

Digital Performance of Public Sector Institutions in South-East Asia*

(working paper)

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ABSTRACT

The paper aims to provide an assessment of the digital performance of the public sector institutions in the South-East Asian region, focusing on Indonesia, Malaysia, and Thailand. The assessment of the digital performance of public authorities in these economies is based on the evidence provided by existing studies as well as on various indicators such as the UN e-government digital indices, the OECD's SME policy indices, the World Bank global competitiveness indicators as well as the IMD digital competitiveness indicators. The paper also investigates factors that have impacted the E-government performance using a panel data set comprising all East Asian countries over the period 2003-2022 using panel data econometric techniques. The empirical analysis showed the importance of institutional and demographic factors and the level of development for improving the e-government performance of South-East Asian countries. Policy recommendations are derived based on this analysis.

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1. INTRODUCTION

Emerging Asian economies have been back on the path of economic recovery after the COVID-19 economic decline. Overall, the average growth rate reached up to 5.8% in 2022 and is projected to reach 5.2% in 2023 (World Bank, 2022; OECD, 2022). Among the drivers of this growth has been the digital transformation that has taken place in all countries but, more dynamically, in the regions which were hit most severely by the pandemic. In particular, digital health and other tools were developed by both public and private actors, initially to manage the pandemic but eventually they resulted in radical changes that have shaped the post pandemic era.

The digital transformation the world is undergoing is not defined by any particular set of technologies, but rather by a transition to new ecosystems built on the infrastructure of the digital revolution. Key questions that arise in this transition period have been how Government and other Authorities design policies to face challenges such as digital inclusion and access, cybercrime and cybersecurity, data privacy and usage, digital transformation of businesses, digital governance, and trade across borders.

Furthermore, while technology has certainly enabled societies to address the problem of financial and digital illiteracy, there have been notable “divides” such as between men and women, urban and rural regions, or small and large firms. This is largely due to various disparities, mostly those associated with access to digital technology tools and, also, individuals’ abilities to use these technologies. A non-inclusive digitalization can undermine equality of opportunities and exacerbate income gaps. Therefore, it is of paramount importance that government authorities and other policy makers strive to bridge existing “digital divides” and create the conditions to help lower-skilled workers and less-productive firms to catch up with best performers.

Such digital disparities are more pronounced among the Emerging Asian countries where technology adoption and diffusion face more obstacles. National authorities in Emerging Asia, mainly Indonesia, Malaysia, and Singapore, have already implemented significant strategies to enhance digital financial literacy since the early 2000s (OECD, 2022). It is vital, however, to investigate to what extent these strategies have been effective and to what extent they are inclusive and diverse. In order to make policy interventions more inclusive, it is crucial for national authorities to identify gaps by systematically collecting data, and incorporating this information into the design and execution of their programs. In addition, broader issues related to digitalization, such as taxation, labor relations, consumer protection, privacy, trust, and cybersecurity also need to be addressed.

Digital transformation has been considered among the priorities for creating the enabling environment towards prosperity and sustainability at the global level. The primary responsibility in activating policies towards these priorities lies on government authorities which need to create the frameworks for the private sector to advance in the adoption of digital technologies and to implement environmental, social and governance standards. Long-term thinking capacity is required within governments to deliver appropriate public services to support the desired digital transformation.

Along these lines, digital innovations and performance of the public sector institutions have received an increased attention due to the rapid development of E-government, defined as the

process of implementation, diffusion, and use in public administration of information and communication technologies to achieve innovative forms of information and public services provision (OECD, 2003). The empirical literature on the factors influencing E-government development has been predominately focused on developed countries. This paper draws attention the government's digital performance in the developing countries of South-East Asia which has been understudied with regard to this area so far.

More specifically, the goal of this paper is to provide an assessment of the digital performance of the public sector institutions in selected countries of the South-East Asian region, more specifically, in Indonesia, Malaysia, and Thailand. The assessment of the digital performance of public authorities in these economies is based on the evidence provided by existing studies as well as on various indicators developed by international organizations such as the Government Digital Transformation indicators compiled by the UN, the OECD's SME policy indices, the World Bank global competitiveness indicators as well as the IMD digital competitiveness indicators. Furthermore, the paper empirically investigates factors that have impacted the E-government development using a panel data set comprising all South-East Asian countries over the period 2003-2022 and panel data econometric techniques. To the best of our knowledge, this is the first attempt for such an analysis in developing countries as the South-East Asian region.

The rest of the paper is organized as follows. A literature review is provided in section 2 to justify the need for the digital transformation in governance and regulation to support the new digital ecosystem and identify factors that influence the E-government development and diffusion. Section 3 presents some stylized facts for the three economies this study focuses on: Indonesia, Malaysia, and Thailand. Section 4 includes an assessment of E-government performance in the South-East Asian region based on appropriate indicators compiled by the UN, the World Bank, and the OECD. Section 5 describes the empirical methodology, data analysis, and results. Section 7 provides concluding remarks.

2. LITERATURE REVIEW

According to Sorbe et al. (2019), a range of government policies are required to support the diffusion and efficient use of digital technologies. That implies that Governments should undergo a digital transformation through proper policies to enable a well-balanced market digitalization. These policies include:

- Implementing regulatory frameworks that support investment in broadband and pro-competition reforms in telecommunication sectors to enable broader and cheaper access to high-speed internet.
- Increasing participation in training – especially of low-skilled workers – and its quality, as well as promoting good cognitive, organizational and managerial skills.
- Enabling the efficient reallocation of labor and capital across firms and industries by reducing administrative burdens on start-ups, facilitating job transition and improving the efficiency of insolvency regimes.
- Reducing financial constraints for young innovative firms and encouraging the development of venture capital markets.
- Enhancing competition in digital markets through reduction of barriers to cross-border digital trade, taking into account the strong network effects and central importance of data characterizing certain digital activities.
- Further developing E-government to exploit the synergies between digitalization of the public and private sectors.

The above policies exhibit strong complementarities between themselves and can boost productivity which has slowed down sharply in most OECD countries over the past two decades despite the ongoing digitalization. As documented in the literature (see Andrews et al., 2018; Gal et al., 2019) gains from digital technologies have been concentrated among the most productive firms, resulting to an increase in the productivity gap between leading and lagging firms (about half of which may result from digitalization) with far-reaching implications, such as a widening of wage dispersion and income inequalities.

Liva et al. (2020) performed a literature review covering studies of the past decade and confirmed that the barriers and preconditions for a successful digital government transformation are complex and often not technology related. This is because the introduction of new technologies by governments is always mediated by organizational, institutional, legal, ethical, and social factors. Digital technologies may virtually transform every process, system and structure of government, resulting into a redefinition of responsibilities and work routines of public officials. Nevertheless, they also create issues and trade-offs that merit careful consideration and preparation before the full implementation of the government digital transformation.

The importance of the Government Digital Transformation (GDT) has also been shown empirically by several studies such as, for example, de Vries et al. (2016) and more recently, Sanina et al. (2023). These studies have demonstrated the important role of GDT in developing, transforming, and reshaping the public sector in terms of socio-economic efficiency. More specifically, Sanina et al. (2023) have shown that digital innovation in the public sector affects the efficiency of public administration, at least as a tool for human development and potential. They propose that any systematic attempt at digital transformation could lead to a better society and governance.

Nanos et al. (2019) emphasized the importance of cloud computing as a fundamental part of E-government strategy in the upcoming years, contributing to the DGT at national, regional and local/municipal levels. Their paper analyzed the role of cloud computing and citizen relationship management and proposed a theoretical model for the exploration of digital government transformation.

Mondejar et al (2021) point out that Covid-19 has accelerated the implementation of digitalization with regard to artificial intelligence in South-East Asia, it has also brought forward the need for reform and structural change in many sectors, esp. education, business, healthcare, communications, and banking, and compressed the time frame for those reforms. Their research covered Cambodia, China, Hong Kong, Indonesia, Malaysia, Myanmar, Philippines, Singapore, Thailand, and Vietnam and emphasized that the digitalization and automation created high likelihood that many low-wage positions would be eliminated by these processes. Thus, the greatest challenges caused by digitalization in the region could be social, and not technological.

The state of digitalization of the public sector has been progressing, an example being the effort to develop a digital public health system using the blockchain technology under the Ministry of Public Health (Yongjoh, et al., 2021). Xavier (2021) discusses the digitalization of public sector services in Malaysia that has enabled about 90% of public services to be delivered online. In this way not only the country kept pace with global trends in the era of fourth industrial

revolution, it has also equipped the public service to help Malaysia achieve its vision of becoming a prosperous nation.

One of the critical success factors required for a successful digital transformation is documented to be a governance structure for executing policies. Research has also shown a positive relationship between the use of E-government in public administration and political trust as well as trust in public institutions. For example, Lissitsa (2021) studied the use of E-government in the Middle East. It was found that the use of E-government and social media was positively related to political trust, however, digitalization of public sector had only a marginal effect on political trust in the Middle East, while the opinion on the functioning of public institutions was found to be the main driver of the political trust.

Despite heavy investments into the development of E-government services by governments, their usage has remained relatively low by citizens (Pérez-Morote et al., 2020). Pérez-Morote et al. (2020) study the use of E-government services in 27 European countries during the period between 2010-2018. They find that the use of E-government services by citizens depends on their trust in government, views on E-government services and access to digital tools associated with individual's income and education. Their longitudinal analysis shows that the trust in government sharply declines in countries, where the use of E-government is low compared to countries, where the use of E-government services is more widespread. Thus, the conclusion from this study points out that governments should use E-government services more widely as a way to develop communication strategies to raise awareness of these services and promote benefits that arise from their use. This can also contribute to increased level of trust in public institutions, as more a widespread use of E-government services should contribute to increasing trust in government, and vice versa (Pérez-Morote et al., 2020).

The research shows that the business sector can also benefit from the integration of digital technologies by the public sector, since the facilitation of technological convergence by public sector institutions and the sustainable integration of digital tools contributes to the integration of digital technologies in the business sector (Ionescu et al., 2022). However, in this regard, also institutional framework represents an important factor contributing to the technological development in the business sector.

The OECD (2014) developed a Recommendation on Digital Government Strategies, which aims to support countries in their development and implementation. They point out that the use of technology by public sector institutions can contribute to the increased effectiveness of public policies and to more open, transparent, innovative, participatory governments as well as increase the trust in governments. However, the OECD also highlights that some governments do not view technology and digital tools as means to shape the outcomes of public governance, even though it has been documented that the current state of technology reinforces existing government processes associated with unsuccessful projects and the dissatisfaction of public.

Another body of literature draws on the theory of technology diffusion to study several groups of variables that have impacted the development of E-government. For example, Zhao et al. (2014) examined four groups of factors (technological, organizational, environmental, and cultural) to explain website implementation based on a large number of French municipalities during the period 2013-2015. Arduini et al. (2010) studied the impact of broadband connections availability as an important technical resource for the provision of advanced E-government services. Their findings suggest that advanced communication infrastructure significantly influences the E-government intensity, but not the start-up of E-government. Baldersheim and

Ogard (2008) showed the importance of economic resources (unemployment rate and demographic change) for E-government development in four Nordic countries. Other factors that have been considered as playing an important role in the E-government development include tourism (Dang Nguyen et al., 2013), the age of population (Arduini et al., 2013), competition, population size, age, and education (Attour and Chaupain-Guillot, 2020).

All studies reported in the previous paragraph represent empirical works conducted at the local (municipality) as well as national levels of developed countries, predominantly in the EU and the USA. Therefore, the above literature indicates a research gap in the study of E-government development and diffusion, as most of the relevant studies are addressed to developed countries. The identified gap is the consequence of several barriers, the most important of which is the data availability in less developed regions. To our knowledge, the present work represents a first attempt to fill this gap by empirically studying the factors that impact the E-government development in the South-East Asian region.

Subsequently, this paper aims to investigate two key research questions:

Q1: How does the digital performance of public institutions (E-government) compare among the countries of South-East Asian region?

Q2: What are the most important factors that influence the E-government development performance of the South-East Asian economies?

3. MAIN STYLISTED FACTS

Table 1 presents the latest stylized facts regarding main macroeconomic indicators of the three Asian economies the present study focuses on: Indonesia, Malaysia, and Thailand. We selected these three South-East Asian countries since they are located in the geographical proximity neighboring countries, have experienced dynamic economic development, and all of them have digitalization among their priorities. Table 1 displays the main economic indicators of these countries for the year 2022, while Figure 1 presents the evolution of real GDP growth since 2005. We observe that all three economies returned back to growth after the COVID-19 recession, with Malaysian economy achieving the fastest growth in 2022.

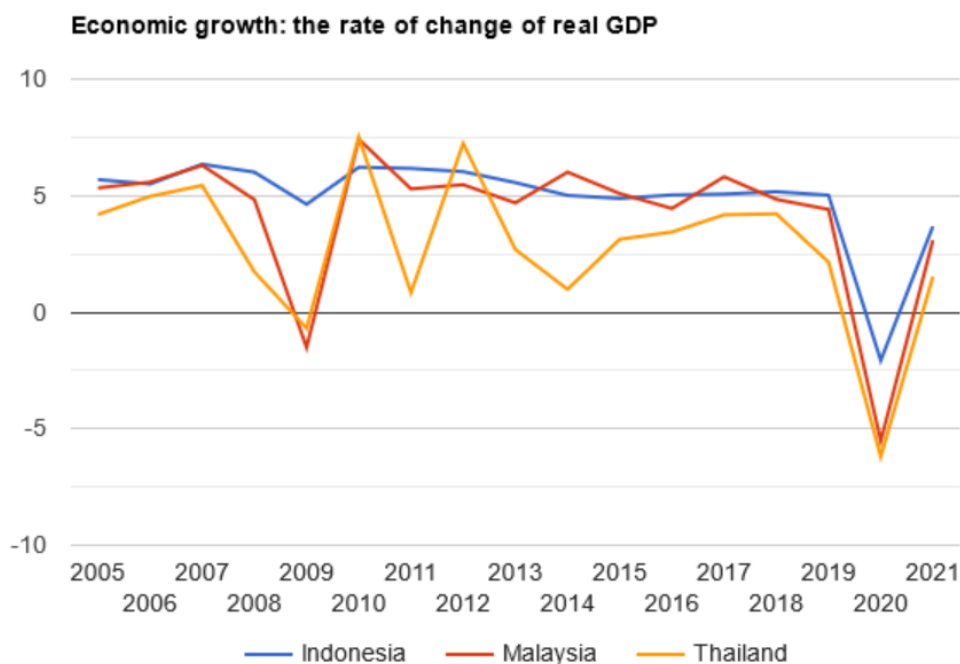
Table 1: Main macroeconomic indicators in the year 2022

	INDONESIA	MALAYSIA	THAILAND
Population, million	274.86	32.99	70.08
Per capita GDP, US \$	4798.12	12364.06	7650.88
GDP growth rate (%)	5.31	8.69	2.64
Inflation rate	5.51	3.77	5.89
Unemployment rate (%)	5.86	3.82	1.00
Total investment, % of GDP	29.75	23.89	27.87
Exports of goods and services, % of GDP	21.60	68.80	58.20
General government net lending/borrowing, % of GDP	-2.34	-5.30	-5.52

General government debt, % of GDP	41.15	63.40	60.67
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Source: International Monetary Fund, World Economic Outlook Database, April 2023, <https://www.imf.org/en/Publications/WEO/weo-database/2023/April> and World Bank

Figure 1: The dynamics of real GDP in the period 2005-2021



Source: World Bank, <https://www.theglobaleconomy.com/compare-countries/>

Indonesia is the largest economy in South-East Asia and has followed a steady growth pattern as shown in Table 1 and Figure 1. It is a member of the G20 group and over the past 50 years, its economy has sustained an average annual growth rate around 5% in GDP, which allowed for substantial decreases in extreme poverty and enabled the country to achieve a middle-income status. The Indonesian middle class has been a major driver of economic growth as the group's consumption has grown at 12% annually since 2002, and now, it represents close to half of all household consumption in Indonesia. Manufacturing is the largest single component of the country's economy. Indonesia's main exports include crude petroleum and natural gas as well as rubber, coffee, cocoa, and palm oil.

As evidenced in Figure 1, Malaysia follows the same growth pattern as Indonesia, but presents higher volatility, while Thailand has been growing with slower and more volatile rates than both Indonesia and Malaysia. The population of Malaysia is almost half the size of Thailand, yet GDP per capita is almost double of the level of Thailand and one of the highest among South-East Asian economies. In Malaysia, the industrial sector has been growing steadily in recent years. The country has a well-developed manufacturing sector, especially in electronics and electrical products, machinery, and transportation equipment. Malaysia has also a strong service sector, particularly in the finance and tourism industries. The country has been one of the world's largest exporters of liquefied natural gas and palm oil. Malaysia's economy is also supported by a strong domestic demand and favorable demographics. However, the country

still faces challenges, such as high household debt, structural issues, and the need for further reforms to attract foreign investment. (World Bank, 2021)

Thailand is also ranked among the fastest-growing economies in South-East Asia, after Indonesia and Malaysia. The country has a relatively diversified economy, with manufacturing, tourism, and agriculture being major sectors. However, the Thai economy has faced substantial challenges caused by such factors as the COVID-19 pandemic, political instability, and high levels of household debt. The pandemic has significantly impacted the tourism sector, which is a major source of foreign exchange and employment in the country. The government has implemented measures to mitigate the effects of the pandemic, such as the establishment of the National Vaccine Institute to accelerate vaccine development and distribution. Despite the challenges, the IMF predicts that in the coming years the Thai economy will continue to grow (IMF, 2021). The Thailand Economic Monitor (The World Bank, 2022) has shown that the Thai economy has successfully overcome shocks caused by the COVID-19 pandemic and related global shocks. In the third quarter of 2022, the Thai economy grew at 4.5 %. This growth was supported mainly by the increasing domestic consumption and government's efforts to mitigate the rising living costs, as well as strong tourist inflow. Similarly to other ASEAN economies, the Thai economy has also experienced a decline in demand for local export goods, which was triggered by a global economic slowdown.

In terms of other macroeconomic indicators displayed in Table 1, we can notice that all three economies have both low inflation and low unemployment rates as compared to Western economies. On average, total investment was 27% of GDP in 2022, close to the pre COVID-19 levels. In 2022, the exports of goods and services reached 21.6% of GDP in Indonesia, compared to 68.8% in Malaysia and 58.2% in Thailand, the last two countries being among the most export focused countries in South-East Asia.

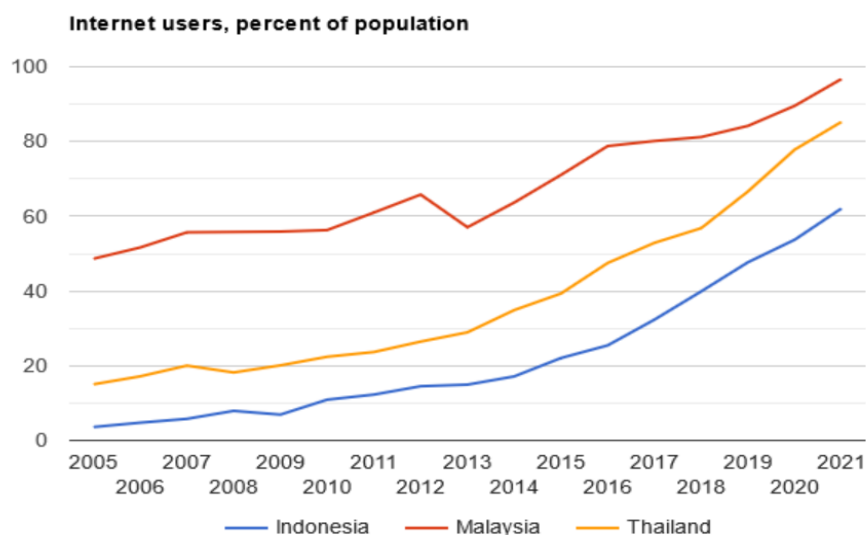
The general government budget deficit in Indonesia is back to the pre COVID-19 levels (around -2%), however, the deficits in Malaysia and Thailand remain higher (above -5%) indicating that the fiscal consequences of COVID-19 have not been yet completely absorbed. None of the three economies exhibits more substantial debt issues as, on average, their debt is around 50% of GDP. In fact, gross public debt/GDP ratio is approaching 60% in Emerging and Developing Asia as opposed to over 100% in the Advanced economies (IMF, 2019).

However, digital exclusion in emerging and developing countries is quite extreme. According to IMF (2020), 95% of the offline population lives in these countries. Households that can access fixed broadband subscriptions are in a minority (11.2%), and over one-half of all households can only use basic fixed-broadband connections with the speed below 10 Mbps. In addition, electricity access in low-income countries is limited or unstable, further reducing the possibility to build a digital economy. Large shares of households or companies have not yet integrated into the digital economy, creating a huge digital divide. Yet, the expansion of digital economy accelerated during the COVID-19 pandemic, primarily due to the fast development of E-commerce and E-learning in all economies.

More specifically, a remarkable progress can be observed in the South-East Asian economies regarding the use of digital means such as the percentage of population that uses the internet (Figure 2), the fixed broadband internet subscriptions per 100 people (Figure 3), and mobile phone subscribers per 100 people (Figure 4). Internet users are individuals, who have used the internet (from any location and via any means such as computer, laptop, mobile, etc.) in the last 3 months. We notice that by the year 2021, in Malaysia, almost everybody has used the

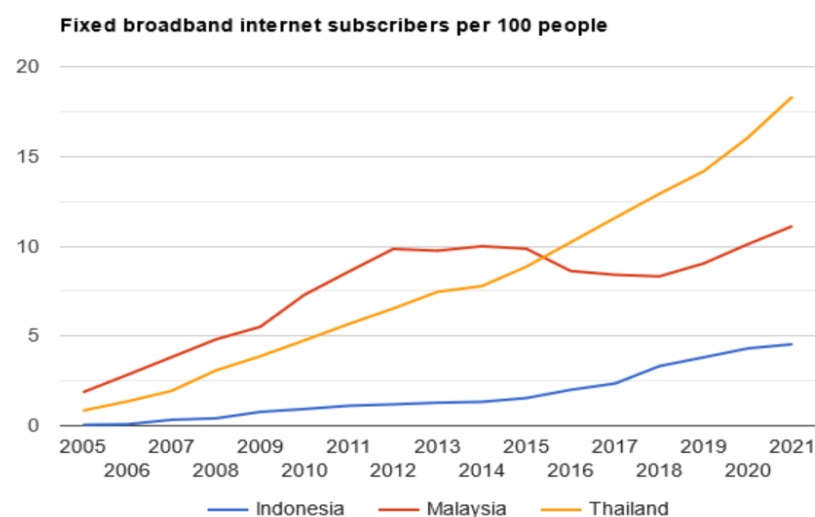
internet (97%), while in Thailand the percentage was 85% and in Indonesia 62%. Similarly, in terms of fixed broadband subscribers, Malaysia ranks first, followed by Thailand and Indonesia. Regarding the mobile phone subscribers per 100 people, an exponential growth can be observed up to 2017 in Thailand that ranks first and Indonesia, while in Malaysia the number of subscribers has levelled out and is close to the level of Indonesia.

Figure 2



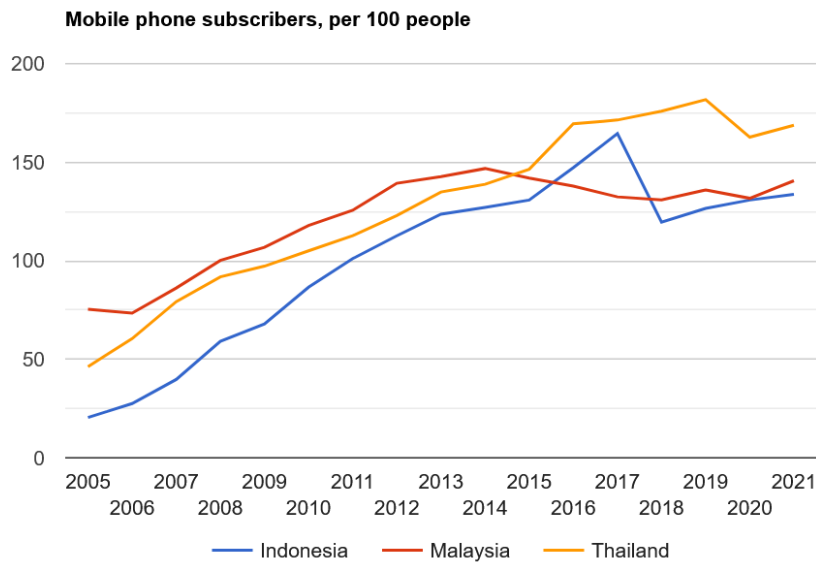
Source: World Bank, <https://www.theglobaleconomy.com/compare-countries/>

Figure 3



Source: The International Telecommunication Union <https://www.itu.int/en/ITU-D/Statistics/>

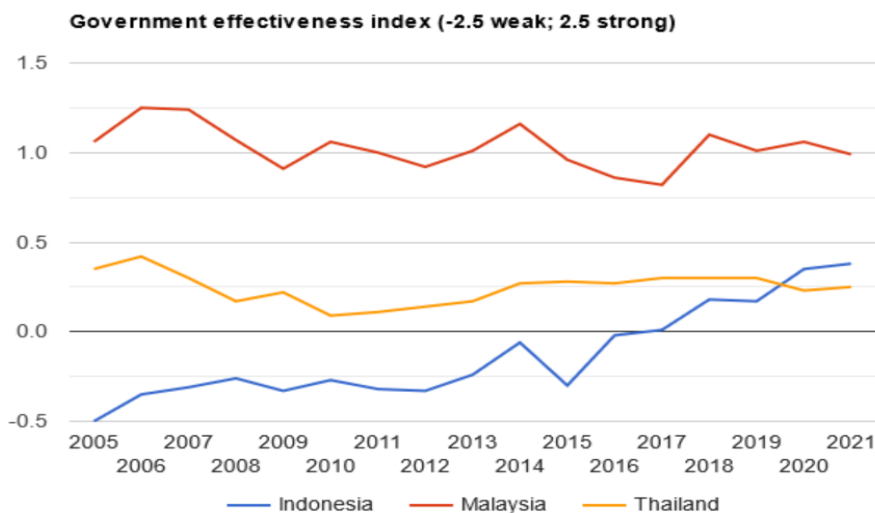
Figure 4



Source: World Bank. (2021). World Development Indicators 2021, <https://databank.worldbank.org/home.aspx>

Finally, Figure 5 presents the evolution of the Government Effectiveness Index compiled by the World Bank. It captures the following features: the quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies.

Figure 5



Source: World Bank. (2021). World Development Indicators 2021, <https://databank.worldbank.org/home.aspx>

Over the years, a remarkable progress has been achieved by Indonesia in the improvement of the quality of public services which was very weak up to 2005 (-0.5) and gradually improved (+0.5) surpassing the level of Thailand by the year 2020. Malaysia exhibits a much higher quality of government services (around +1.0) compared to both Indonesia and Thailand, but

has remained almost stable over the years without any signs of further improvement. In Thailand, the Index of Government Effectiveness has remained almost unchanged for many years (around 0.25) and is at the weakest position among the three economies.

In the next section, we provide a comparative analysis of the government effectiveness regarding the digital transformation initiatives that have been undertaken towards the objective of a digital improvement enabling faster growth and sustainability in the long run.

4. GOVERNMENT DIGITAL PERFORMANCE INDICATORS

To answer the first research question we set in section 2 (Q1: *How does the digital performance of public institutions (E-government) compare among the countries of South-East Asian region?*), we collected the following indicators (a) the E-Government Development Index (EGDI) compiled by the United Nations (UN), (b) the SMS Policy Indicators compiled by the OECD, (c) the Global Competitiveness Indicators compiled by the World Economic Forum, and (d) IMD World Digital Competitiveness Ranking, (e) OECD Digital Government Index

(a) E-Government Development Index (EGDI)

This index has been compiled by the UN to examine the state of E-Government Development Fofor in its Member States. It is a composite index that provides an assessment of the website development patterns in a country. It also incorporates the access characteristics, such as the infrastructure and educational levels, to reflect, how a country uses information technologies to promote access and inclusion of its people.

The EGDI consists of the weighted average of three independent subcomponents, that are classified as follows:

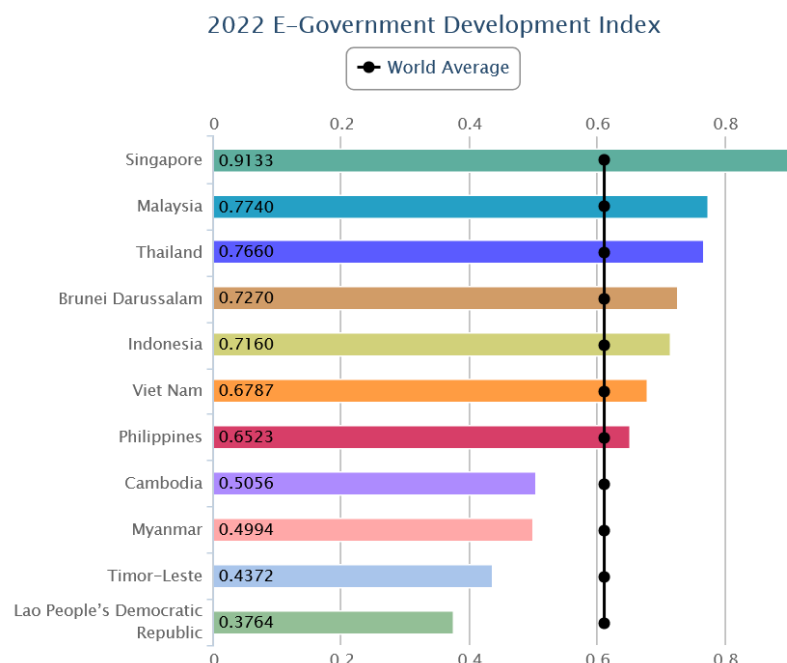
- the Online Services Index (OSI),
- the Telecommunications Infrastructure Index (TII), and
- the Human Capital Index (HCI).

As indicated by the report of the United Nations (2022), the EGDI is not designed to capture E-government development in an absolute sense but, rather, it aims to provide a performance rating of national governments relative to one another. Its methodology is based on a comprehensive survey of the online presence of all 193 United Nations Member States, which assesses national websites and how E-government policies and strategies are applied in general and in specific sectors for delivery of essential services. The survey results are tabulated and combined with a set of indicators embodying a country's capacity to participate in the information society, without which E-government development efforts are of limited immediate use.

Mathematically, the EGDI is a weighted average of three normalized scores on the above mentioned three most important dimensions of E-government. Each of these indices is a composite measure that can be extracted and analyzed independently. The EGDI values range between 0 and 1 and countries are grouped into four levels mathematically defined as follows: very high EGDI values range from 0.75 to 1.00 inclusive, high EGDI group values range from 0.50 to 0.7499 inclusive, middle EGDI values range from 0.25 to 0.4999 inclusive, and low EGDI values range from 0.0 to 0.2499 inclusive. Among all 193 countries included in the survey of 2022, Denmark ranks first with an EGDI value of 0.9717, followed by Finland and the Republic of Korea with values 0.9533 and 0.9529 respectively.

Figure 6 displays the relative position of all South-East Asian economies in the global ranking of EGDI of 2022. It is worth noticing that all three countries concerned lie above the world average and that the position of Malaysia is very close to the position of Thailand, while Indonesia lags behind both of them.¹

Figure 6: Relative position of Indonesia, Malaysia, and Thailand in global E-Government Development ranking of 2022



Source: United Nations, E-government Survey 2022.

Table 2 presents the 2022 ranking of the three South-East Asian economies with regard to the overall **EGDI** index. According to the EGDI values, among the three countries, Malaysia stands at the highest position (0.774), followed by Thailand (0.766) and Indonesia (0.716). Among all 193 countries included in the evaluation, both Malaysia and Thailand rank quite high, on 53rd and 55th place respectively. Indonesia ranks 77 which is 32 positions higher than the 2010 ranking. Thailand also improved its rank by 21 points since 2010, in contrast to Malaysia that moved down 21 positions (from the 32nd rank to the 53rd rank) in the global ranking. According to the standards of the ranking, the positions of Malaysia and Thailand are very high, while Indonesia is considered high (last column).

The 2022 ranking of **EGDI** by its subcomponents is presented in Table 3. In the third column, E Part Index (EPI) declares **E-Participation** of the government and includes availability of social networking features, live chat support functionality, leave feedback option to improve useability and/or accessibility of E-services, report corruption by public servants or institutions, announcements about any upcoming public engagement, or E-participation activities, online tools to obtain raw inputs for policy deliberation, evidence of any outcome of E-consultations resulted in new policy decisions/regulations/services, Open Government datasets and many others.

¹ Ten of the eleven states of South-East Asia are members of the [Association of Southeast Asian Nations](#) (ASEAN), while [East Timor](#) is an observer state.

Table 2: The E-Government Digital Index (EGDI) for 2022

COUNTRY	Rank 2010	Rank 2022	EGDI 2022	Rank Change
Brunei	68	68	0.727	
Cambodia	140	127	0.5056	13
Indonesia	109	77	0.716	32
Laos	151	159	0.3764	-8
Malaysia	32	53	0.774	-21
Myanmar	141	134	0.4994	7
Philippines	78	89	0.6523	-11
Singapore	11	12	0.9133	-1
Thailand	76	55	0.766	21
Timor-Leste	162	147	0.4372	15
Viet Nam	90	86	0.6787	4

Source: United Nations, E-government Survey 2022.

Thus, the EPI is a multifaceted framework, composed of three core components: (i) *E-information*: Enabling participation by providing citizens with public information and access to information without or upon demand, (ii) *E-consultation*: Engaging citizens in contributions to and deliberation on public policies and services, and (iii) *E-decision-making*: Empowering citizens through co-design of policy options and co-production of service components and delivery modalities. According to the UN E-government 2022 survey, government efforts to actively engage the public in E-consultations and other forms of E-participation remain somewhat limited.

Table 3: The EGDI index by components for survey year 2022

COUNTRY	EDGI	EPART	OSI	TII	HCI
Brunei	0.7270	0.4773	0.5871	0.8372	0.6903
Cambodia	0.5056	0.2841	0.3073	0.5605	0.5468
Indonesia	0.7160	0.7159	0.7644	0.6397	0.7645
Laos	0.3764	0.2614	0.3005	0.2820	0.5380
Malaysia	0.7740	0.6818	0.7630	0.7945	0.7629
Myanmar	0.4994	0.3068	0.3931	0.6082	0.5546
Philippines	0.6523	0.4886	0.6303	0.5638	0.7438
Singapore	0.9133	0.9773	0.9620	0.8758	0.9021
Thailand	0.7660	0.7841	0.7763	0.7338	0.7879
Timor-Leste	0.4372	0.4773	0.4181	0.3640	0.5829
Viet Nam	0.6787	0.5341	0.6484	0.6973	0.7567

Source: United Nations, E-government Survey 2022.

The **Online Service Index (OSI)** is a tool designed to provide evidence-based data on online E-government service provision across the 193 Member States. The questions on which the assessment is based are categorized into 5 discrete thematic areas forming 5 subindices: Institutional Framework (IF), Services Provision (SP), Content Provision (CP), Technology (TEC), and E-participation (EPI), with the OSI as a whole calculated based on the normalized values for each subindex.

The **Telecommunication Infrastructure Index (TII)** is an arithmetic average composite of four indicators: (i) estimated internet users per 100 inhabitants; (ii) number of mobile subscribers per 100 inhabitants; (iii) number of wireless broadband subscriptions per 100 inhabitants; and (iv) number of fixed broadband subscriptions per 100 inhabitants. The International Telecommunication Union is the primary source of data and the data was extracted in February 2022.

The **Human Capital Index (HCI)** consists of four components: (i) adult literacy rate; (ii) the combined primary, secondary and tertiary gross enrolment ratio; (iii) expected years of schooling, and (iv) average years of schooling. The data for HCI components was extracted from the UNESCO-UIS source in October 2021.

The ranking in Table 3 indicates that Thailand ranks higher than both Indonesia and Malaysia in the first three subindices (E-Part, OSI, and HCI), while Malaysia is ahead of the others in the Telecommunication infrastructure. In view of the overall EGDI ranking that brings Malaysia at the top of the three signifies the importance of TII in the weighting of the sub-indices.

(b) The ASEAN SME Policy Index assessment

This assessment is conducted by the OECD on SMEs Policy initiatives in the **ASEAN area** (*Association of Southeast Asian Nations*: Brunei Darussalam, Cambodia, Indonesia, Lao PDR, Malaysia, Myanmar, the Philippines, Singapore, Thailand, and Viet Nam). The SME sector is dominant in this region (Micro, small and medium-size enterprises represent around 97-99% of the enterprise population in most ASEAN countries). The SME Policy Index covers all areas of policy (see Appendix) the main objectives being: i) to promote productivity, technology and innovation; ii) to increase access to finance; iii) to enhance market access and internationalization; iv) to enhance the policy and regulatory environment; and v) to promote entrepreneurship and human capital development. It was launched at the ASEAN Business and Investment Summit in November 2015 and has a time horizon till 2025. Here, we will focus on those actions mostly related to government digital performance, namely E-commerce and E-governance which are covered by the assessment.

E-commerce is becoming increasingly important in South-East Asia. Table 4 presents the assessment of the use of E-commerce in 2018 among the ASEAN countries. Google and Temasek (2017) estimate that the gross merchandise value of E-commerce sales in first-hand goods in South-East Asia will increase from around USD 10.9 billion in 2017 to around USD 88.1 billion by 2025. The E-commerce criterion concerns the availability of E-trading platforms (such as E-payment and logistic facilities and online marketplaces), government programs to facilitate access to these platforms, and at the sophistication of legal and regulatory frameworks to govern E-commerce activities. The 2018 scores presented in Table 4 show that

the region performs moderately well in this area as a whole, and particularly in planning and design, where it registers a median score of 4.44.

More specifically, Indonesia, Malaysia, Singapore and Thailand appear to be the most advanced in the area of planning and design. These countries have clear legal instruments in place to govern E-commerce, E-payments and consumer protection. They also have the highest scores in implementing targeted E-commerce programs for SMEs on a national scale. These programs include the Smart Online SMEs program in Thailand and the SMEs Go Digital initiative in Singapore and Indonesia. In Malaysia, the government launched a Digital Free Trade Zone (DFTZ) in partnership with Alibaba in 2017.

Table 4: Scores of use of e-commerce among ASEAN member states

	BRN	KHM	IDN	LAO	MYS	MMR	PHL	SGP	THA	VNM	Med.	STD.
Planning and design	4.74	2.24	5.58	3.90	6.00	3.50	5.58	6.00	6.00	5.16	5.37	1.21
Implementation	3.77	2.33	5.89	2.54	5.32	1.44	4.98	6.00	5.89	3.53	4.37	1.59
Monitoring and evaluation	1.55	1.00	4.87	1.00	4.88	1.00	4.32	6.00	4.30	2.10	3.20	1.85
Total sub-dimension score	3.66	2.03	5.57	2.71	5.47	2.07	5.06	6.00	5.61	3.82	4.44	1.46

Source: ASEAN SME POLICY INDEX 2018 © OECD, ERIA 2018. Note: Scores range from 1 to 6 with 6 being the highest score.

Table 5 reports the scores of E-government facilities as a sub-criterion of government digital effectiveness. Digital government facilities can greatly increase the ease of interacting and exchanging information between enterprises and public institutions. Micro and small enterprises can particularly benefit from the access to digital government services via time and resource savings. The fact that most economies have achieved a good level of IT infrastructure and a relatively advanced level of internet and mobile phone penetration is a good base for the introduction of digital government services. This sub-dimension focuses on a limited number of E-government services that are highly relevant for SMEs, namely, the existence of online platforms for filing tax, social security, and pension contributions as well as whether an electronic signature or electronic ID has been adopted. The second row looks at whether these platforms are fully operational and integrated with other government services. For instance, it explores, whether enterprises must submit information to a number of different government bodies, which may increase the compliance burden on SMEs. The final row looks at whether the government collects satisfaction surveys and whether feedback from these surveys feeds back into the enhancement of these platforms.

Table 5: Scores of E-government services among ASEAN member states

	BRN	KHM	IDN	LAO	MYS	MMR	PHL	SGP	THA	VNM	Median	StD.
Planning and design	6.00	1.83	5.15	1.41	4.74	1.00	5.16	6.00	5.15	3.49	4.94	1.82
Implementation	5.33	1.28	2.66	1.55	3.49	1.00	2.93	6.00	3.21	1.83	2.79	1.59
Monitoring and evaluation	6.00	1.00	4.30	1.00	5.15	1.00	2.65	6.00	3.48	1.00	3.06	2.01
Total sub-dimension score	5.70	1.41	3.86	1.39	4.26	1.00	3.65	6.00	3.94	2.24	3.76	1.69

Source: ASEAN SME POLICY INDEX 2018 © OECD, ERIA 2018. Note: Scores range from 1 to 6 with 6 being the highest score.

E-government services are at a relatively good level in Indonesia, Malaysia, and Thailand regarding planning and design as well as monitoring and evaluation, but very low in implementation. The median score of 3.76 indicates a fair deployment of E-government services, nevertheless, this masks a considerable variation across the region. Based on the total score per country, Malaysia ranks higher than both Indonesia and Thailand.

(c) *Global Competitiveness Indicators - World Economic Forum*

The World Economic Forum's Global Competitiveness Report (2020) studies countries' preparedness for the post-pandemic recovery. It highlights that the COVID-19 pandemic should act as a catalyst for countries to take on digitalization reforms, motivate businesses to shift towards digital business models and boost investment in ICT and digital skill development.

Research suggests that with the investment in the digital and technological development, the technology frontier will significantly move forward. It suggests that private companies are expected to double their investments in digital transformation between 2021-2024. However, it is important that, at the same time, economies invest in the development of human capital and legal framework, since an economy's productivity depends on how efficiently and effectively, and to what extent, businesses and citizens adopt these tools.

It is also important that legal frameworks were also used to reflect the developments in the field of digital technology and that the frameworks for digital business models were developed. The data show that some countries, e.g., South Korea and Japan, already widely use ICT tools (Table 6), however, the reform of their business organizational models will be also needed to support the revival of their economies. The results show that Malaysia scored well on the readiness of the digital legal framework, suggesting that the country's legal framework adapts relatively fast to digital business models, such as E-commerce, sharing economy, or fintech.

Table 6. Best performing countries in the area of ICT adoption, flexible work arrangements, digital skills and digital legal framework [score]

	ICT adoption	Flexible work arrangements	Digital skills	Digital legal framework
1	South Korea [93.7]	Netherlands [82.7]	Finland [84.3]	USA [78]
2	UAE [92.3]	New Zealand [77.7]	Sweden [79.5]	Luxembourg [77.4]
3	Hong Kong SAR [90.2]	Switzerland [75.8]	Estonia [77.9]	Singapore [76.5]
4	Sweden [89.7]	Estonia [75]	Iceland [77.6]	UAE [72.5]
5	Japan [88.3]	USA [74.2]	Netherlands [77.3]	Malaysia [70]

6	Singapore [88.1]	Luxembourg [73.6]	Singapore [77.3]	Estonia [69.3]
7	Iceland [87.8]	China [73.6]	Israel [76.5]	Sweden [67.9]
8	Norway [84.7]	Australia [72.9]	Denmark [74.7]	Finland [67.7]
9	Qatar [83.9]	Finland [72.5]	Saudi Arabia [74.1]	Germany [67.3]
10	Lithuania [83.8]	Denmark [72.4]	South Korea [73]	Netherlands [65.5]

Source: World Economic Forum, Global Competitiveness Indicators, 2020.

(d) IMD World Digital Competitiveness Ranking

The IMD World Digital Competitiveness Ranking (2022) studies and measures the preparedness of countries to adopt digital technologies, which help to drive countries' economic transformation in the public and private sectors as well as a wider society. Considering South-East Asian countries, Singapore ranked 4th (improved by one place compared to the previous ranking), Malaysia ranked 31st, Thailand 40th and Indonesia 51st (improved by two places compared to the previous ranking). South Korea and Hong Kong took 8th and 9th places respectively in this ranking.

Globalization, digital technology advancements and the COVID-19 pandemic contributed to increased interconnectedness across economies and moved more business and personal interactions to online space, which also spurred the increase of cyber-attacks. The World Digital Competitiveness Ranking (2022) shows that cybersecurity measures represent an important element for both the public and private sectors. If economies want to become digitally competitive, they need to have services and tools in place to protect their digital infrastructure from cyber-attacks. Furthermore, the protection of the infrastructure will further encourage an uptake and use of digital recourses. Also, if governments want their citizens to uptake the E-government services and digital technology tools, they need to ensure the safety of the digital systems and transparency of institutions providing digital services, especially when it comes to the data usage (IMD, 2022). In addition, the privacy of digital and E-government service users must be protected by law and appropriate cybersecurity tools.

(c) OECD Digital Government Index

The OECD Digital Government Index (DGI) measures and monitors the implementation of the OECD Recommendation of the Council on Digital Government Strategies (2014). The digital government is perceived as one that uses digital technology and services to create value and is an integral part of government's modernization approaches. These approaches should create an environment, where government institutions and bodies, NGOs, businesses, and citizens have access to data, services, and content via interactions with the government.

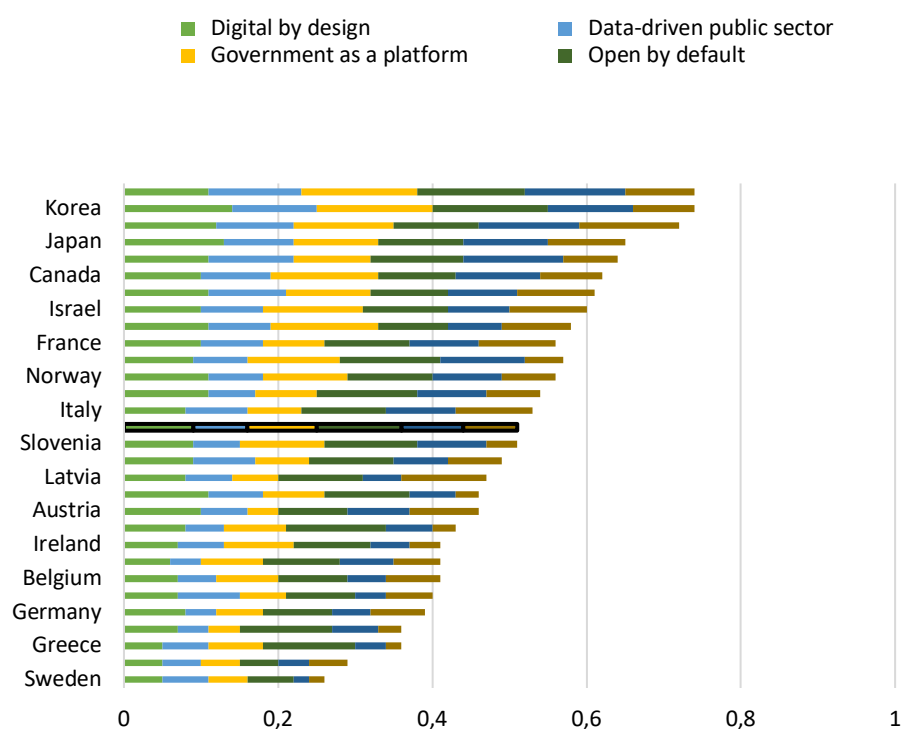
The DGI assesses the extent and coherent implementation of digital government policies. The total DGI scores range from 0 to 1, where 0 represents the lowest and 1 the highest score. The index comprises the following six dimensions, which are based on the OECD Digital Government Policy Frameworks (2020):

- **Digital by design** refers to a whole-of-government plan and approach for the use of digital technologies.
- **Data-driven public sector** refers to a country's data governance structures, infrastructure, and standards which it can use to benefit from the value of data.
- **Government as a platform** refers to policy frameworks for the use of digital technologies.

- **Open by default** refers to the openness and accessibility of data, information, and processes.
- **User-driven** refers to governments’ adoption of tools that are in the public’s interest and fulfil their demands and needs.
- **Proactiveness** assesses, whether governments deliver data and services to the public, without formal requests for them, and anticipating the demand for them.

Figure 7 shows the performance of selected OECD countries that took part in the survey. The average score reached by the OECD countries was 0.5, with the United Kingdom, South Korea, Colombia, Japan and Denmark as top performers. These countries have comprehensive digital government plans and strategies in place, developed institutional arrangements, which suggest a better implementation of the digital government reforms (OECD, 2021).

Figure 7. OECD Digital government index (2019)



Source: OECD, Digital Government Index (2021).

Note: Those OECD countries, which did not provide feedback on the questionnaire (including Poland, Hungary and Slovakia) are not included in this list.

The data show that, on average, OECD countries perform best with regard to the “open by default” dimension. On the other hand, on average, the countries performed worst in the “data driven public sector” and “proactiveness” dimensions. These results suggest that countries can improve in the usage of the data as an important public asset. It can help them to predict stakeholders’ needs and avoiding burdening them with excessive data access and delivery measures.

In terms of strategy, the OECD recommends countries to implement the following measures to support the digital transition of governments from citizen-centric to citizen-driven approaches,

i.e., the state, in which the citizens and businesses determine their needs together with the government:

- Utilisation of technology for better government accountability, inclusiveness and partnerships with citizens,
- Transformation of the culture in the public sector to a data-drive one,
- Coherent use of technologies across public policy areas and levels of government,
- Improvement of the ties between digital government and public agendas,
- Utilisation of e a risk management approach to address digital security and privacy issues,
- Development of business cases to sustain the funding and success of digital technology projects,
- Strengthening of institutional management and monitoring capacities,
- Evaluation of existing assets to guide procurement of digital technologies,
- Reviewing legal and regulatory frameworks to enable digital opportunities to be seized.

5. ECONOMETRIC METHODOLOGY AND DATA

To answer the second research question (Q2: *What are the most important factors that influence the E-government performance of the South-East Asian economies?*) we build on the theoretical models presented in section 2. Within this framework, we hypothesize that E-government performance depends on factors that have been previously identified for developed economies and test their significance for the group of East Asia countries. Nevertheless, empirical implementation in this group of countries faces several obstacles, the most important of which is the data limitations as detailed below.

The econometric model we use to test empirically Q2 is the following:

$$Y_{it} = \alpha_i + \beta_1 Macroecon_{it} + \beta_2 Institutions_{it} + \beta_3 Demographic_{it} + \varepsilon_{it} \quad (1)$$

where i indexes individual countries and t indexes years, α_i are the country unobserved effects and β_i symbolizes a regression coefficient. The dependent variable Y_{it} is the *e-government* index (overall and sub-components); *Macroecon* denotes the set of macroeconomic factors assumed to influence the dependent variable; *Institutions* and *Demographic* are the set of institutional and demographic factors respectively, while ε_{it} is the error term.

Table 7 presents the list of all dependent and explanatory variables to be used in the econometric estimations of model (1). At the top stands the overall e-government digital index (EGDI) which is our main dependent variable and was also used for the performance assessment in section 3. This index comprises four sub-components which will also be used as alternative dependent variables in the model estimations. The second part of the table presents the list of influencing factors determined from the literature review as important factors explaining e-government performance. The last column of the table includes the data sources.

Table 7: The list of variables with definitions and sources

A: Dependent variable	Symbol	Source ¹
E-Government Development Index	EGDI	UN e-government surveys
E-participation Index	EPI	UN e-government surveys
Telecommunications Infrastructure Index	OSI	UN e-government surveys
Human Capital Index	HCI	UN e-government surveys
Online Services Index	TII	UN e-government surveys
B: Influencing factors/Explanatory variables	Symbol	Source
Macroeconomic		
GDP per capita (constant 2015 US\$)	gdpcs	World Bank and OECD NA
Unemployment, total (% of total labor force)	ur	World Bank, WDI
Gross capital formation (% of GDP)	gcf	World Bank and OECD NA
Institutional		
Rule of Law ²	law	World Bank, WDI
Political instability ³	ps	World Bank, WDI
Regulatory Quality: Percentile Rank ⁴	regul	World Bank, WDI
Demographic		
Urban population (% of total population)	urban	UN Population Division
Population ages 65 and above (% of total population)	pop65on	World Bank, WDI
Population density (people per sq. km of land area)	popdens	World Bank, WDI

NOTES

1. The surveys were conducted in the years 2003, 2004, 2005, 2008, 2010, 2012, 2014, 2016, 2018, 2020 and 2022.

2. It captures perceptions of the extent to which agents have confidence in and abide by the rules of society. Estimate ranging from -2.5 to 2.5 in units of a standard normal distribution)

ITU=International Telecommunication Union

3.The value 0 corresponds to lowest rank and 100 to highest rank)

4. It captures perceptions of the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development.

Model (1) was estimated using a panel data set comprising of all the years the UN E-government surveys were conducted (11 years) and all South East countries except for East Timor (10 countries).² Table 8 presents the descriptive statistics (mean, median and standard error) of all the e-government digital indicators, while Figure 8 displays the evolution of the overall index EGDI over the period under study for each country in the sample. Separate regressions were run for each dependent variable and results are reported in Tables 9-12.

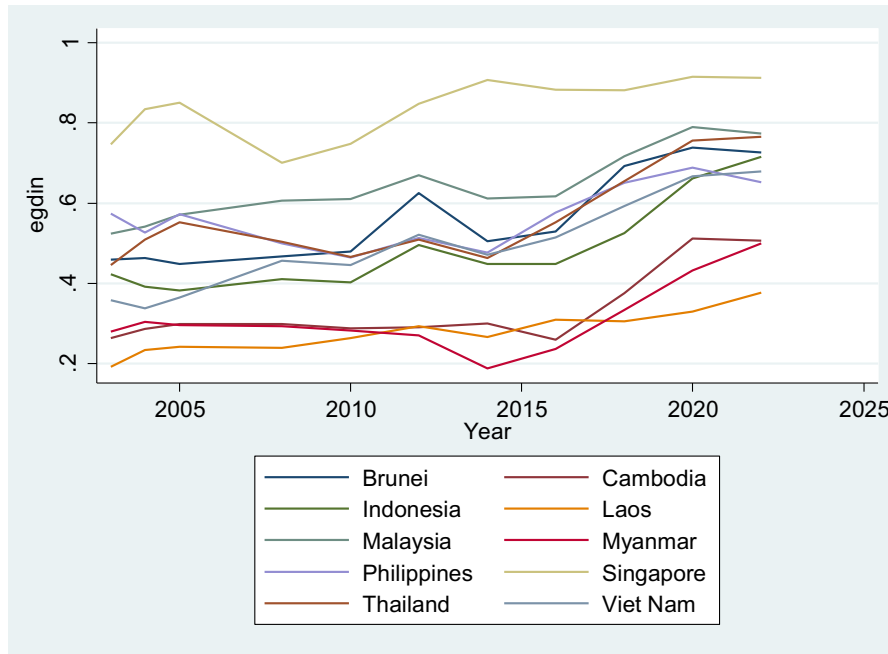
From the data in table 8, we see that there is considerable variation among the countries in their performance across different social, governmental, and environmental metrics. Singapore consistently shows high scores, indicating strong performance across all indices. Meanwhile, countries like Cambodia and Laos show room for significant improvement in several areas.

Table 8: Mean values, median, and standard errors of E-government digital indices

country	egdi	epi	osi	tii	hci
Brunei	.5575491	.2619127	.4304073	.4259209	.8174145
	.50424	.17142	.3622	.35119	.82525
	.1153344	.2341156	.1806918	.2292111	.0628297
Cambodia	.3342527	.1764055	.22164	.18396	.5986027
	.2989	.1742	.19732	.08141	.59967
	.0911623	.1101867	.1193764	.2125149	.0763412
Indonesia	.4820882	.3583645	.4426464	.2411582	.7630918
	.44784	.28571	.36232	.18966	.79
	.111572	.2345222	.1671784	.2096861	.0622228
Laos	.2770673	.1132482	.1456582	.1126182	.5739673
	.26588	.12857	.14173	.09976	.5539
	.0518989	.1149092	.0940134	.1042657	.0689009
Malaysia	.6392555	.4996836	.6859191	.4548655	.7767391
	.61152	.52941	.67716	.43975	.76911
	.0886379	.2842618	.1351066	.1819398	.0582049
Myanmar	.3100155	.0876373	.1550582	.1346064	.6414236
	.2922	.04761	.15384	.00449	.70642
	.086952	.1078142	.0847086	.2268861	.1159506
Philippines	.5631473	.5015282	.6245827	.2529255	.8121245
	.57211	.4886	.6303	.20822	.83414
	.0756102	.2349413	.1456561	.1921672	.0883313
Singapore	.8387736	.8447418	.8947264	.7434809	.8785418
	.8503	.91525	.96911	.69229	.87
	.0747933	.1733359	.1484309	.1145594	.0288549
Thailand	.5615154	.4199327	.5570182	.3262109	.8016845
	.50956	.3158	.53281	.23608	.7903
	.1139518	.2582257	.1493912	.2338245	.0733007
Viet Nam	.4913773	.3624464	.4319	.30683	.7358427
	.47045	.49019	.42483	.37145	.74336
	.1180019	.2902805	.2033504	.2363294	.0916892
Total	.5055042	.3625901	.4589556	.3182576	.7399433
	.49975	.271955	.442875	.267785	.7586
	.1854459	.2976762	.270209	.2613962	.1212891

Figure 8: The evolution of EGDI in the South-East Asian region

² East Timor was excluded due to the large number of missing values in some independent variables for this country.



Source: Graph constructed using EGDI data from the UN e-government surveys

6 RESULTS

Table 9 displays the results with independent variable being the overall development index EGDI and independent variables as defined in Table 7. The estimates in columns 1-2 are derived from the pooled sample with robust standard errors to account for the heteroskedasticity that may result from the cross-sectional part of the panel. The values in parenthesis report the significance levels (p-values). The pooled OLS regressions (1) and (2) indicate that per capita output (*gdpccs*) exerts a positive and statistically significant impact at the level of 6%, while the other two variables that control for the macro-economic environment, i.e., the unemployment rate (*ur*) and investment as a percentage of GDP (*gcf*) are insignificant. From the group of institutional variables, we included two: the variable *law* which captures perceptions of the extent to which agents have confidence in and abide by the rules of society, and *regul* which captures perceptions of the ability of the government to formulate and implement sound policies and regulations that permit and promote the private sector development. It is of particular interest that *law* is highly significant, and its impact is not affected by the presence of *regul*. The variables that reflect demographic context (*urban* and *popdens*) are not statistically significant. The diagnostics are quite satisfactory and show high explanatory power of the model.

Regressions (3)-(5) derive from the panel data fixed effects (FE) estimator which accounts for heterogeneity problems among the countries in the sample and is very common when dealing with panel data. It is noticeable that the FE estimates differentiate substantially from the pooled sample estimates indicating that heterogeneity issues are in place which are treated by the FE estimators. Apart from the variable *law* that keeps its high significance across all regressions, the coefficients of demographic variables *urban* and *popdens* turned out significant as well.

Table 9: Regression estimates of model (1) with dependent variable Y=EDGI

	(1) egdi	(2) egdi	(3) egdi	(4) egdi	(5) egdi
gdpcs	9.33e-14 (0.066)	9.92e-14 (0.056)	1.17e-13 (0.592)	2.23e-13 (0.251)	7.39e-14 (0.631)
ur	-0.00858 (0.098)	-0.00873 (0.113)	0.0103 (0.226)	0.00895 (0.287)	0.00787 (0.348)
gfc	-0.000695 (0.723)	-0.000941 (0.624)	0.00140 (0.632)	0.00104 (0.721)	0.000501 (0.862)
law	0.110* (0.047)	0.113** (0.005)	0.163* (0.013)	0.176** (0.006)	0.152* (0.013)
regul	0.000770 (0.533)		-0.00169 (0.448)	-0.00258 (0.208)	
urban	0.00235 (0.096)	0.00255 (0.082)	0.0123** (0.004)	0.0104** (0.006)	0.0122*** (0.001)
popdens	-0.00000544 (0.405)		0.0000342 (0.315)		
_cons	0.406** (0.001)	0.437*** (0.000)	-0.137 (0.629)	0.0287 (0.901)	-0.147 (0.427)
N	72	72	72	72	72
R-sq	0.796	0.792	0.548	0.540	0.527
adj. R-sq	0.774	0.777	0.417	0.417	0.411
rmse	0.0805	0.0800	0.0622	0.0622	0.0626

p-values in parentheses

* p<0.05, ** p<0.01, *** p<0.001

When using as dependent variable the sub-component of E-participation index the results are as follows: Y=EPI indicates a highly significant impact coming from per capita output in the pooled sample regressions (1) and (2) and an absence of impact from any other factor. In contrast, the FE estimates indicate strong impact from both, the institutional *law* variable and demographic factor *urban* (at 5% and 1% level of significance respectively). A similar picture results from Table 10 which displays the estimates with the dependent variable being the sub-component of online service index: Y=OSI.

In the case of telecommunications infrastructure index: Y=IIT, the results from the pooled regressions (1) and (2) indicate a statistically significant impact coming from the unemployment rate (negative) and the investment as percentage of GDP (positive), but not any impact from any institutional or demographic variable. These results are indicative of the

importance of market conditions and general infrastructure (e.g., gross physical capital investment like ICT) required for the telecommunications development of the government services. The FE estimates indicate a weaker impact from unemployment but no impact from investment. The institutional *law* variable and demographic factor *urban* remain significant. Finally, Table 13 includes the results on the human capital index with Y=HCI, which are similar in significance with those of the TII index (Table 12).

Table 10: Regression estimates of model (1) with dependent variable Y=EPI

	(1) epi	(2) epi	(3) epi	(4) epi	(5) epi
gdpcs	3.06e-13* (0.012)	3.01e-13** (0.009)	2.23e-13 (0.550)	4.31e-13 (0.436)	2.23e-13 (0.566)
ur	-0.0264 (0.089)	-0.0272 (0.079)	0.0339 (0.107)	0.0402 (0.064)	0.0339 (0.112)
gfc	-0.00368 (0.510)	-0.00434 (0.347)	-0.000772 (0.952)	0.00162 (0.826)	-0.000772 (0.916)
law	0.0868 (0.600)	0.113 (0.333)	0.389 (0.050)	0.434** (0.009)	0.389* (0.012)
regul	0.000528 (0.884)			-0.00567 (0.313)	
urban	0.00460 (0.285)	0.00496 (0.277)	0.0388** (0.001)	0.0377*** (0.001)	0.0388*** (0.000)
popdens	0.0000101 (0.597)			0.0000757 (0.376)	
_cons	0.235 (0.537)	0.278 (0.271)	-1.744* (0.014)	-1.589* (0.029)	-1.744*** (0.000)
N	72	72	72	72	72
R-sq	0.501	0.498	0.598	0.619	0.598
adj. R-sq	0.446	0.460	0.567	0.508	0.499
rmse	0.218	0.215	0.147	0.157	0.158

p-values in parentheses

* p<0.05, ** p<0.01, *** p<0.001

Table 11: Regression estimates of model (1) with dependent variable Y=OSI

	(1) osi	(2) osi	(3) osi	(4) osi	(5) osi
gdpcs	2.06e-13* (0.016)	2.24e-13** (0.010)	1.41e-13 (0.737)	2.39e-13 (0.517)	2.60e-14 (0.929)
ur	-0.0115 (0.208)	-0.0113 (0.261)	0.0243 (0.139)	0.0231 (0.152)	0.0215 (0.178)
gfc	-0.00633 (0.082)	-0.00644 (0.064)	0.00273 (0.627)	0.00240 (0.666)	0.00163 (0.766)
law	0.177 (0.095)	0.164* (0.024)	0.365** (0.004)	0.377** (0.002)	0.342** (0.004)
regul	0.00145 (0.552)		-0.00286 (0.503)	-0.00369 (0.345)	
urban	0.00271 (0.290)	0.00292 (0.296)	0.0169* (0.036)	0.0152* (0.034)	0.0177** (0.009)
popdens	-0.0000201 (0.095)		0.0000317 (0.627)		
_cons	0.475 (0.053)	0.520** (0.002)	-0.403 (0.460)	-0.250 (0.571)	-0.501 (0.157)
N	72	72	72	72	72
R-sq	0.680	0.664	0.444	0.442	0.433
adj. R-sq	0.645	0.639	0.283	0.293	0.294
rmse	0.150	0.152	0.120	0.119	0.119

p-values in parentheses

* p<0.05, ** p<0.01, *** p<0.001

Table 12: Regression estimates of model (1) with dependent variable Y=TII

	(1) tii	(2) tii	(3) tii	(4) tii	(5) tii
gdpcs	-1.52e-16 (0.999)	-4.09e-16 (0.997)	3.97e-13 (0.288)	5.71e-13 (0.085)	2.27e-13 (0.390)
ur	-0.0297* (0.014)	-0.0304* (0.012)	0.00568 (0.693)	0.00340 (0.811)	0.000902 (0.950)
gfc	0.00956* (0.027)	0.00888* (0.028)	0.00436 (0.381)	0.00375 (0.446)	0.00251 (0.612)
law	0.0574 (0.580)	0.0799 (0.359)	0.255* (0.021)	0.276* (0.011)	0.219* (0.036)
regul	0.000917 (0.680)		-0.00448 (0.237)	-0.00596 (0.088)	
urban	0.00570 (0.099)	0.00611 (0.064)	0.0262*** (0.000)	0.0232*** (0.000)	0.0272*** (0.000)
popdens	0.00000427 (0.748)		0.0000566 (0.326)		
_cons	-0.166 (0.455)	-0.111 (0.545)	-1.078* (0.028)	-0.803* (0.043)	-1.210*** (0.000)
N	72	72	72	72	72
R-sq	0.652	0.650	0.676	0.670	0.652
adj. R-sq	0.613	0.624	0.581	0.581	0.567
rmse	0.154	0.152	0.106	0.106	0.107

p-values in parentheses

* p<0.05, ** p<0.01, *** p<0.001

Table 13: Regression estimates of model (1) with dependent variable Y=EPI

	(1) hci	(2) hci	(3) hci	(4) hci	(5) hci
gdpcs	7.35e-14 (0.101)	7.35e-14 (0.106)	-1.93e-13 (0.336)	-1.48e-13 (0.399)	-3.25e-14 (0.814)
ur	0.0153* (0.042)	0.0154* (0.034)	0.000548 (0.943)	-0.0000452 (0.995)	0.000790 (0.917)
gfc	-0.00530* (0.013)	-0.00526* (0.017)	-0.00294 (0.273)	-0.00310 (0.241)	-0.00268 (0.305)
law	0.0937 (0.103)	0.0925 (0.053)	-0.133* (0.026)	-0.127* (0.028)	-0.108* (0.049)
regul	-0.0000494 (0.968)		0.00238 (0.243)	0.00199 (0.282)	
urban	-0.00134 (0.504)	-0.00136 (0.480)	-0.00631 (0.097)	-0.00710* (0.037)	-0.00844** (0.009)
popdens	-0.000000216 (0.970)		0.0000147 (0.633)		
_cons	0.907*** (0.000)	0.904*** (0.000)	1.065*** (0.000)	1.136*** (0.000)	1.272*** (0.000)
N	72	72	72	72	72
R-sq	0.377	0.377	0.457	0.454	0.443
adj. R-sq	0.309	0.330	0.299	0.308	0.306
rmse	0.0914	0.0900	0.0567	0.0564	0.0564

p-values in parentheses

* p<0.05, ** p<0.01, *** p<0.001

Table 14: Robustness checks

	(1) egdi	(2) epi	(3) osi	(4) tii	(5) hci
gdpcs	3.90e-13* (0.031)	1.14e-12 (0.054)	4.81e-13 (0.071)	9.91e-13* (0.049)	-3.00e-13 (0.199)
gcfn	0.00232 (0.430)	0.00419 (0.543)	0.00512 (0.257)	0.00380 (0.517)	-0.00203 (0.294)
law	0.173* (0.011)	0.514* (0.011)	0.377** (0.009)	0.283* (0.010)	-0.142 (0.142)
ps	-0.00208 (0.071)	-0.00766 (0.077)	-0.00461 (0.057)	-0.00189 (0.467)	0.000266 (0.866)
popdens	0.00000748 (0.696)	0.00000847 (0.897)	0.000000555 (0.986)	-0.00000670 (0.892)	0.0000289 (0.247)
_cons	0.464*** (0.001)	0.403 (0.214)	0.479* (0.024)	0.106 (0.640)	0.810*** (0.000)
N	94	94	94	94	94
R-sq	0.425	0.486	0.410	0.490	0.364
adj. R-sq	0.393	0.456	0.376	0.461	0.328
rmse	0.0628	0.154	0.110	0.120	0.0597

p-values in parentheses

* p<0.05, ** p<0.01, *** p<0.001

The estimates reported in Tables 9-13 may be subject to sample bias given the large number of missing values in the panel of countries considered which are developing and the database is incomplete for several variables. To alleviate the problem and increase credibility in our estimates, we re-estimated the model by dropping variables that restricted the sample like the unemployment rate that was statistically insignificant. In addition, we tested for the robustness of the effect of *law* by including the variable of political instability (*ps*) on one hand and omitted the urbanization variable to avoid multicollinearity with the *population density* variable and *law* which may introduce bias in the estimates.

This robustness analysis is presented in Table 14 which reports panel FE estimates with robust standard errors for each E-government digital performance index. The sample size has increased substantially, from 72 observations to 94, while the main result of a positive and significant impact from *law* on E-government development performance remains valid. It can also be noticed that per capita output has turned out as significant in all but the last regression (5). The new variable of political instability (*ps*) has the right size, but it is significant at a lower level (6% and 7%) only in the first three regressions.

Finally, we also experimented with other factors related to political factors, schooling and education, tourism activity, competition as suggested in the literature (Lee and Chang, 2011; Dang Nguyen et al., 2013; Arduini et al., 2013; Attour and Chaupain-Guillot, 2020). However, the number of observations after considering the missing values in the panel data set was very limited for robust panel data estimates.

6. CONCLUDING REMARKS

The evidence gathered in our study underlines the transformative potential of E-governance for reinforcing the trust in democratic institutions. It appears that the deployment of E-government services represents an effective avenue for governments to enhance their communication strategies, raise awareness of these services, and highlight the benefits that arise from their use.

More broadly, these advancements in digital public service provision can significantly contribute to the elevation of trust levels in public institutions. Widespread usage of E-government services can serve as a catalyst for fostering an environment of transparency, efficiency, and inclusivity, thereby strengthening trust in government.

South-East Asian countries, particularly Indonesia, Malaysia, and Thailand, are in the midst of the digital transformation of their public sectors. While they have embarked on the journey towards developing their E-governance capabilities, our findings suggest that much work remains.

An empirical analysis was conducted using a panel data set of 10 South-East countries for 11 time periods and panel econometric techniques to test the impact of influencing factors from the macroeconomic, institutional, and demographic environment. The results indicate the importance of institutions (perceptions of the extent to which agents have confidence in and abide the rules of a society and to a lower degree the political stability) for improving the digital performance of public institutions. Among the demographic factors, urbanization rate of population was also found significant. When considering macroeconomic factors, the level of development (measured by GDP per capita in constant prices) matters, while the unemployment rate had low significance in this analysis. Robustness checks have been provided up to the extent feasible given the data limitations for this particular group of countries.

Further research is needed to gain a comprehensive understanding of the state of digitalisation in the public sectors and the status of E-government in South-East Asian countries. One possible avenue for deepening our understanding of this area could be the application of the OECD methodology, leading to the construction of the OECD Digital Government Index for these countries. This could provide critical insights into the effectiveness and reach of their digital government initiatives, thereby facilitating more targeted and effective policy interventions. By promoting E-governance in line with research findings of the state of digitalisation, these South-East Asian countries can leverage the power of digital technology to improve public service delivery, enhance citizen engagement, and strengthen trust in their democratic institutions.

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APPENDIX

This appendix contains a discussion on the digitalization facts and government digital performance of the three economies on which this study focuses on: Indonesia, Malaysia, and Thailand.

Indonesia

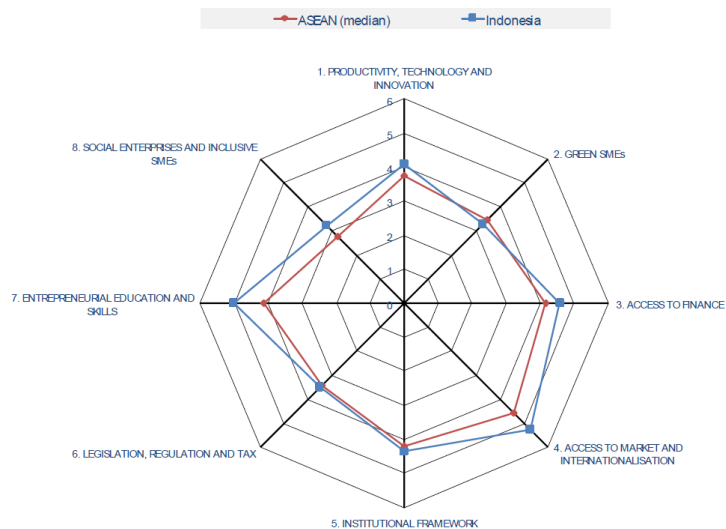
Indonesia is the largest economy in Southeast Asia (the world's 16th largest economy with a GDP of more than \$1 trillion) and has made significant progress in digitalization in recent years. The government has recognized the importance of digitalization and has implemented various policies to promote the growth of the digital economy. For that purpose, Indonesian government has launched various initiatives to improve digital services and infrastructure. The country has prioritized the digitalization of public services and has made efforts to increase the availability of online services and E-government platforms. A large and growing internet user base has been formed with over 175 million internet users as of 2021 (The Indonesia Digital Report, 2021). In percentage terms, the internet users exceeded 60% of the country population in 2021, as was displayed earlier in Figure 2.

Infrastructure is recognized as a key enabler for digital transformation in Indonesia, and the government has identified specific ICT Infrastructure development priorities including the completion of 4G infrastructure in more than 10,000 subregions by 2022. Other initiatives include the Palapa Ring project, which aims to provide high-speed internet access to all regions in Indonesia. Some of the challenges that Indonesia faces in terms of digitalization include the lack of digital skills and infrastructure in rural areas, as well as issues related to data privacy and cybersecurity.

In terms of Digital Government, a masterplan was set out in 2018 for an eGovernment system that focuses on several areas including budget planning, business process, data, and information, eGovernment infrastructure, eGovernment applications, eGovernment security, and eGovernment services. The Indonesian government is also targeting 30 million micro, small and medium enterprises (MSMEs) across the country to go digital by 2024.

Despite all efforts for increased digital development so far, the progress has been uneven and regionally not equally distributed. To fight these obstacles, which are partially due to the archipelago nature of the country, Indonesian government has taken initiatives such as the National Movement on Digital Literacy and the Digital Talent Scholarship to increase society's readiness to adopt digital knowledge. The government has also established a Digital Transformation Office to oversee the digitalization of public services and has focused on significant investments in developing the country's digital infrastructure. (Google, Temasek, Bain & Company, 2022).

FIGURE A1: The 2018 ASEAN SME Policy Index assessment framework and relative position of Indonesia vs the ASEAN median.



Malaysia

The Malaysian government has been pushing for the adoption of digital technologies as part of its efforts to transform the country into a digital economy. The Malaysian government launched the Malaysia Digital Economy Blueprint in 2016, which outlines the country's vision to become a fully digitalized nation by 2025. The blueprint focuses on eight strategic priorities, which include building a robust digital infrastructure, a strong digital workforce, and increasing the use of digital technologies in all sectors of the economy.

In recent years, Malaysia has made significant progress in the digitalization. The country has a high penetration rate of mobile phones, and an increasing number of citizens have access to the internet. The government has also actively promoted the use of digital technologies in different sectors such as education, healthcare, and transportation. In 2016, the Digital Government Transformation Initiative was launched to develop the digital government that would provide efficient and effective services to the people.

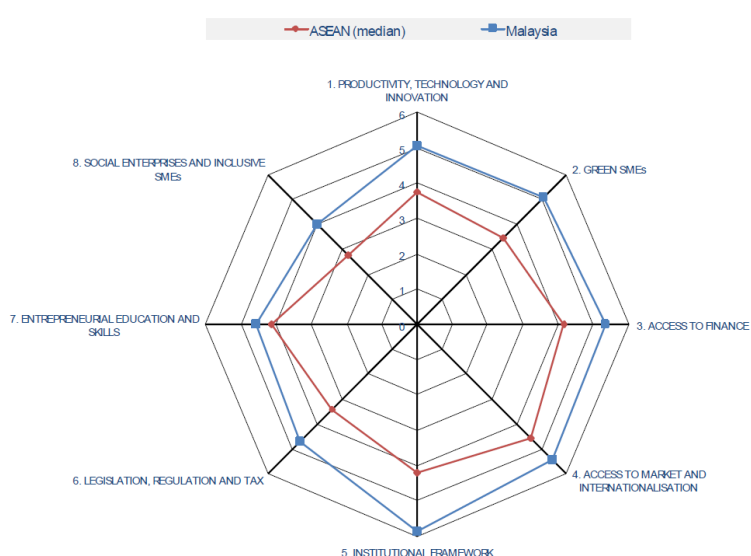
According to the World Bank (2021), Malaysia ranked 45th out of 190 economies in the Doing Business index, which indicates favorable business environment for digital start-ups and entrepreneurs. The country also ranks 38th out of 141 countries in the Global Competitiveness Report (World Economic Forum, 2019), which highlights Malaysia's strength in the ICT adoption and the ability to leverage technology for innovation.

Malaysian public sector has also experienced dynamic progress in digitalization. The government has implemented various initiatives and programs to enhance the quality of public service delivery through the digital transformation. One such initiative is the Digital Government Transformation Initiative (DGTI) launched by the Malaysian Administrative Modernization and Management Planning Unit (MAMPU) to accelerate digitalization in the public sector.

The Malaysia Digital Economy Blueprint 2021-2025 by the Malaysia Digital Economy Corporation (MDEC) outlines the country's vision to become a leading digital economy in the region. It includes strategies for digitalizing the public sector, such as enhancing E-government services, promoting digital adoption among businesses and the public, and improving digital infrastructure.

Malaysia ranks 7th out of 190 countries in the "Getting Credit" indicator, thanks to its robust credit reporting system that enables businesses to access credit easily through online platforms. Additionally, the country ranks 12th in the "Starting a Business" indicator, indicating the ease and efficiency of starting a business in Malaysia (World Bank, 2022). The Global Competitiveness Report also ranks Malaysia 27th out of 141 countries in the Technological Readiness Pillar, which measures the country's preparedness to adopt and leverage new technologies (World Economic Forum, 2019). This indicates the Malaysia's progress achieved in digitalization, especially in the public sector. The Malaysia's efforts to digitalize the public sector should lead to enhancement of public service delivery and improving country's overall competitiveness in the global digital economy.

FIGURE A2: The 2018 ASEAN SME Policy Index assessment framework and relative position of Malaysia vs the ASEAN median.



Thailand

Thailand has been on a path to increase digitalization and several initiatives have been undertaken by the government to drive this transformation. The country has progressed on the internet penetration. As of January 2022, there have been around 50 million internet users and the internet penetration rate achieved 73.2% (Datareportal, 2022). The mobile phone penetration reached over 100%, indicating that digital devices have been used by virtually the whole population.

The Thai government has launched several initiatives to promote digitalization, including the Thailand 4.0 initiative, which aims to transform the country into a digital hub in the region. It focuses on developing 10 targeted industries and promoting the adoption of digital technologies to enhance the competitiveness of the Thai economy. The country is also home to several technological start-ups, and Bangkok has been recognized as a hub for technological innovation in South-East Asia. In 2018, Thailand's gross expenditures on R&D from both public and private sectors comprised only 1.11% of GDP, or about 182 billion Thai baht. These expenditures were lower than those of most other countries in the upper-middle-income group category, meanwhile, the high-income countries' gross expenditures on R&D have been two times higher (2.43% of GDP). The government budget for R&D increased from 17 billion Thai

baht in 2017 to 26 billion Thai baht in 2021. However, these were cut to only 15 billion Thai baht in 2022, which represents a 43% drop compared to the previous year.

Despite the progress achieved, there are still challenges of further digitalization in Thailand. For example, the country has relatively low levels of E-commerce adoption, with only around 7% of total retail sales in the country made online in 2021 (Statista, 2022). The government has introduced measures to address this, such as the establishment of the Digital Economy Promotion Agency, which aims to promote the adoption of E-commerce by SMEs. Additionally, the efforts also focus on the improvement of digital infrastructure and increasing the digital literacy of the population.

Thailand has made significant progress in digitizing its public sector, with the government launching several initiatives to drive the digital transformation. Thailand 4.0 policy aims to transform the country into a high-income, innovation-driven economy with a strong focus on digitalization. One of the key components of the Thailand 4.0 initiative has been the creation of the Digital Government Development Agency (DGA) responsible for promoting and supporting the use of digital technologies in the public sector.

The DGA has launched several digital initiatives, including the Thailand Government Data Centre (TGDC) and the Government Information Network (GIN), which aim to improve the data management and the data sharing across government agencies. Additionally, the DGA focuses on developing digital services for citizens, such as the "One Stop Service" portal, which allows citizens to access government services online.

According to the report by the World Economic Forum (2019), Thailand ranked 38th out of 139 countries in terms of government digitization. Major challenges in this area are linked to increasing the use of digital technologies in public services and improving the quality and accessibility of government data.

FIGURE A3: The 2018 ASEAN SME Policy Index assessment framework and relative position of Malaysia vs the ASEAN median.

