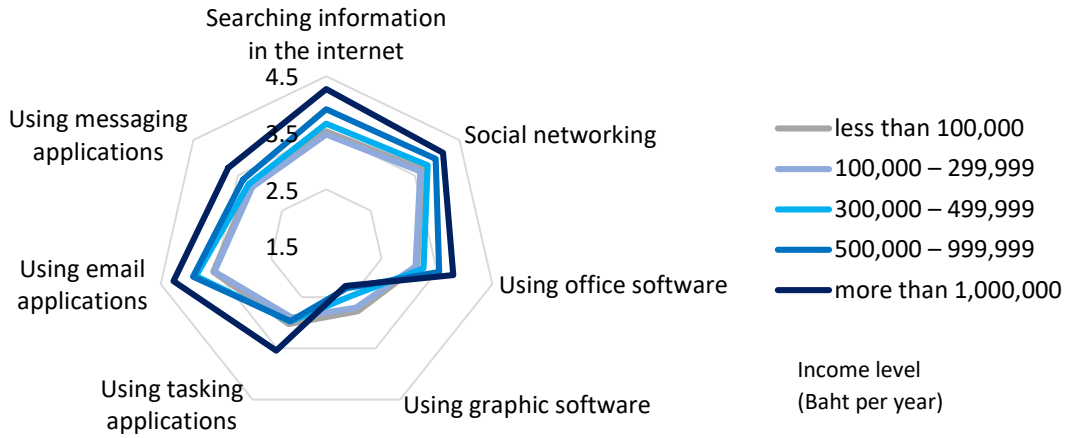
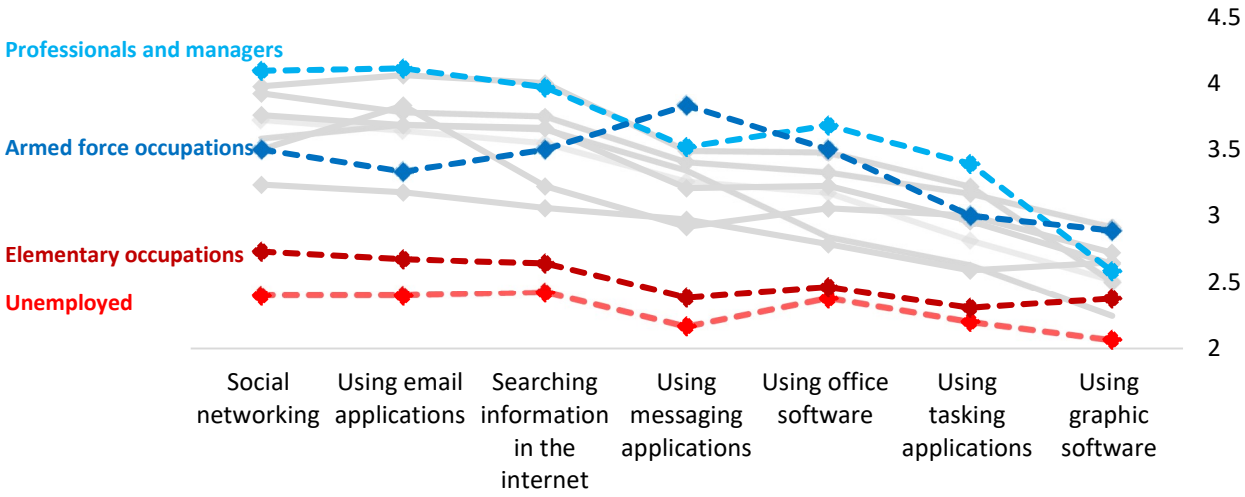
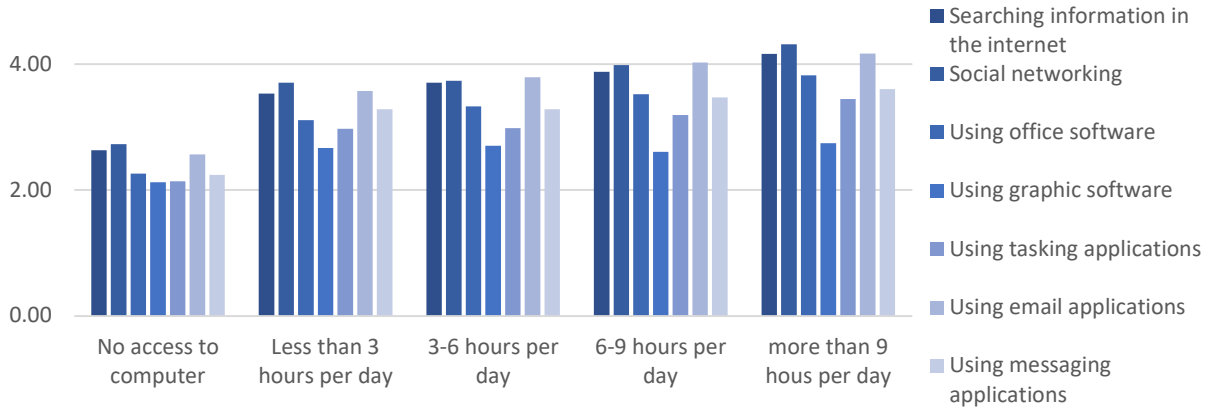


Figure 19 Digital skills of the samples across different occupation types



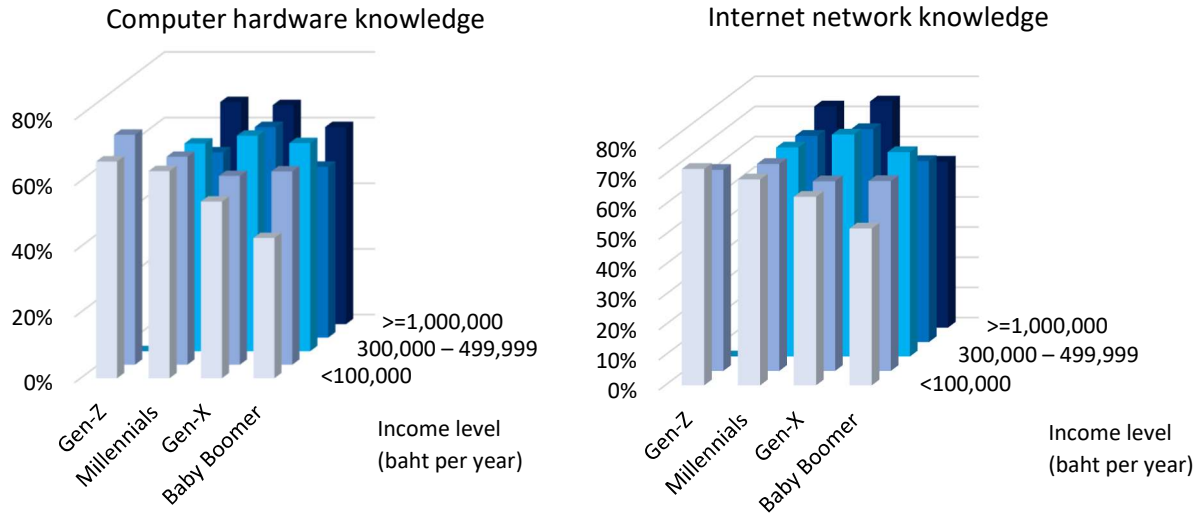
In addition, the survey finds that the levels of digital skills tend to have a positive relationship with the length of time in using computers as illustrated in Figure 20. This suggests that the digital access sub-dimension is also an important factor that could determine the level of digital skills. However, it does not mean that the development of digital skills does not require a proper system of education in digital literacy because the length of time in using computers tend to be positively related with education levels, income levels, and occupation types. The high levels of digital skills may result from the interplay of those factors.

Figure 20 Relationship between the length of time in using computers and digital skills



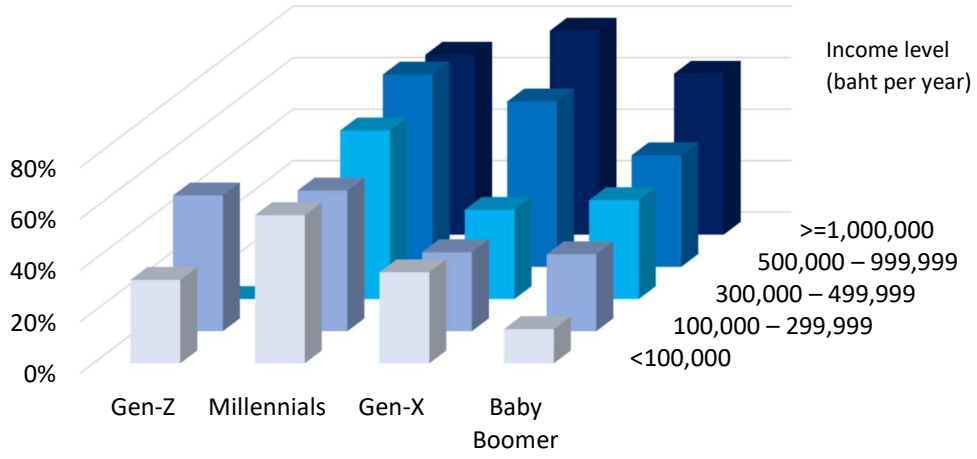
When asking the samples to do a self-assessment about their knowledge of computer hardware and internet network, Gen-Z considers themselves having high knowledge (the average Likert score at 60% - 70% as shown in Figure 21) while other generations do not think they possess much knowledge. This evidence shows that young generations tend to have high confidence level about their digital technology knowledge.

Figure 21 Self-assessment knowledge of computer hardware and internet network



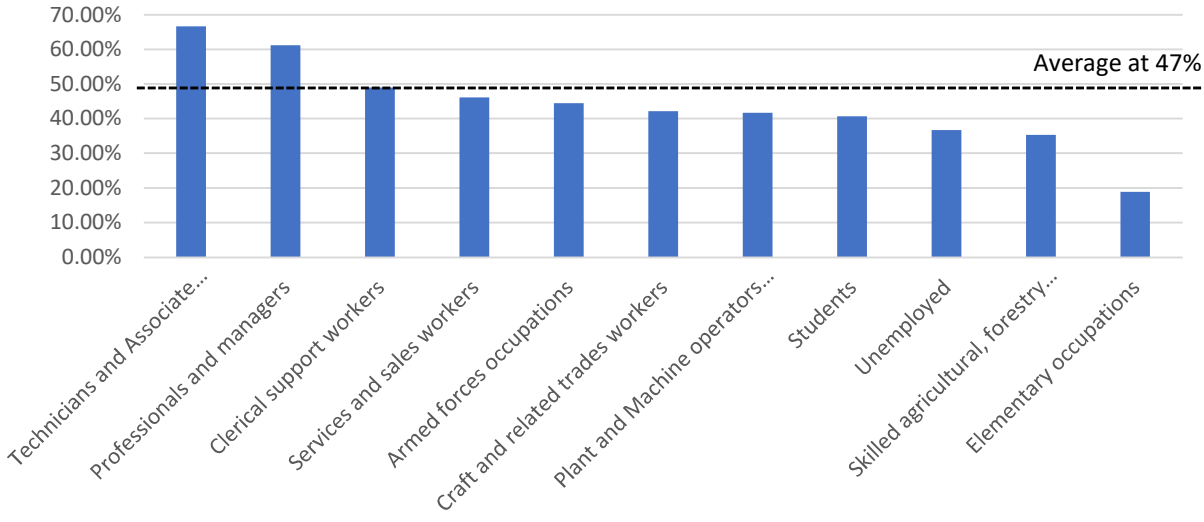
However, when asking all the samples to do a test on 6 multiple-choice questions with right and wrong answers, Figure 22 shows that Gen-Z has the average score of only 33% which is quite low compared to 61% for Millennials, 41% for Gen-X and 33% for Baby boomers. This evidence suggests that young generations who are often referred to as “digital natives” do not possess high levels of digital knowledge as expected. Their high confidence of digital knowledge could also limit their willingness to learn new knowledge.

Figure 22 Digital knowledge measured by the 6-question test



Digital knowledge also appears to have positive relationship with income levels. The samples with income of more than 500,000 baht per year could obtain score of around 70% compared to only 40% for low-income groups. When analyzing the level of digital knowledge together with digital skills and education levels, it also suggests that the samples with high levels of education tend to have high digital skills and digital knowledge. All these factors lead them to be competitive in the labor market and allow them to demand high compensations. As can be seen from Figure 23, the samples who work as technicians, managers, and professionals have high digital knowledge scores compared to other occupations with the average score of only 47%.

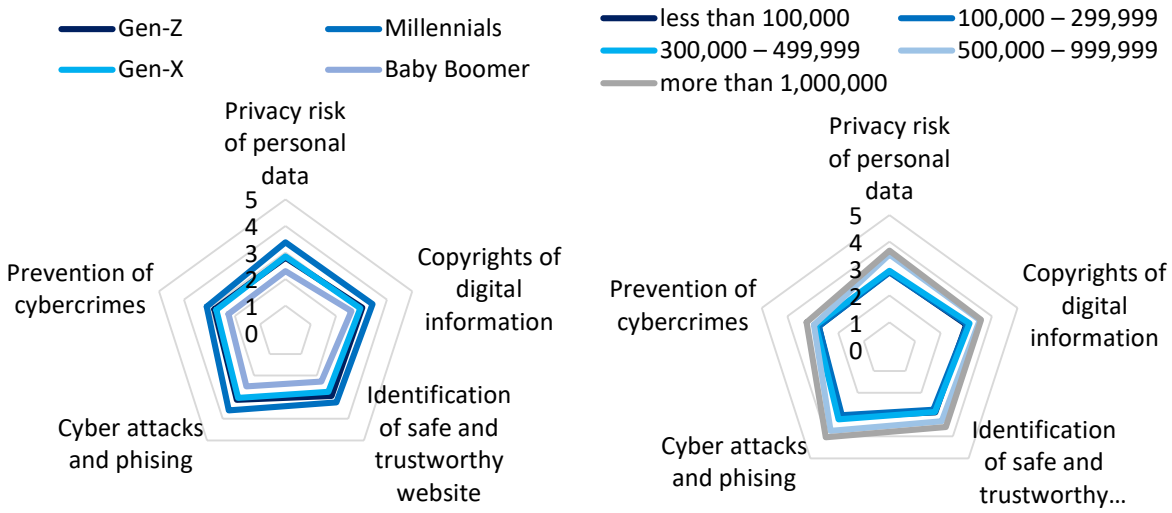
Figure 23 Digital knowledge score measured by the 6-question test



Regarding the awareness in using and sharing information in the digital world, the results from the questionnaire shows that Gen-Z, Gen-X and Baby boomers have low scores in all those aspects as demonstrated in Figure 24. They could not identify high risk websites, phishing attacks or recognize copyright issues when using digital information. The samples

with high income and professional occupations tend to have more awareness about using digital information than the others.

Figure 24 Digital information awareness across different generations and income groups



Because there are many questions representing the measurement of digital literacy in each sub-dimension, the Principle Component Analysis (PCA) is used to develop a scoring system of each sub-dimension and the result of factor loadings is shown in Table 7. The factor loadings are the coefficients used to calculate the standardized Z-score of each sub-dimension.

Table 7 Factor loadings of the variables used to measure each sub-dimension of digital literacy

Digital access		**Digital skill**		**Digital information awareness**	
Desktop/laptop	0.756	Keyboard_skills	0.770	Data_risk	0.880
Smartphone/Table	0.895	Internet_skills	0.909	Data_usage	0.873
SmartTV/Smartwatch	0.784	Social_skills	0.821	Website_trust	0.889
Others	0.684	Microsoft_skills	0.846	Cyber_risk	0.886
Digital knowledge		Graphic_skills	0.603	Protection_cyber_risk	0.844
Hardware_knowledge	0.915	Tasking_skills	0.735		
Internet_knowledge	0.924	Email_skills	0.799		
Knowledge_score	0.339	Messaging_skills	0.831		

When estimating the Pearson's correlation of these digital literacy scores, Table 8 illustrates that 'Digital access' has low correlation with all of the other sub-dimensions. This firmly suggests that the internet inclusion and the availability of digital technologies may not guarantee that all population groups would benefit equally from the digital economy. The access to digital technologies is only the minimum requirement for households to participate in the digital economy. The high correlation coefficients at more than 0.5 among digital skills, digital knowledge and digital information awareness suggest that policies aiming to improve one of these skills could help populations to gain higher level of literacy in other related areas.

Table 8 Pearson's correlation coefficients of digital literacy sub-dimensions

	Digital access	Digital Skills	Digital knowledge	Digital Information awareness
Digital access	1			
Digital Skills	0.163**	1		
Digital knowledge	0.084*	0.640**	1	
Digital Information awareness	0.207**	0.587**	0.508**	1

** significant at 1%, * significant at 5%

In order to understand more about the relationship between socioeconomic status and digital literacy, Table 9 shows that females have significantly lower scores in digital access, digital knowledge and digital information awareness than males. Moreover, Millennials are outstanding in terms of the digital literacy across all four sub-dimensions. Even though Gen-Z's score in digital skills and digital knowledge are not significantly different from Millennials, their scores are lower than those of Millennials. Baby boomers are the generation that policy makers will have to pay particular attention as their scores are significantly lower than other generations.

Table 9 The average value of digital literacy Z-scores across different socioeconomic classes

	Digital access	Digital skills	Digital knowledge	Digital Information awareness
Male	0.3238	0.1284	0.2076	0.3019
Female	-0.1150	-0.0456	-0.0737	-0.1072
Age group				
Z	-0.2065	0.2161	0.1271	-.01826
Millennial	0.4107	0.5469	0.1502	0.7209
X	-0.3418	-0.3480	-0.0907	-0.3519
Baby boomers	-0.3868	-1.3416	-0.4881	-1.3794
Occupation types				
Unemployed	1.0056	-2.9341	-1.3671	-1.7618
Students	-0.0934	0.4064	0.0922	-0.0585
Professional	0.6342	0.8111	0.4278	0.8385
Middle class	-0.1728	-0.2532	-0.0057	0.0810
Labor intensive	-0.3318	-0.4570	0.2099	-0.3604
Income group				
< 100,000	-0.1268	-0.1377	-0.0578	-0.2089
100,000 – 299,999	-0.2892	-0.2742	-0.1407	-0.2950
300,000 – 499,999	0.0362	0.0905	0.1697	-0.0508
500,000 – 999,999	0.5551	0.4228	0.0573	0.8243
1,000,000 – 1,999,999	0.9717	1.1696	.4084	1.0743
>= 2,000,000	1.8914	1.4355	.7958	2.1061

Note: The different shades of each cell represent the statistical tests of whether the estimated scores of each group/type are significantly different from the scores of adjacent groups at the 95% confidence level. Professional occupation includes managers, professionals, technicians and associate professionals. Middle class occupation includes clerical support workers, services and sales workers, and armed forces occupations. Labor intensive occupation includes skilled agricultural, forestry and fishery workers, craft and related trades workers, plant and machine operators and assemblers, and elementary occupations.

The unemployed group is the samples that have been severely affected by the digital transformation. The low digital literacy score seen in this group could imply that they may have trouble in finding jobs in the next decades. Students do not possess high digital literacy as expected and it means that some policies related to the provision of digital-related knowledge are required to make them achieving high digital literacy levels. Other occupation types appear to have similar levels of digital literacy and the average scores of these group are not too low to pose any serious concerns. Because occupation status is directly related to income levels, the samples who possess high digital literacy scores manage to receive much higher income compared to other groups.

Because the analysis in Table 9 only estimates the statistically significant differences across a single key factor, it does not give a complete picture about which socioeconomic status significantly determines the digital literacy level on a ceteris paribus basis. The regression analysis between socioeconomic factors and digital literacy scores are therefore conducted and the results are shown in Table 10.

Table 10 Regression results between socioeconomic factors and digital literacy z-scores

Variable	Digital access	Digital skills	Digital knowledge	Information awareness
Intercept	1.959** (0.242)	1.220** (0.291)	1.405** (0.316)	1.292** (0.277)
Z	-0.016 (0.191)	0.344 (0.229)	0.474 (0.249)	0.709** (0.218)
Millennial	1.063** (0.104)	0.718** (0.125)	0.298* (0.136)	1.097** (0.119)
X	0.255* (0.111)	0.331** (0.133)	0.234 (0.145)	0.462** (0.127)
Students	0.453 (0.269)	0.989** (0.324)	0.627 (0.351)	0.360 (0.308)
Professional	0.149 (0.254)	0.868** (0.306)	1.193** (0.332)	0.722** (0.291)
Middle_class	-0.087 (0.293)	0.434 (0.352)	0.703 (0.382)	0.580 (0.335)
Labor intensive	-0.240 (0.247)	0.429 (0.297)	0.736* (0.323)	0.294 (0.283)
100,000 – 299,999	-0.221 (0.120)	0.005 (0.144)	0.069 (0.156)	-0.081 (0.137)
300,000 – 499,999	0.408** (0.131)	0.192 (0.158)	0.164 (0.172)	0.037 (0.151)
500,000 – 999,999	0.734** (0.146)	0.152 (0.176)	-0.059 (0.191)	0.460** (0.168)
1,000,000 – 1,999,999	0.627** (0.200)	0.475* (0.241)	0.007 (0.261)	0.339 (0.229)
>= 2,000,000	0.900** (0.355)	0.651 (0.427)	0.287 (0.464)	0.694 (0.406)
Women	-0.115 (0.077)	0.126 (0.092)	-0.097 (0.100)	-0.094 (0.088)
Adjusted R-square	0.338	0.109	0.036	0.199
N	500	500	500	500

Note: The number in parentheses are standard errors. Baby boomers who are males, unemployed and receive income less than 100,000 baht per year are the reference group.

It is found that gender is no longer the significant factor in explaining the variation in digital literacy scores. Millennials and Gen-X are the two generations that have significantly higher digital literacy scores compared to Baby boomers. Gen-Z only has the scores in digital information awareness that are significantly higher than Baby boomers.

Students only show significantly higher scores in digital skills than the unemployed group. This means that some improvements in digital knowledge and digital information awareness are required to guarantee that they would be successful in the digital economy. The high-income group significantly has higher ability to access digital technology due to their high purchasing power, but this group does not significantly has higher digital literacy scores in other sub-dimensions.

The regression analysis above is the analysis that can be used to understand key significant determinants of digital literacy scores in each sub-dimension. However, in order to investigate the socioeconomic status that can explain the comprehensive score of digital literacy in all sub-dimensions, the k-mean cluster analysis is used to classify the samples into groups. The number of clusters that appear to provide a good fit with the data is 3, which can be named as 1) the digital fluency group 2) the digital neutral group and 3) the digital illiterate group.

The results from the k-mean cluster analysis is demonstrated in Table 11. It is found that 26% of the samples are included in the digital fluency group. This group possesses significantly high scores in digital skills, digital knowledge and digital information awareness. As this classification is purely derived from mathematical algorithms, it is necessary to investigate further the socioeconomic characteristics of each group.

Table 11 Results of the cluster analysis

Cluster	Digital access	Digital skills	Digital knowledge	Digital Information awareness	Proportions of samples
1 – Digital fluency	0.55	2.05	0.99	2.37	26.31%
2 – Digital neutral	-0.22	0.18	0.03	-0.43	54.96%
3 – Digital illiterate	-0.53	-3.40	-1.48	-2.05	18.73%

After doing the multinomial logistic regression by setting Cluster 3 (digital illiterate) group as a reference, Table 12 illustrates that Gen-Z, Millennials and Gen-X have a significantly higher probability to be in the Digital fluency group. The large proportion of samples in the digital illiterate group is Baby boomers at 35%. Students are also significantly not in the digital illiterate group. Those that are in the digital fluency groups also significantly work in professional levels with high-income levels.

In summary, the analysis on the digital literacy of Thai household indicates that there exist some degrees of digital divide across households with different socioeconomic status. The ability to access digital technologies is not a challenge in Thailand but low-income and low-working status populations appear to have significantly low digital skills, digital knowledge and digital information awareness.

An interesting insight gleaned from this finding is the fact that the assumption of digital natives with high digital literacy skills does not exist. It requires some policy actions to ensure that every group of populations possesses a minimum level of digital literacy. Proper curriculums in elementary and high school levels that focus on developing digital literacy are required. Short-term actions to improve the literacy of those unemployed are also crucial as this group of populations has already been severely affected by the digital economy.

Table 12 Results from the multinomial logistic regression

	Digital fluency	Digital neutral
Intercept	-3.583** (1.052)	-1.118 (0.682)
Z	2.680** (0.902)	.996 (0.684)
Millennial	3.401** (0.582)	.829* (0.301)
X	1.688** (0.592)	.060 (0.290)
Students	1.716 (1.096)	2.072* (0.882)
Professional	2.158* (0.983)	1.947* (0.753)
Middle_class	0.875 (1.100)	.924 (0.831)
Labor intensive	0.579 (0.947)	1.108 (0.699)
100,000 – 299,999	0.196 (0.435)	.321 (0.357)
300,000 – 499,999	0.794 (0.490)	.865* (0.403)
500,000 – 999,999	0.805 (0.528)	.139 (0.466)
1,000,000 – 1,999,999	0.980 (0.793)	.382 (0.750)
>= 2,000,000	19.840** (0.961)	18.475** (0.000)
Women	-0.161 (0.293)	.070 (0.256)
Pseudo R-Square	0.207	
Cluster 3 (Digital illiterate) as reference		

Note: The number in parentheses are standard errors. Baby boomers who are males, unemployed and receive income less than 100,000 baht per year are the reference group.

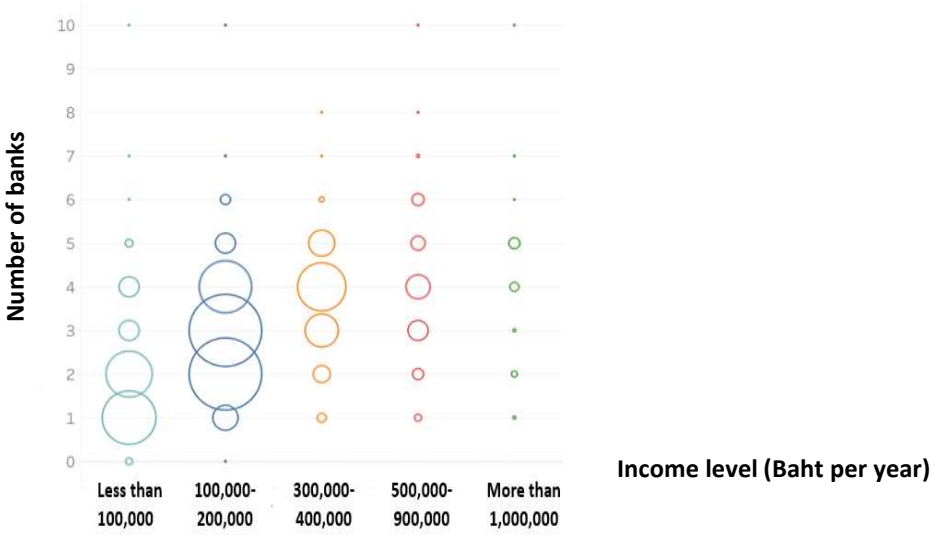
7. An analysis on banking preferences of Thai households

In this section, the study to investigate behavior of Thai households in using banking services is explored. This analysis is interesting because the services provided by financial institutions are the main foundation determining the growth of the digital economy. Digital transformation has led many financial institutions to convert their services from a traditional way of branch banking into a digital format that customers can access banking services anytime and anywhere.

Although the digital transformation is considered by World Bank as one of the policies that can improve the degree of financial inclusion especially in developing countries, it does not guarantee that this policy will be effective if underbanked populations are still having problems in accessing digital technologies and do not possess certain level of digital literacy so as to effectively use mobile or online banking services.

When measuring the access to financial services of the samples in this research, the survey finds that most of young generations started having bank accounts at the age of around 13-18 which is much earlier than the age of 30 for older generations. This implies that there are some improvements of financial inclusion in Thailand over the past decades. However, the number of banks that high-income groups are customers is still higher than low-income group as shown in Figure 25.

Figure 25 Number of banks that the samples in different income levels are customers



Regarding the type of financial services that the samples are currently use, Figure 26 shows that saving accounts are the main products with nearly 100% penetration rates. Even though Gen-Z is the youngest generation, they have access to savings accounts at higher penetration rates (98%) than older generations. The high penetration rates of Millennials and Gen-X in credit cards may result from the fact that these two generations are currently in working age groups and credit cards were highly marketed in Thailand during the 1990s. There are still low penetration rates of mutual fund investments and insurance products in Thailand with only high-income groups that have high level of access (Figure 27).

Figure 26 Access to financial services of the samples across different generations

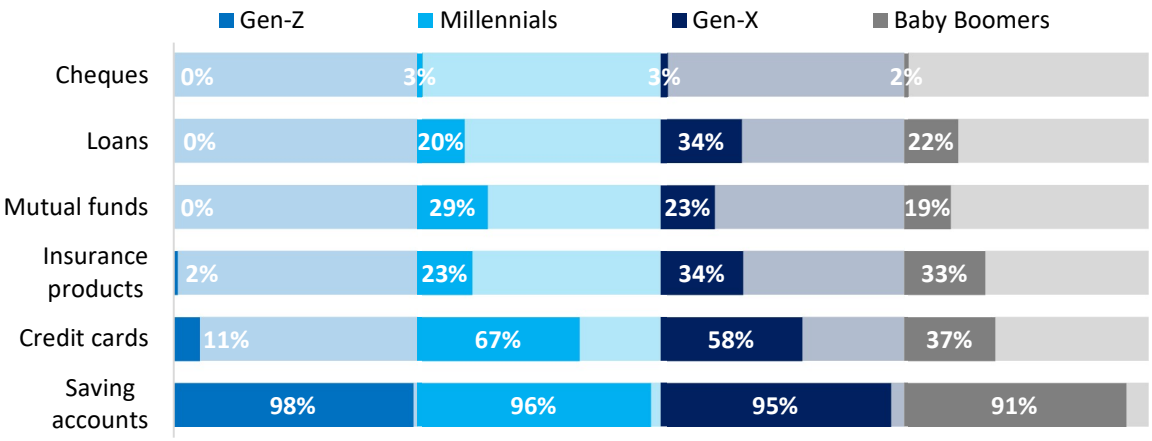
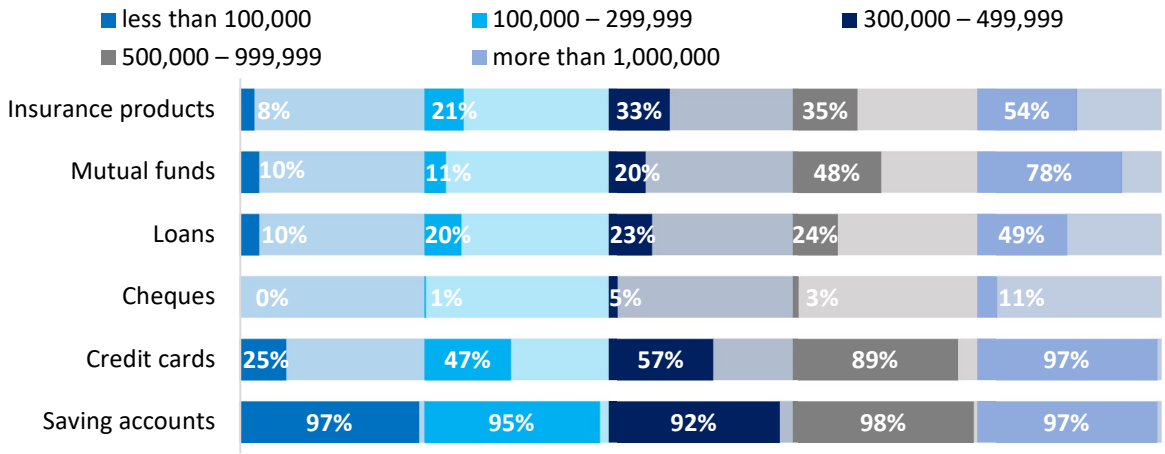


Figure 27 Access to financial services of the samples across different income groups



ATM usage behavior is not drastically different among old generations, but Gen-Z appears to use ATM significantly less often (Table 13). This suggests that they may have already been familiar of using mobile banking and cashless transactions.

Table 13 ATM usage behavior of the samples across different generations

Generation	1-2 times	2-4 times	4-8 times	> 8 times
Gen-Z	63.3%	21.7%	8.3%	6.7%
Millennials	18.2%	34.8%	29.2%	17.9%
Gen-X	29.7%	42.3%	17.0%	11.0%
Baby Boomers	35.4%	37.4%	19.2%	8.1%

When asking the samples about key factors influencing them to choose banks, Table 14 illustrates that Gen-Z is still highly influenced by their family and friends while Millennials focus on the features of mobile banking. Gen-X and Baby boomers who are highly familiar with branch banking still consider convenience in accessing bank branches as the key factors. Interestingly, the level of interest rates on loans is not a key determinant in choosing banks at all.

Table 14 Key reasons in choosing banks across different generations

Influencing reasons	Gen-Z	Millennials	Gen-X	Baby boomers
Similar banks with family and friends	45%	24%	19%	18%
Attractive saving rates	24%	36%	34%	31%
Attractive borrowing rates	7%	14%	15%	22%
Attractive fee levels	28%	27%	25%	24%
Convenience of ATMs	24%	38%	33%	41%
Mobile banking features	28%	57%	30%	20%
Convenience of branches	27%	39%	34%	36%

Note: Different colors represent the different scales of opinions for each generation.

The classification of the samples based on the level of digital literacy also show interesting findings. Samples in the digital fluency group significantly access more credit card products and more investment in mutual funds. They also significantly use more banking services and are customers of more than 3 financial institutions. This evidence suggests that the level of digital literacy has led to the situation where certain groups of populations benefit more in the digital economy and therefore these groups use banking services in a more productive way than the others.

Table 15 Access to banking products across different digital literacy groups

Banking products	Cluster		
	Digital fluency	Digital neutral	Digital illiterate
Deposits	97.38%	95.24%	92.65%
Credit card*	70.68%	45.61%	39.71%
Insurance Product*	25.65%	25.81%	13.97%
Investment in mutual funds*	36.13%	15.79%	15.44%
Loan*	26.18%	15.54%	25.00%
Check*	5.24%	0.75%	2.21%
Number of services and banks	**Digital fluency**	**Digital neutral**	**Digital illiterate**
No. of services	2.61	1.99	1.89
No. of banks	3.49	3.11	2.82

Note: *Significant at 5% level (Pearson's Chi Square) and the different shades of each cell represent the statistical tests of whether the estimated values of certain cells are significantly different from the values of adjacent cells at the 95% confidence level.

However, the behavior in using ATM is not significantly different across different clusters. Although the digital fluency group highly focuses on the convenience of bank branches when deciding to be a customer of certain banks as shown in Table 16, the second key influencing factor is the features of mobile banking that match their needs. This result implies that the digital fluency group highly considers the convenience aspect of using banking services as the key factor in choosing banks.

Table 16 Frequency of using ATM and reasons for choosing banks across different digital literacy groups

	Cluster		
Frequency of using ATM	**Digital fluency**	**Digital neutral**	**Digital illiterate**
1-2 times per month	21.47%	35.09%	33.82%
2-4 times per month	35.08%	34.09%	36.76%
4-8 times per month	26.18%	20.05%	18.38%
More than 8 times per month	17.28%	10.78%	11.03%
Influencing factors	**Digital fluency**	**Digital neutral**	**Digital illiterate**
Convenience of branches	71.73%	43.86%	56.62%
Similar banks with family and friends	17.28%	28.57%	26.47%
Attractive saving rates	33.51%	35.34%	24.26%
Attractive borrowing rates	16.75%	12.53%	13.97%
Attractive fee levels	27.75%	29.82%	17.65%
Convenience of ATMs	41.88%	29.57%	41.18%
Mobile banking features	66.49%	32.58%	24.26%

Note: Different colors represent the different scales of opinions for each digital literacy group.

Because it is currently impossible to do every activity online such as opening an account or applying for a loan, the convenience of bank branches is still required. Nevertheless, due to the establishment of NDID in Thailand and the implementation of pilot projects in using digital ID as the new technique in doing the KYC process, bank branches will become significantly less important in the next decades. Therefore, it can be concluded that the digital fluency group is waiting for a better experience from mobile banking in the future.

The digital fluency group also expects financial institutions to be a leader in innovation in the next 5 years while the digital neutral and digital illiterate groups expect fees reduction to be the main focus of financial institutions' strategy. Maintaining trust is still the significant aspect that all levels of digital literacy groups expect from financial institutions as illustrated in Table 17.

One interesting finding is the fact that the samples in all digital literacy levels do not expect financial institutions to be an expert in certain products or to try providing tailor-made products that serve different needs of customers. This evidence appears to contradict with the recommendations proposed by many consulting firms (Deloitte, 2016; McKinsey, 2019; Accenture, 2019) that the disaggregation in financial services, which results from the emergence of fintechs, will push banks to identify their key product champions instead of being a universal bank that can provide every service to customers.

Table 17 Customers' opinions about the image that financial institutions should have in the next decades

Banks in the future	Cluster		
	Digital fluency	Digital neutral	Digital illiterate
Innovation leaderships	78.53%	41.35%	33.82%
Friendly staffs	20.42%	23.06%	41.18%
Personalization of products/services	18.32%	17.04%	10.29%
Fast services	40.31%	26.07%	19.12%
Universal of products/services	25.65%	17.29%	8.82%
Highly expertise in particular products/services	16.75%	20.30%	5.88%
Lowest fees	43.98%	44.61%	44.12%
Attractive interest rates	17.80%	30.83%	33.09%
Transparency in price comparison	28.80%	21.80%	27.21%
Trust	55.50%	35.59%	52.94%
Partnerships with other merchants	25.65%	12.28%	13.97%

Note: Different colors represent the different scales of opinions for each digital literacy group.

Although digital technologies allow banks to personalize their products for different customers, products that have specific features and conditions also limit the degree of price transparency. Customers will find it more difficult to compare the pricing of each product. Some market abuses such as price discrimination can also easily occur.

The types of banking services that the digital fluency group prefers the most in the next 5 years are 1) super mobile banking app that allow customers to do every transaction they prefer 2) smart notification service that alert specific information in real-time and 3) automatic machines that they can do many activities by themselves at bank branches. Table 18 demonstrates that the samples in the digital neutral group and digital illiterate group still prefer banks to improve the convenience of bank branches and ATMs which suggests that these population groups still lack behind in terms of using digital banking and they may be left out if policy makers aggressively transform the financial services industry into a fully digital banking industry.

Financial services that populations in all digital literacy groups prefer the least in the next 5 years is the ability to communicate with bank staffs by chat bot or video call. They also do not prefer notification messages by email or the ability to deposit cheque by using the smartphone.

Table 18 Most preferable banking services of the samples across different digital literacy groups

The top 3 preferable services	Cluster		
	Digital fluency	**Digital neutral**	**Digital illiterate**
1st	- Universal mobile banking services - Smart notification services	Convenience of branch banking in the aspect of - Branch location - Fast service - All-in-one Automatic machines	Convenience of branch banking in the aspect of - Branch location - Fast service - All-in-one Automatic machines
2nd	Convenience of branch banking in the aspect of - All-in-one Automatic machines	- Universal mobile banking services - Smart notification services	- Innovative marketing campaign and promotions with partnered merchants - Easy to search products/services information online.
3rd	- Innovative marketing campaign and promotions with partnered merchants - Easy to search products/services information online.	- Innovative marketing campaign and promotions with partnered merchants	- Integration of services across offline, online, mobile, chat and call. - Incorporating services in social network and messaging platforms.

This study also conducts a survey of top executives of financial institutions in Thailand. There are 18 financial institutions decided to participate in this executive survey comprising of 6 commercial banks, 6 insurance companies, 5 fund management teams and 1 brokerage firm. The positions of persons who fill out the questionnaire include CEO, head of strategy and chief officer in finance and investment.

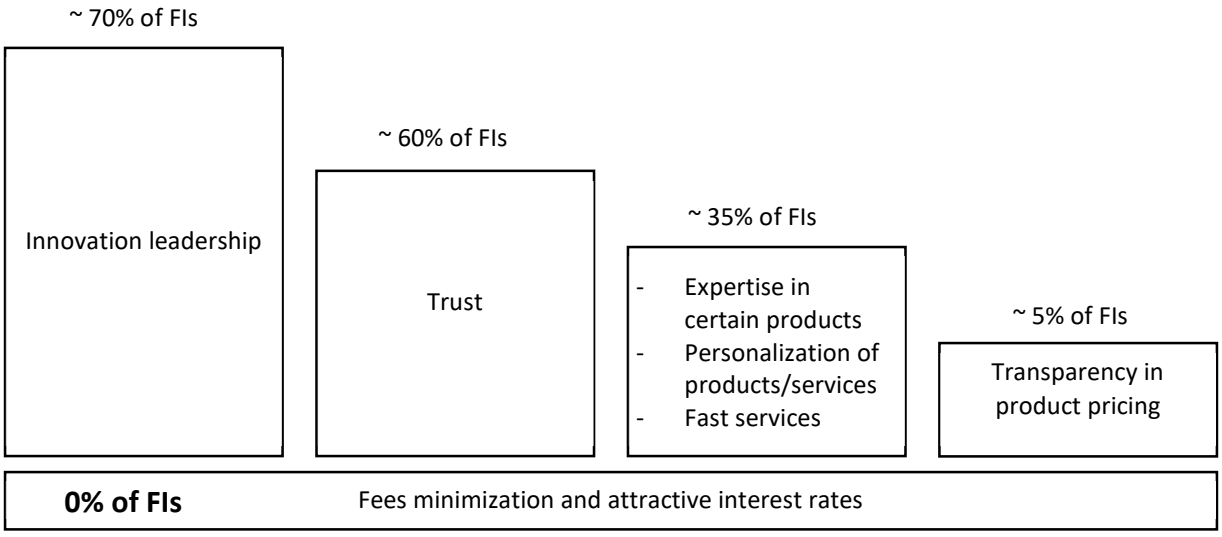
When asking those executives about the types of financial services that financial institutions should develop in the next 5 years, Table 19 shows that most financial institutions aim to offer are 1) super mobile banking app 2) integration of distribution channels and 3) big data analytic for product customization. These views appear to be slightly different from what the samples in the digital neutral and digital illiterate group prefer. Moreover, most top executives also do not plan to improve branch banking, the convenience of ATM and email notification. This evidence implies that populations in the digital illiterate group may be left behind and face some difficulties in accessing banking services through the channels they are familiar with and highly prefer.

Table 19 Financial services that financial institutions plan to focus in the next 5 years

	The top 3 services of interests		
	1st	**2nd**	**3rd**
Financial institutions	- Universal mobile banking services - Integration of services across offline, online, mobile, chat and call.	- Smart notification - Big data analytic to personalize products and services - Incorporating services in social network and messaging platforms.	- Innovative marketing campaign and promotions with partnered merchants - Easy to search products/services information online.

The view of top executives also contradicts with what customers expect the financial institutions to be in the next 5 years. Instead of focusing on the use of digital technologies for fees reductions, top executives of financial institutions desire to improve their expertise on the provisions of certain services (Figure 28). Because all financial institutions agree that they need to have a customer-centric mindset, their strategies tend to focus on customization of banking products to match different needs of customers. This view is not in line with what customers expect because customers appear to prefer banks to streamline distribution channels and simplify banking services. The transparency of product details and ease of price comparison are more favorable for all groups of digital literacy levels.

Figure 28 Executives' opinion about the image that financial institutions should have in the next decades



In order to form a forward-looking view about financial institutions in Thailand, the executive questionnaire also asks about the digital technology that they will be investing in the next 5 years. Table 20 shows that they will focus on cyber security, data analytics and public cloud infrastructure. Based on this result, it suggests that financial institutions in Thailand currently aware the needs to develop an open banking ecosystem where data are shared among financial institutions and third-party apps. This open banking concept requires

an investment in cyber security to protect sensitive data of customers. In order to leverage on the data stored in the cloud infrastructure, each bank also needs to develop its own data analytics team.

Table 20 Technology investment plans of financial institutions in Thailand

Types of technology	Proportions of FIs invest today	Proportions of FIs expect to invest in the next 5 years
Distributed ledger technology (Blockchain)	16.67	66.67
Artificial intelligence	33.33	60.00
Extended reality	11.11	20.00
Quantum	0.00	26.67
Data analytics	72.22	93.33
Cyber security	88.89	100.00
Robotic process automation	44.44	66.67
Biometrics and identity management	33.33	66.67
Public cloud infrastructure	66.67	80.00

When financial institutions create partnerships with fintechs or other financial institutions, the key concern that may obstructs the success of the deal are differences in the knowledge of new technology and in organizational culture. Top executives appear to agree that they currently lack key personnel in generating new ideas and innovations. There are also concerns about regulations that limit their ability to implement new innovative business models.

In short, this research finds that populations with different levels of digital literacy prefer different types of financial services. Those in the digital illiterate group still require face-to-face communication and branch banking. They also expect bank to use digital technologies in simplifying the products and distribution channels. They hope that this strategy would, in the end, lead to fee reductions. This evidence suggests that financial institutions should not focus only on the customization of banking products, but it should attempt to use data analytic to understand the demands of each customer in order to allow banks to select standardized and easy-to-understand products for customers.

8. Conclusion

Digital economy has created both challenges and opportunities especially for developing countries such as Thailand. On the positive sides, it empowers micro and small enterprises to compete more aggressively with large incumbents by offering the possibilities of new business models such as platform business, everything as a service model and omnichannel marketing strategies.

This growth prospect can only be obtained if consumers and enterprises possess a certain level of digital literacy. The policies that aim to promote the digital infrastructure inclusion is not enough to guarantee that every sector in the digital economy will benefit from the access to digital technologies and digital information. Other aspects such as digital skills,

digital knowledge or the awareness about legal rights in using the digital information are also crucial.

This research proposes the measurement of digital literacy and provides a statistical technique to develop the digital literacy scoring system. The analysis shows that all generations regardless of their income have similar access to digital technologies but there are some degrees of digital divide in the aspect of digital skills, digital knowledge, and digital information awareness. Gen-Z appears to have too high confidence in their digital knowledge even though their actual knowledge is lower than the knowledge level of Millennials. An interesting insight gleaned from this finding is the fact that the assumption of digital natives with high digital literacy skills does not exist. Gen-Z also has low awareness about the cyber risk and legal issues when using digital information.

Because Millennials appear to have significantly high digital literacy scores across different sub-dimensions, this suggests that a careful design of the curriculum that includes digital literacy is needed. Digital literacy should not be assumed to be the knowledge that students can obtain by their own experience in using the digital technology. The results from this research confirm that if the samples possess an appropriate level of digital literacy, they could work in a high-ranking position and receive high incomes.

In addition, low levels of digital literacy could be the cause of unemployment. It has been found that the samples with the unemployed status possess significantly lower digital literacy scores compared to other groups. Therefore, the training in digital skills and digital knowledge is required in order to help these populations to become more competitive in the labor market.

After conducting the cluster analysis to classify the samples according to the level of digital literacy, it is found that the digital fluency group access higher number of banking services than others. They are also looking for new banking services such as a universal mobile banking app with smart notification services. Although branch banking will become less important after the successful implementation of digital ID, financial institutions need to find a balance between serving the digital illiterate and digital fluency group. The middle way is to maintain the convenience of branch banking network but redesign and resize the branch by using more of automated machines.

Even though the customer centric strategy is the way forward for most financial institutions in Thailand, they also need to be aware that most customers regardless of their levels of digital literacy do not prefer tailor-made financial services with personalized features and conditions. This is because customization reduces the transparency in price setting. Financial institutions should pay more attention on developing an open banking ecosystem that use data analytic to help banks offering easy-to-understand products for appropriate customers.

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Appendix I: Digital literacy questionnaire

ส่วนที่ 1 ข้อมูลพื้นฐานของผู้ตอบแบบสอบถาม

1. เพศของท่าน ☐ ชาย ☐ หญิง
2. ปี พ.ศ. เกิดของท่าน _____
3. ท่านกำลังศึกษาอยู่ในระดับใด หรือจบการศึกษาสูงสุดในระดับใด
   ☐ ประถมต้น ☐ ประถมปลาย ☐ มัธยมต้น ☐ มัธยมปลาย
   ☐ ปริญญาตรี ☐ ปริญญาโท ☐ ปริญญาเอก
4. สถานภาพการสมรสของท่าน ☐ โสด ☐ สมรส ☐ ม่าย
5. สถานะการทำงานของท่านในปัจจุบัน
   ☐ ไม่ได้ทำงานเพราะกำลังศึกษาเล่าเรียน
   ☐ ไม่ได้ทำงานเพราะยังหางานทำไม่ได้
   ☐ ประกอบอาชีพในระดับผู้จัดการ ข้าราชการระดับอาวุโส และผู้บัญญัติกฎหมาย
   ☐ ผู้ปฏิบัติงานที่มีฝีมือด้านการเกษตร ป่าไม้ และประมง
   ☐ ประกอบอาชีพในระดับเสมียน
   ☐ พนักงานบริการหรือผู้จำหน่ายสินค้า
   ☐ เจ้าหน้าที่เทคนิคในด้านต่างๆ
   ☐ ช่างฝีมือและผู้ปฏิบัติงานที่เกี่ยวข้อง
   ☐ ผู้ปฏิบัติงานในโรงงานเช่นควบคุมเครื่องจักร และการประกอบ
   ☐ ผู้ประกอบอาชีพงานพื้นฐาน เช่นแม่บ้าน คนขับรถ และรปภ. เป็นต้น
   ☐ ทหาร ตำรวจ
6. ช่วงระดับรายได้เฉลี่ย**<u>ต่อปี</u>** ของท่าน
   ☐ น้อยกว่า 100,000 บาทต่อปี
   ☐ 100,000 – 299,999 บาทต่อปี
   ☐ 300,000 – 499,999 บาทต่อปี
   ☐ 500,000 – 999,999 บาทต่อปี
   ☐ 1,000,000 – 1,999,999 บาทต่อปี
   ☐ มากกว่าหรือเท่ากับ 2,000,000 บาทต่อปี

ส่วนที่ 2 ประเมินความรู้ความเข้าใจด้าน Digital technologies

7. จำนวน Digital technologies ที่ครัวเรือนของท่านมี

Desktop computer	จำนวน _____ เครื่อง	Tablet	จำนวน _____ เครื่อง
Laptop/Notebook	จำนวน _____ เครื่อง	Smartwatch	จำนวน _____ เครื่อง
Smartphone	จำนวน _____ เครื่อง	Printer	จำนวน _____ เครื่อง
Smart TV	จำนวน _____ เครื่อง	MP3/4 player (รวม ลำโพงBluetooth)	จำนวน _____ เครื่อง

8. ท่านเคยใช้ Digital technologies ในระดับใด

	ระดับการใช้			
	ใช้ได้ตามต้องการ (Unlimited access)	ใช้บางครั้ง (Limited access)	ไม่เคยใช้ (No access)	ไม่รู้จัก (Not sure)
Desktop computer	☐	☐	☐	☐
Laptop/Notebook	☐	☐	☐	☐
Smartphone	☐	☐	☐	☐
Smart TV	☐	☐	☐	☐
Tablet	☐	☐	☐	☐
Smartwatch	☐	☐	☐	☐
Printer	☐	☐	☐	☐
MP3/4 player (รวม ลำโพงBluetooth)	☐	☐	☐	☐

9. ท่านใช้ Digital technologies เหล่านี้เพื่อเหตุผลใด **(ตอบได้มากกว่า 1 ข้อ)**

	เหตุผลการใช้			
	เพื่อการทำงาน/ การศึกษา	เพื่อความบันเทิง สันทนากร	เพื่อการ ติดต่อสื่อสาร	เพื่อหาข้อมูลที่ ต้องการ
Desktop computer	☐	☐	☐	☐
Laptop/Notebook	☐	☐	☐	☐
Smartphone	☐	☐	☐	☐
Smart TV	☐	☐	☐	☐
Tablet	☐	☐	☐	☐
Smartwatch	☐	☐	☐	☐
Printer	☐	☐	☐	☐
MP3/4 player (รวม ลำโพงBluetooth)	☐	☐	☐	☐

10. ท่านคิดว่าท่านมีทักษะการใช้งานในแต่ละหัวข้ออยู่ในระดับใด

	1 (ต่ำมาก)	2	3	4	5 (สูงมาก)
ทักษะการพิมพ์ด้วย Keyboard	☐	☐	☐	☐	☐
ทักษะการค้นหาข้อมูลทางอินเตอร์เน็ต	☐	☐	☐	☐	☐
อ่านบทความผ่านหน้าจอคอมพิวเตอร์	☐	☐	☐	☐	☐
คุ้นเคยกับการใช้ Social network	☐	☐	☐	☐	☐
Word processor: Word or pages	☐	☐	☐	☐	☐
Spreadsheet: Excel or numbers	☐	☐	☐	☐	☐
Presentation: PowerPoint or Keynote	☐	☐	☐	☐	☐
Video editing: iMovie or MovieMaker	☐	☐	☐	☐	☐
Photo/image editing: Photoshop or Photoscape	☐	☐	☐	☐	☐
Web design software: Dreamweaver or Frontpage	☐	☐	☐	☐	☐
Mobile devices organizer: address book or calendar	☐	☐	☐	☐	☐
Email	☐	☐	☐	☐	☐
Web browser	☐	☐	☐	☐	☐
Instant messaging apps เช่น Line หรือ Messenger	☐	☐	☐	☐	☐
Blog	☐	☐	☐	☐	☐
Video conference	☐	☐	☐	☐	☐
Computer game	☐	☐	☐	☐	☐

11. จำนวนชั่วโมงต่อวันโดยเฉลี่ยที่ท่านใช้ Smartphone _____ ชั่วโมงต่อวัน

12. จำนวนชั่วโมงต่อวันโดยเฉลี่ยที่ท่านใช้ Computer/Laptop _____ ชั่วโมงต่อวัน

13. ท่านคิดว่าท่านมีระดับความรู้ความเข้าใจในหัวข้อดังกล่าวอย่างไร

	1 (ต่ำมาก)	2	3	4	5 (สูงมาก)
การทำงานของ computer hardware	☐	☐	☐	☐	☐
เครือข่าย Internet	☐	☐	☐	☐	☐

14. ข้อใดคือสิ่งที่ต้อง install ใน computer เพื่อให้สามารถใช้ video conference ได้

☐ Scanner ☐ Webcam ☐ Printer ☐ DVD player ☐ ไม่รู้

15. Digital camera เก็บรูปภาพไว้ที่ใด

☐ Battery ☐ Film ☐ Adapter ☐ Memory card ☐ ไม่รู้

16. ไฟล์ AVI และ MP4 คือตัวอย่างของไฟล์ประเภทใด

☐ Digital audio file formats ☐ Digital video file formats ☐ ไม่รู้

☐ Digital graphic file formats ☐ Digital text file formats

17. ข้อใดคือคำศัพท์อธิบาย junk email หรือข้อความไม่พึงประสงค์

☐ Spam ☐ Firewall ☐ Malware ☐ Spyware ☐ ไม่รู้

18. ข้อใดคือชื่ออาชญากรรมที่พยายามล้วงข้อมูลที่อ่อนไหวเช่นบัตรเครดิต หรือ password เป็นต้น

☐ Synthesizing ☐ Streaming ☐ Phishing ☐ Crowdsourcing ☐ ไม่รู้

19. ข้อใดคือสมองของคอมพิวเตอร์

☐ CPU ☐ LAN ☐ RAM ☐ ROM ☐ ไม่รู้

20. ท่านเคยสร้างข้อมูลประเภทใดบ้างในโลก online **(ตอบได้มากกว่า 1 ข้อ)**

☐ ภาษา ตัวอักษร ☐ วิดีโอ ☐ เพลง ☐ ภาพ ☐ Survey หรือ quiz ☐ Websites

21. ท่านมีความมั่นใจในการใช้แหล่งข้อมูล Digital ในระดับใด

	1 (ต่ำมาก)	2	3	4	5 (สูงมาก)
ตระหนักรับรู้ว่าข้อมูลของท่านในโลก Online ถูกนำไปใช้อย่างไร	☐	☐	☐	☐	☐
รับรู้เงื่อนไขหากท่านนำภาพ ข้อความ และเสียงจากโลกออนไลน์ไปใช้เพื่อประโยชน์ของตนเอง	☐	☐	☐	☐	☐
สามารถบ่งชี้ website ที่ปลอดภัย และน่าเชื่อถือ	☐	☐	☐	☐	☐
ตระหนักถึงความเสี่ยงในโลกออนไลน์จากการโจรกรรมข้อมูล	☐	☐	☐	☐	☐
รู้วิธีการป้องกันการโจรกรรมข้อมูลในรูปแบบต่างๆ	☐	☐	☐	☐	☐

22. เวลามีคนคอมเม้นต์ไม่ดีต่อท่าน ท่านจะโต้ตอบหรือไม่

☐ ตอบโต้ ☐ ไม่ตอบโต้

23. ท่านเคยช่วยใครที่ถูกกลั่นแกล้งในโลกออนไลน์หรือไม่

☐ เคย ☐ ไม่เคย

24. ท่านทราบหรือไม่ว่าการกระทำอย่างไรผิดกฎหมายในโลก online

☐ ทราบ ☐ ไม่ทราบ

25. ท่านเคย report สิ่งที่ไม่ถูดต้องที่คุณเห็น ในโลก online หรือไม่

☐ เคย ☐ ไม่เคยเพราะคิดว่าไม่จำเป็น

☐ ไม่เคยเพราะไม่รู้จะทำอย่างไร ☐ ไม่เคยเพราะการ report คงไม่ได้เปลี่ยนแปลงอะไร

26. หากท่านพบสิ่งที่ไม่พึงประสงค์ในโลกออนไลน์ ท่านจะทำอย่างไร

☐ ออกจาก website เหล่านั้น ☐ รายงานบุคคลที่เกี่ยวข้องในโลก offline

☐ รายงานบุคคลที่เกี่ยวข้องในโลก online ☐ เพิกเฉย

☐ บอกเพื่อนฝูง

27. Social network profile ของท่านกำหนดระดับ privacy อย่างไร

☐ ไม่มี profile ☐ เฉพาะเพื่อนเท่านั้นที่เห็น

☐ มีคนช่วงตั้ง privacy ให้ ☐ ไม่รู้ว่าจะตั้งอย่างไร

☐ ไม่รู้ว่า privacy setting คืออะไร ☐ ตั้งเป็น Public เปิดเผยทั้งหมดตลอดเวลา

28. สรุปความคิดเห็นของท่านเกี่ยวกับ Digital technologies

	1 (ต่ำมาก)	2	3	4	5 (สูงมาก)
ท่านคิดว่าท่านมีความรู้ด้าน Digital literacy ในระดับใด	☐	☐	☐	☐	☐
ท่านชอบที่จะศึกษาเกี่ยวกับ Digital technologies บ่อยเพียงใด	☐	☐	☐	☐	☐
ท่านรู้สึกว่าอยู่ล้าหลังคนอื่นในเรื่อง digital technologies	☐	☐	☐	☐	☐
ท่านคิดว่าเป็นสิ่งสำคัญที่จะต้องพัฒนาทักษะด้าน digital	☐	☐	☐	☐	☐

ส่วนที่ 3 ความคิดเห็นต่อผลิตภัณฑ์และบริการทางการเงิน (Financial services)

29. ปัจจุบันท่านใช้บริการด้านใดบ้างจากธนาคารพาณิชย์ **(ตอบได้มากกว่า 1 ข้อ)**

☐ บัญชีเงินฝาก หรือสลากออมทรัพย์ ☐ เงินกู้ ☐ เช็ค

☐ บัตรเครดิต ☐ กองทุนรวม ☐ ผลิตภัณฑ์ประกัน

30. จำนวนธนาคารพาณิชย์ที่ท่านเป็นลูกค้า จำนวน _____ แห่ง

31. ท่านเป็นลูกค้าธนาคารมาแล้วกี่ปี จำนวน _____ ปี

32. **หากท่านเป็นลูกค้าธนาคารหลายแห่ง** ท่านมีสาเหตุอย่างไร **(ตอบได้มากกว่า 1 ข้อ)**

☐ ใช้ ATM ได้หลายธนาคาร ☐ มีเงินกู้หลายธนาคาร

☐ เข้าถึงสาขาของธนาคารได้สะดวก ☐ ดอกเบี้ยเงินฝากจูงใจให้เป็นลูกค้าหลายธนาคาร

☐ ธนาคารที่รับเงินเดือนเป็นคนละธนาคารกับที่ตัวเองต้องการ ☐ เพื่อเป็นลูกค้าธนาคารเดียวกับเพื่อนและคนในครอบครัว

☐ มีบัตรเครดิตหลายธนาคาร ☐ มุ่งเน้นใช้บริการคนละด้านในแต่ละธนาคาร

33. ขอให้ท่านเลือกสาเหตุที่ทำให้ท่านตัดสินใจเป็นลูกค้าธนาคาร **(เลือกได้ 3 ข้อ)**

☐ การแนะนำของเพื่อนและครอบครัว
☐ มีสาขาอยู่ที่ทำงานหรือสถานศึกษา
☐ อัตราดอกเบี้ยเงินฝากจูงใจ
☐ อัตราดอกเบี้ยเงินกู้จูงใจ
☐ ค่าธรรมเนียมน่าสนใจ
☐ จำนวนตู้ ATM ทำให้สะดวก
☐ มี Mobile app ที่ตอบสนองความต้องการ
☐ มีสาขาที่เข้าถึงสะดวกสบาย

34. ท่านใช้บริการตู้ ATM บ่อยเพียงใด

☐ เฉลี่ยเดือนละ 1-2 ครั้ง
☐ เฉลี่ยเดือนละ 2-4 ครั้ง
☐ เฉลี่ยเดือนละ 4-8 ครั้ง
☐ เฉลี่ยมากกว่า 8 ครั้งต่อเดือน

35. ข้อความใดสะท้อนตัวตนของธนาคาร ที่ท่านต้องการเห็นในอนาคต **(เลือกได้ 3 ข้อ)**

☐ การมีนวัตกรรมและเทคโนโลยี
☐ พนักงานธนาคารเข้าถึงง่าย
☐ นำเสนอผลิตภัณฑ์และบริการที่จำเพาะเจาะจงกับตัวท่าน
☐ ความรวดเร็วในการซื้อผลิตภัณฑ์และบริการ
☐ การมีผลิตภัณฑ์และบริการที่รอบด้าน
☐ การมีความเชี่ยวชาญอย่างมากในบางผลิตภัณฑ์หรือบริการ
☐ ค่าธรรมเนียมต้องต่ำ
☐ อัตราดอกเบี้ยต้องต่ำ
☐ มีความโปร่งใส สามารถเปรียบเทียบราคาได้
☐ มีความน่าเชื่อถือ
☐ การมีพันธมิตรร้านค้าที่หลากหลาย

36. **<u>ในอีก 5 ปีข้างหน้า</u>** ท่านอยากให้ธนาคารให้ความสำคัญกับบริการในด้านต่างๆเหล่านี้ในระดับใด

	1 (ต่ำมาก)	2	3	4	5 (สูงมาก)
บริการผ่าน Mobile banking ที่รอบด้าน	☐	☐	☐	☐	☐
บริการผ่าน Online banking (Computer) ที่รอบด้าน	☐	☐	☐	☐	☐
ได้รับการแจ้งเตือน Notification เกี่ยวกับธุรกรรมต่างๆ ทาง smartphone	☐	☐	☐	☐	☐
ได้รับ email แจ้งเตือนในการชำระเงินหรือเรื่องการเงินต่างๆ	☐	☐	☐	☐	☐
ความสามารถในการเปิดบัญชีผ่าน mobile banking	☐	☐	☐	☐	☐
ความสามารถในการเปิดบัญชีผ่าน online banking (Computer)	☐	☐	☐	☐	☐
ความสามารถในการติดต่อพนักงานธนาคารผ่าน Chat bot	☐	☐	☐	☐	☐
ความสามารถในการติดต่อพนักงานธนาคารผ่าน video call	☐	☐	☐	☐	☐
การที่รายละเอียดผลิตภัณฑ์และบริการต่างๆของธนาคารเปิดเผยอย่างละเอียดบน Website และช่องทาง online	☐	☐	☐	☐	☐
พูดคุยกับพนักงานธนาคารแบบ Face-to-face	☐	☐	☐	☐	☐
สาขาธนาคารอยู่ในพื้นที่เข้าถึงสะดวก รวดเร็ว	☐	☐	☐	☐	☐
ความสามารถที่จะฝากเช็คผ่าน smartphone	☐	☐	☐	☐	☐
จำนวนตู้ ATM หลายพื้นที่ เข้าถึงสะดวก	☐	☐	☐	☐	☐
ธนาคารจะต้องมีเครื่อง automatic ที่ทำได้หลายอย่างเช่นฝากเงิน และupdate สมุดบัญชี เป็นต้น	☐	☐	☐	☐	☐
ธนาคารต้องมีพันธมิตรร้านค้าที่หลากหลายเพื่อเชื่อมโยง Promotions และบริการต่างๆ	☐	☐	☐	☐	☐
ธนาคารวิเคราะห์ข้อมูลการใช้งานของลูกค้าจนสามารถนำเสนอบริการที่ตอบโจทย์ความต้องการ	☐	☐	☐	☐	☐
ธนาคารเชื่อมโยงบริการทั้ง off-line, online, mobile, chat และ call เข้าถึงกัน	☐	☐	☐	☐	☐
ธนาคารเชื่อมโยงกับ Platform ต่างๆที่ลูกค้าใช้บริการประจำ เช่น Line, Facebook, Instagram เป็นต้น	☐	☐	☐	☐	☐

Appendix 2: Executive questionnaire

ส่วนที่ 1 ข้อมูลพื้นฐานขององค์กร

1. องค์กรของท่านเป็นประเภทใด

   ☐ ธนาคารพาณิชย์ (Commercial bank)
   ☐ บริษัทหลักทรัพย์จัดการลงทุน (Fund management company)
   ☐ บริษัทประกัน (Insurance company)
   ☐ ผู้แนะนำการลงทุน (Advisory/Brokerage)
   ☐ ผู้ให้บริการทางการเงินด้วยเทคโนโลยี (Fintech)

2. ท่านมีตำแหน่งอยู่ในระดับใด

   ☐ CEO
   ☐ CTO/Head of IT/Digital/Technology
   ☐ CDO/Business development
   ☐ Head of innovation
   ☐ COO
   ☐ Others โปรดระบุ .....
   ☐ Director/Head of department
   ☐ CFO
   ☐ Head of strategy
   ☐ Head of products
   ☐ CRO/Risk manager

3. ยอดขายโดยประมาณขององค์กรท่านในปีที่ผ่านมา _____

ส่วนที่ 2 ประเมินการแข่งขันของอุตสาหกรรมการให้บริการทางการเงิน

4. ในปัจจุบัน Non-traditional players เช่น Fintechs, Startups และบริษัทในอุตสาหกรรมอื่น ต่างมีการนำเสนอผลิตภัณฑ์และบริการที่เกี่ยวเนื่องกับการให้บริการทางการเงิน ท่านประเมินว่าถือเป็นความเสี่ยง หรือโอกาสทางธุรกิจ

   ☐ เป็นความเสี่ยงอย่างมีนัยสำคัญ (Significant threat)
   ☐ เป็นความเสี่ยงเฉพาะกรณีการนำเทคโนโลยีล้ำสมัยที่สามารถปรับเปลี่ยนพฤติกรรมของผู้บริโภคเท่านั้น
   ☐ เป็นโอกาสขององค์กรในการนำเสนอผลิตภัณฑ์และบริการใหม่ๆเพื่อแข่งขันกับ Non-traditional players

5. ในปัจจุบันได้มีการพูดถึง Simplification ซึ่งคือการปรับให้สิ่งต่างๆง่ายขึ้น เข้าใจง่ายขึ้น หรือมีประสิทธิภาพมากขึ้น ท่านคิดว่าผู้บริโภคต้องการให้สถาบันการเงิน Simplify อะไร

   ☐ Products and services ☐ Distribution channels ☐ Price and rates

6. ขอให้ท่านประเมินระดับความสำคัญของประเด็นต่างๆ ด้านล่าง (1 หมายถึงต่ำมาก และ 5 หมายถึงสูงมาก)

ประเด็นพิจารณา	1	2	3	4	5
▪ ท่านคิดว่าข้อมูลที่เกี่ยวกับลูกค้าที่ท่านมีอยู่ในฐานข้อมูลขององค์กจะเติบโตอย่างไรในอีก 5 ปีข้างหน้า	☐	☐	☐	☐	☐
▪ ท่านคิดว่าข้อมูลที่เกี่ยวกับลูกค้าจะทำให้ท่านสามารถขยายขอบเขตผลิตภัณฑ์และบริการให้แก่ลูกค้าได้ในระดับใด	☐	☐	☐	☐	☐
▪ ท่านคิดว่าองค์กรมีความพร้อมในระดับใดในการจัดการและวิเคราะห์ข้อมูลของลูกค้าเพื่อสร้างประโยชน์ทางธุรกิจ	☐	☐	☐	☐	☐
▪ ท่านคิดว่าการสร้างความสัมพันธ์หรือความร่วมมือทางการค้ากับองค์กรอื่นที่ถือว่าเป็น Ecosystem partners มีความสำคัญในระดับใด	☐	☐	☐	☐	☐
▪ ท่านให้ความสำคัญกับระบบรักษาความปลอดภัยทาง Cyber เมื่อร่วมมือกับองค์กรอื่นอย่างไร	☐	☐	☐	☐	☐
▪ ท่านคิดว่าในอีก 5 ปีข้างหน้า สถาบันการเงินแบบดั้งเดิมจะถูก Disrupt ด้วยเทคโนโลยีและผู้ประกอบการรายใหม่ในระดับใด	☐	☐	☐	☐	☐

7. ขอให้ท่านประเมินปัจจัยต่างๆด้านล่าง ว่าแต่ละปัจจัยมีระดับความท้าทายต่อผู้ให้บริการทางการเงินอย่างไรในอีก 5 ปีข้างหน้า (1 หมายถึงต่ำมาก และ 5 หมายถึงสูงมาก)

ปัจจัยความท้าทาย	1	2	3	4	5
▪ ผู้ให้บริการจะต้องดำเนินงานให้สอดคล้องกับกฎเกณฑ์ที่เข้มงวดและซับซ้อนมากยิ่งขึ้น	☐	☐	☐	☐	☐
▪ ผู้ให้บริการจะต้องพยายามหากลุ่มลูกค้าใหม่ๆ	☐	☐	☐	☐	☐
▪ ผู้ให้บริการได้รับแรงกดดันให้เพิ่มอัตราการทำกำไร	☐	☐	☐	☐	☐
▪ ผู้ให้บริการจะต้องรับความน่าเชื่อถือในสายตาผู้บริโภค	☐	☐	☐	☐	☐
▪ ผู้ให้บริการจะต้องพยายามรักษาฐานลูกค้าเดิม	☐	☐	☐	☐	☐
▪ ผู้ให้บริการประสบปัญหาด้านพนักงานที่มีทักษะและความรู้ที่เหมาะสมสำหรับการแข่งขันในอนาคต	☐	☐	☐	☐	☐
▪ ผู้ให้บริการจะต้องแข่งขันกับผู้ประกอบการรายใหม่	☐	☐	☐	☐	☐

8. ขอให้ท่านเรียงลำดับกลยุทธ์การแข่งขันด้านล่าง ว่ากลยุทธ์ใดมีความสำคัญมากที่สุด (อันดับ 1) ไปจนถึงกลยุทธ์ใดมีความสำคัญน้อยที่สุด (อันดับ 6) สำหรับการแข่งขันในอีก 5 ปีข้างหน้า

กลยุทธ์การแข่งขัน	อันดับความสำคัญ
Customer-centric business model	
Optimized distribution	
Simplification of products and services	
Information advantage	
Enabling innovation	
Proactively managing risks and regulation	

9. ขอให้ท่านเรียงลำดับความสำคัญของนวัตกรรมที่จำเป็นสำหรับการแข่งขันในอีก 5 ปีข้างหน้า โดยอันดับ 1 คือนวัตกรรมที่มีอันดับความสำคัญมากสุด และอันดับ 3 คือนวัตกรรมที่มีอันดับความสำคัญน้อยที่สุด

ประเภทของโครงการลงทุน	อันดับความสำคัญ
นวัตกรรมที่เกี่ยวกับตัวผลิตภัณฑ์	
นวัตกรรมที่เกี่ยวกับ Customer interfaces/Channels	
นวัตกรรมที่เกี่ยวกับ Core platforms	

10. ท่านคิดว่าบริการทางการเงินในแต่ละด้าน ควรได้รับการปรับปรุงในด้านใดมากที่สุดเพื่อให้สามารถแข่งขันได้ในอีก 5 ปีข้างหน้า (ขอให้ท่านเลือกกลยุทธ์ที่สำคัญที่สุด 1 กลยุทธ์สำหรับแต่ละประเภทบริการ)

กลยุทธ์เพื่อความสำเร็จ	ประเภทของบริการ			
	Payments	Banking	Insurance	Wealth management
Ease of use, intuitive product design	☐	☐	☐	☐
Faster service	☐	☐	☐	☐
24/7 accessibility	☐	☐	☐	☐
Superior customer service	☐	☐	☐	☐
Cost reduction	☐	☐	☐	☐
Price and rates	☐	☐	☐	☐

11. ขอให้ท่านประเมินว่ากลยุทธ์ด้านล่างมีผลต่อความสำเร็จของผู้ให้บริการทางการเงินในอีก 5 ปีข้างหน้าอย่างไร (1 หมายถึงต่ำมาก และ 5 หมายถึงสูงมาก)

กลยุทธ์การแข่งขัน	1	2	3	4	5
การเปิดบัญชีเงินฝาก และบัญชีเงินกู้อย่างอัตโนมัติ	☐	☐	☐	☐	☐
วิเคราะห์ฐานข้อมูลเพื่อให้คำแนะนำจำเพาะเจาะจงแก่ลูกค้ารายบุคคล	☐	☐	☐	☐	☐
การมีโปรแกรมบริหารเงินให้แก่ลูกค้า	☐	☐	☐	☐	☐
การนำเสนอบริการและผลิตภัณฑ์จำเพาะเจาะจงกับลูกค้า (Customization)	☐	☐	☐	☐	☐
การมุ่งเป้าเรื่องความปลอดภัยทาง Cyber	☐	☐	☐	☐	☐
การเปลี่ยนแปลงจาก Human relationship เป็น Digital experience	☐	☐	☐	☐	☐
นำ Digital solutions เพื่อให้บริการแก่กลุ่มลูกค้ากลุ่มใหม่ (Unserved/underserved customers)	☐	☐	☐	☐	☐
การพัฒนาช่องทางชำระเงินแบบใหม่ New payment options	☐	☐	☐	☐	☐
วิเคราะห์ฐานข้อมูลเพื่อลดความเสี่ยงขององค์กร และเพิ่มความสามารถในการตัดสินใจ	☐	☐	☐	☐	☐

12. ท่านคิดว่าผลิตภัณฑ์และบริการทางการเงินในแต่ละด้านมีโอกาสถูก Disrupt ในระดับใด (1 หมายถึงต่ำมาก และ 5 หมายถึงสูงมาก)

ผลิตภัณฑ์และบริการทางการเงิน	1	2	3	4	5
Payments and fund transfer	☐	☐	☐	☐	☐
Personal finance	☐	☐	☐	☐	☐
Personal loans	☐	☐	☐	☐	☐
Deposits/Savings accounts	☐	☐	☐	☐	☐
Insurance	☐	☐	☐	☐	☐
Wealth management	☐	☐	☐	☐	☐

13. ในอีก 5 ปีข้างหน้า ท่านคิดว่าเทคโนโลยีด้านล่างจะมีผลกระทบต่อธุรกิจการให้บริการทางการเงินในระดับใด (1 หมายถึงต่ำมาก และ 5 หมายถึงสูงมาก)

ประเภทของเทคโนโลยี	1	2	3	4	5
Distributed ledger technology (Blockchain)	☐	☐	☐	☐	☐
Artificial intelligence	☐	☐	☐	☐	☐
Extended reality	☐	☐	☐	☐	☐
Quantum	☐	☐	☐	☐	☐

ส่วนที่ 3 เทคโนโลยี การลงทุน และกลยุทธ์ขององค์กรของท่านในอนาคต

14. ท่านคิดว่าองค์กรของท่านเป็น Innovation leaders หรือไม่ ☐ เป็น ☐ ไม่เป็น
15. ท่านคิดว่าองค์กรของท่านมีแผนระยะยาวสำหรับการลงทุนเพื่อสร้างนวัตกรรม หรือไม่ ☐ มี ☐ ไม่มี
16. ท่านคิดว่าองค์กรของท่านมีความรวดเร็วในการนำเทคโนโลยีมาใช้เพื่อปรับปรุงผลิตภัณฑ์และบริการอย่างไร ในช่วง 5 ปีที่ผ่านมา

    ☐ มีอัตราเร่งอย่างมากเมื่อเทียบกับอดีต ☐ มีอัตราเร่งกว่าในอดีต

    ☐ มีอัตราเร็วเท่าเดิมเหมือนในอดีต ☐ มีอัตราเร็วที่ช้าลงเทียบกับในอดีต
17. ท่านคิดว่าสถาบันการเงินที่ท่านบริหารมีโอกาสที่จะถูก Disrupt ด้วยความน่าจะเป็นในระดับใด

    ☐ Extremely high ☐ High ☐ Moderate ☐ Low ☐ Extremely low
18. ในปัจจุบัน องค์กรของท่านมีความร่วมมือทางการค้ากับ Fintechs หรือผู้ให้บริการทางการเงินรายใหม่ในระดับใด

    ☐ Extremely high ☐ High ☐ Moderate ☐ Low ☐ Extremely low
19. ในกระบวนการ Simplification ของกระบวนการทำงานต่างๆ ท่านคาดหวังให้องค์กรได้รับประโยชน์ในด้านใดบ้าง โปรดเรียงอันดับจากสูงที่สุด (อันดับ 1) ไปจนน้อยที่สุด (อันดับ 5)

ประโยชน์จากการ Simplification	อันดับความสำคัญ
องค์กรมีการให้บริการที่ตอบสนองความต้องการของผู้บริโภคมากขึ้น	
องค์กรมีอัตราการทำกำไรที่สูงขึ้น	
องค์กรสามารถลดต้นทุนการดำเนินงาน	
องต์กรสามารถขยายฐานลูกค้าใหม่ได้อย่างมีประสิทธิภาพ	
องค์กรสามารถลดระยะเวลาในการนำเสนอผลิตภัณฑ์และบริการใหม่สู่ตลาด	

20. องค์กรของท่านได้มีการลงทุนในโครงการที่มุ่งเน้นในด้านใดบ้าง และขอให้ท่านประเมินระดับความสำเร็จของโครงการดังกล่าวในปัจจุบัน (1 หมายถึงต่ำมาก และ 5 หมายถึงสูงมาก)

ลักษณะของโครงการลงทุน	มีหรือไม่	ระดับความสำเร็จ				
		1	2	3	4	5
Customer-centric business model	☐ มี ☐ ยังไม่มี	☐	☐	☐	☐	☐
Optimized distribution	☐ มี ☐ ยังไม่มี	☐	☐	☐	☐	☐
Simplification of products and services	☐ มี ☐ ยังไม่มี	☐	☐	☐	☐	☐
Information advantage	☐ มี ☐ ยังไม่มี	☐	☐	☐	☐	☐
Enabling innovation	☐ มี ☐ ยังไม่มี	☐	☐	☐	☐	☐
Regulatory compliance	☐ มี ☐ ยังไม่มี	☐	☐	☐	☐	☐
Proactively managing risks and regulation	☐ มี ☐ ยังไม่มี	☐	☐	☐	☐	☐

21. องค์กรของท่านจะมีการลงทุน หรือซื้อเทคโนโลยีด้านใดบ้าง

ประเภทของเทคโนโลยี	ในปัจจุบัน	ในอีก 5 ปีข้างหน้า
Distributed ledger technology (Blockchain)	☐ มี ☐ ยังไม่มี	☐ มีแผนลงทุน ☐ ยังไม่มีแผน
Artificial intelligence	☐ มี ☐ ยังไม่มี	☐ มีแผนลงทุน ☐ ยังไม่มีแผน
Extended reality	☐ มี ☐ ยังไม่มี	☐ มีแผนลงทุน ☐ ยังไม่มีแผน
Quantum	☐ มี ☐ ยังไม่มี	☐ มีแผนลงทุน ☐ ยังไม่มีแผน
Data analytics	☐ มี ☐ ยังไม่มี	☐ มีแผนลงทุน ☐ ยังไม่มีแผน
Cyber security	☐ มี ☐ ยังไม่มี	☐ มีแผนลงทุน ☐ ยังไม่มีแผน
Robotic process automation	☐ มี ☐ ยังไม่มี	☐ มีแผนลงทุน ☐ ยังไม่มีแผน
Biometrics and identity management	☐ มี ☐ ยังไม่มี	☐ มีแผนลงทุน ☐ ยังไม่มีแผน
Public cloud infrastructure	☐ มี ☐ ยังไม่มี	☐ มีแผนลงทุน ☐ ยังไม่มีแผน

22. ท่านคิดว่าองค์กรของท่านมีความพร้อมในระดับใดสำหรับการริเริ่มและลงทุนในเทคโนโลยีแห่งอนาคตเพื่อให้องค์กรสามารถแข่งขันได้ใน Digital economy

☐ ต่ำมาก ☐ ค่อนข้างต่ำ ☐ ปานกลาง ☐ ค่อนข้างสูง ☐ สูงมาก

23. เมื่อพิจารณาอุปสรรคต่างๆที่มีผลกระทบต่อการสร้างนวัตกรรมขององค์กรด้านล่าง ท่านคิดว่าองค์กรของท่านพบกับอุปสรรคในด้านใดบ้าง (1 หมายถึงไม่พบกับอุปสรรคด้านนี้ และ 5 หมายถึงพบกับอุปสรรคด้านนี้อย่างมาก)

อุปสรรคต่อการสร้างนวัตกรรม	1	2	3	4	5
ความซับซ้อนด้านกฎหมาย	☐	☐	☐	☐	☐
ขาดเงินทุน	☐	☐	☐	☐	☐
ความขัดแย้งภายในองค์กรที่เกิดจากการเปลี่ยนผ่านทางเทคโนโลยี	☐	☐	☐	☐	☐
ขาดทรัพยากรบุคคลที่มีทักษะสำหรับการสร้างนวัตกรรม	☐	☐	☐	☐	☐
ความผันผวนของผลประกอบการช่วงลงทุนสร้างนวัตกรรม	☐	☐	☐	☐	☐
ขาดวินัยและความกล้า	☐	☐	☐	☐	☐
ขาดการกำหนดผู้ที่มีหน้าที่รับผิดชอบ	☐	☐	☐	☐	☐
ขาดการหากลยุทธ์ทางธุรกิจเพื่อรองรับการคิดนวัตกรรม	☐	☐	☐	☐	☐
ขาดการกระตุ้นสนับสนุนจากผู้บริหารระดับบน	☐	☐	☐	☐	☐

24. อุปสรรคต่อการพัฒนานวัตกรรมในองค์กรของท่าน ส่งผลกระทบต่อความล่าช้าในการนำเสนอเทคโนโลยีต่อผู้บริโภคในระดับใด (1 หมายถึงไม่ทำให้ล่าช้าเลย และ 5 หมายถึงทำให้ล่าช้าอย่างมาก)

ลักษณะของเทคโนโลยี	1	2	3	4	5
เทคโนโลยีด้านการเก็บข้อมูล และประมวลผลข้อมูล	☐	☐	☐	☐	☐
เทคโนโลยีด้านการพิสูจน์ตัวตน	☐	☐	☐	☐	☐
เทคโนโลยีที่นำมาช่วยสร้าง Platform business เช่น Crowdfunding และ P2P lending	☐	☐	☐	☐	☐
เทคโนโลยีที่นำมาสร้างสกุลเงินใหม่ๆ (E-money/Cryptocurrency)	☐	☐	☐	☐	☐

25. หากท่านลงทุนในนวัตกรรมใหม่ๆ ท่านคาดหวังผลตอบแทน Return on Investment (ROI) ในระดับใด
ระดับ ROI ที่ต้องการ _____%

26. เมื่อท่านร่วมมือกับ Fintechs และสถาบันการเงินอื่น ท่านประสบปัญหาในด้านใดบ้าง

ลักษณะของปัญหา	ประสบปัญหากับ Fintechs	ประสบปัญหากับสถาบันการเงินอื่น
IT security	☐ ประสบ ☐ ไม่ประสบ	☐ ประสบ ☐ ไม่ประสบ
Regulatory uncertainty	☐ ประสบ ☐ ไม่ประสบ	☐ ประสบ ☐ ไม่ประสบ
ความแตกต่างทางวัฒนธรรมองค์กร	☐ ประสบ ☐ ไม่ประสบ	☐ ประสบ ☐ ไม่ประสบ
ความแตกต่างทางกลยุทธ์ธุรกิจ	☐ ประสบ ☐ ไม่ประสบ	☐ ประสบ ☐ ไม่ประสบ
IT compatibility	☐ ประสบ ☐ ไม่ประสบ	☐ ประสบ ☐ ไม่ประสบ
ความแตกต่างด้านกระบวนการทำงานภายใน	☐ ประสบ ☐ ไม่ประสบ	☐ ประสบ ☐ ไม่ประสบ
ความแตกต่างด้านทักษะความรู้	☐ ประสบ ☐ ไม่ประสบ	☐ ประสบ ☐ ไม่ประสบ
ขาดเงินทุน	☐ ประสบ ☐ ไม่ประสบ	☐ ประสบ ☐ ไม่ประสบ

27. ข้อความใดคือภาพลักษณ์ที่ท่านต้องการให้องค์กรของท่านเป็นในอนาคต **(เลือกได้ 3 ข้อ)**

☐ การมีนวัตกรรมและเทคโนโลยี
☐ นำเสนอผลิตภัณฑ์และบริการที่จำเพาะเจาะจงกับตัวท่าน
☐ การมีผลิตภัณฑ์และบริการที่รอบด้าน
☐ การมีความเชี่ยวชาญอย่างมากในบางผลิตภัณฑ์หรือบริการ
☐ มีความโปร่งใส สามารถเปรียบเทียบราคาได้
☐ การมีพันธมิตรร้านค้าที่หลากหลาย
☐ พนักงานธนาคารเข้าถึงง่าย
☐ ความรวดเร็วในการซื้อผลิตภัณฑ์และบริการ
☐ ค่าธรรมเนียมต่ำ
☐ อัตราดอกเบี้ยต่ำ
☐ มีความน่าเชื่อถือ

28. **<u>ในอีก 5 ปีข้างหน้า</u>** ท่านคิดว่าบริการทางการเงินในแต่ละด้านมีความสำคัญในระดับใด (1 หมายถึงมีความสำคัญน้อยมาก และ 5 หมายถึงมีความสำคัญมาก)

	1	2	3	4	5
บริการผ่าน Mobile banking ที่รอบด้าน	☐	☐	☐	☐	☐
บริการผ่าน Online banking (Computer) ที่รอบด้าน	☐	☐	☐	☐	☐
ได้รับการแจ้งเตือน Notification เกี่ยวกับธุรกรรมต่างๆทาง smartphone	☐	☐	☐	☐	☐
ได้รับ email แจ้งเตือนในการชำระเงินหรือเรื่องการเงินต่างๆ	☐	☐	☐	☐	☐
ความสามารถในการเปิดบัญชีผ่าน mobile banking	☐	☐	☐	☐	☐
ความสามารถในการเปิดบัญชีผ่าน online banking (Computer)	☐	☐	☐	☐	☐
ความสามารถในการติดต่อพนักงานธนาคารผ่าน Chat bot	☐	☐	☐	☐	☐
ความสามารถในการติดต่อพนักงานธนาคารผ่าน video call	☐	☐	☐	☐	☐
การที่รายละเอียดผลิตภัณฑ์และบริการต่างๆของธนาคารเปิดเผยอย่างละเอียดบน Website และช่องทาง online	☐	☐	☐	☐	☐
พูดคุยกับพนักงานธนาคารแบบ Face-to-face	☐	☐	☐	☐	☐
สาขาธนาคารอยู่ในพื้นที่เข้าถึงสะดวก รวดเร็ว	☐	☐	☐	☐	☐
ความสามารถที่จะฝากเช็คผ่าน smartphone	☐	☐	☐	☐	☐
จำนวนตู้ ATM หลายพื้นที่ เข้าถึงสะดวก	☐	☐	☐	☐	☐
ธนาคารจะต้องมีเครื่อง automatic ที่ทำได้หลายอย่างเช่นฝากเงิน และupdate สมุดบัญชี เป็นต้น	☐	☐	☐	☐	☐
ธนาคารต้องมีพันธมิตรร้านค้าที่หลากหลายเพื่อเชื่อมโยง Promotions และบริการต่างๆ	☐	☐	☐	☐	☐
ธนาคารวิเคราะห์ข้อมูลการใช้งานของลูกค้าจนสามารถนำเสนอบริการที่ตอบโจทย์ความต้องการ	☐	☐	☐	☐	☐
ธนาคารเชื่อมโยงบริการทั้ง off-line, online, mobile, chat และ call เข้าถึงกัน	☐	☐	☐	☐	☐
ธนาคารเชื่อมโยงกับ Platform ต่างๆที่ลูกค้าใช้บริการประจำ เช่น Line, Facebook, Instagram เป็นต้น	☐	☐	☐	☐	☐