# Chapter 3

# Indonesia's Development of Digital Economy

Chaikal Nuryakin

This chapter should be cited as:

Nuryakin, C. (2025), 'Indonesia's Development of Digital Economy', in Ing, L.Y. (ed.), *ASEAN Digital Community 2045: Country Perspectives*. ERIA Research Project Report FY2025 No. 13, Jakarta: ERIA, pp.27-44.

# Chapter 3
# Indonesia's Development of Digital Economy

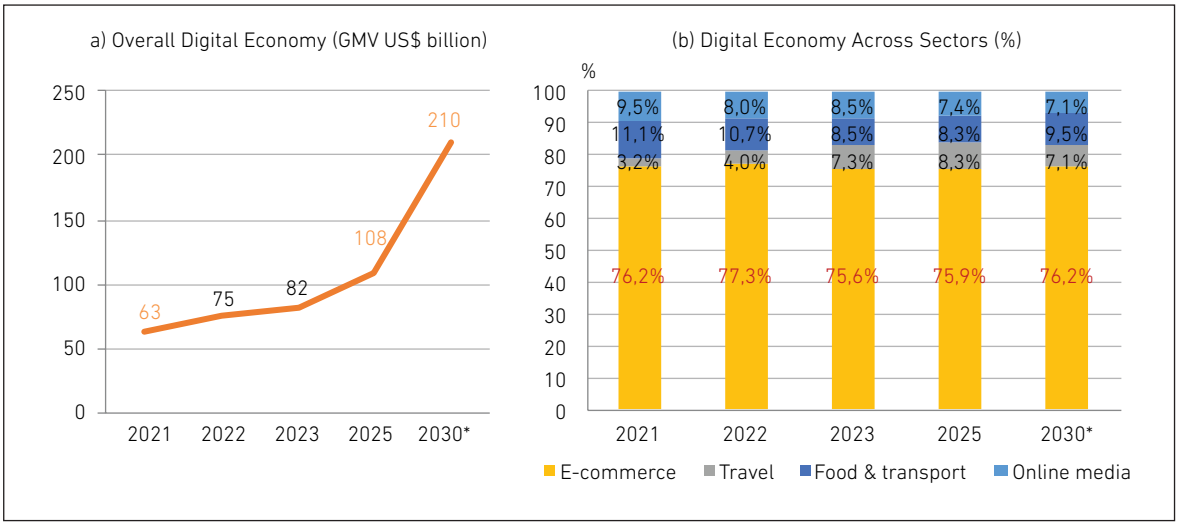
Chaikal Nuryakin

## 1. Introduction: Development of the Digital Economy in Indonesia

The digital sector's development has permeated numerous areas in Indonesia due to the extensive adoption of digitalisation. Digital development has entered multiple critical sectors, becoming a main driver of national progress. The Golden Indonesia Vision 2045 (Visi Indonesia Emas 2045), introduced by the Ministry of National Planning and Development, outlines four main goals, one of which is to cultivate a workforce proficient in science and technology. In alignment with the national development agenda outlined in the Golden Indonesia Vision 2045, the Ministry of Communication and Informatics has formulated the Digital Indonesia Vision 2045 (*Visi Indonesia Emas 2045*), which serves as a strategic framework for advancing the nation's digital transformation. This digital vision prioritises strengthening digital infrastructure to develop a robust digital ecosystem, focusing on data security and safety, human resources in digital sectors, digital research and development, and digital regulation and policy.

Recent years have seen a marked increase in the value of digital activities in Indonesia. According to statistics from Google, Temasek, and Bain & Company (2023), Indonesia's Gross Merchandise Value (GMV) in 2021 was US$63 billion, rising to US$82 billion in 2023 (Figure 3.1 [a]), reflecting a 30% increase over 2 years. As digital technology continues to integrate into broader sectors, projections estimate that this value will soar to US$210 billion by 2030. Within the digital sector, e-commerce has consistently commanded the largest share of Indonesia's GMV. Projections indicate that e-commerce will maintain a 76.2% share of total GMV in 2030, whilst the online media sector's share is expected to decline. Figure 3.1 (b) shows detailed information on the digital economy's GMV in Indonesia over recent years. In terms of its contribution to gross domestic product (GDP), the digital economy accounted for 6.12% (Rp1,490 trillion) in 2021 (Kementerian PPN/Bappenas, 2022). This contribution is expected to rise to 20.7% (Rp22,513 trillion) by 2045.

**Figure 3.1. Digital Economy Gross Merchandise Value of Indonesia**

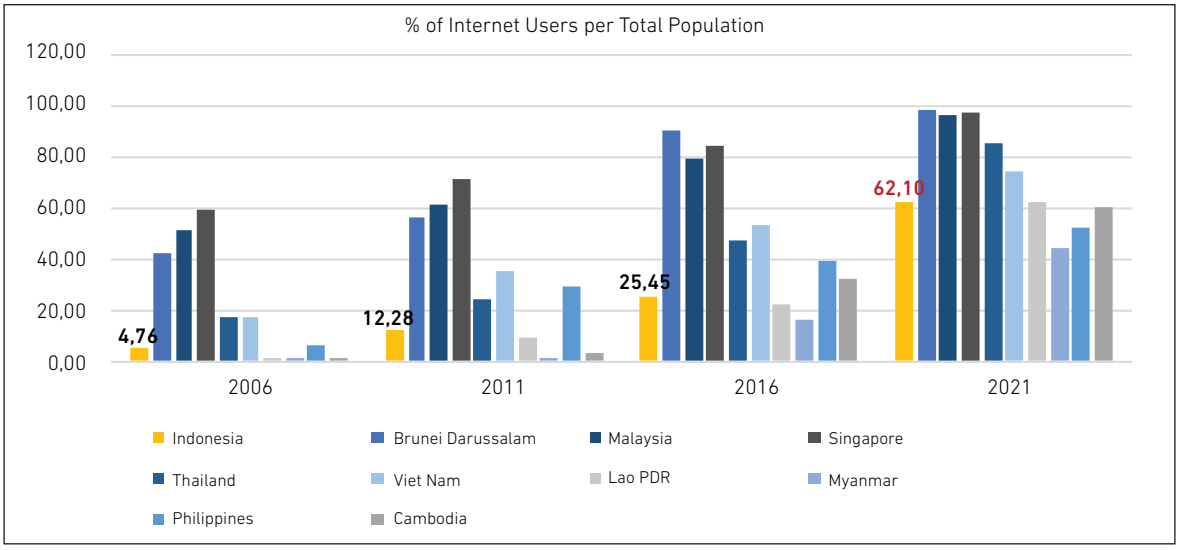



Source: Google, Temasek, and Bain & Company (2023).

## 2. Potential of the Digital Economy

Indonesia's digital economy holds considerable potential, particularly when compared with other ASEAN Member States. In 2022, Indonesia's population was approximately 274.86 million, and the country is expected to enjoy a demographic dividend until 2045 (Statista, 2022). The large population provides a substantial direct market for the digital economy in Southeast Asia. Figure 3.2 shows the increasing percentage of the population amongst ASEAN Member States from 2006 to 2021. Indonesia has seen a significant increase in the share of internet users, from 4.76% in 2006 to 62.10% in 2021. As the population continues to grow in the coming years, the number of active internet users is also expected to increase.

## Figure 3.2. Share of Internet Users per Total Population (%)

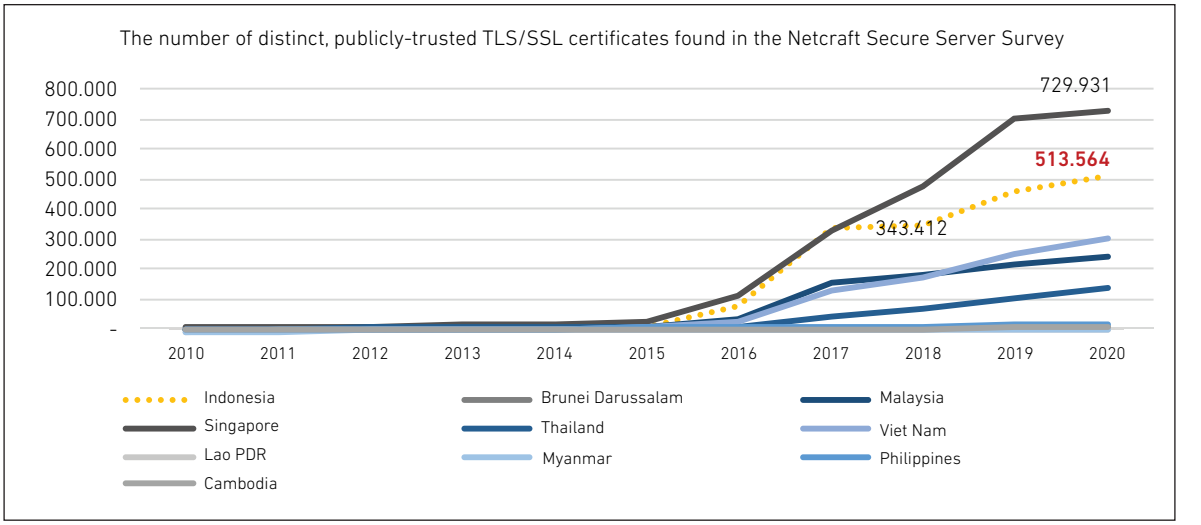



Lao PDR = Lao People's Democratic Republic.

Source: World Bank (2022a).

Beyond the direct potential provided by its population and active internet users, Indonesia also shows potential in terms of secure internet servers. These servers are measured by the number of distinct, publicly trusted secure sockets layer and transport layer security (SSL/TLS) certificates in the Netcraft Secure Server Survey. According to World Bank data (2022b), the number of secure internet servers in ASEAN Member States from 2010 to 2020 increased significantly. Whilst digital economies were still in their infancy in 2010, with limited servers available, the number of secure internet servers in these states began to grow rapidly from 2015 onwards. By the end of 2020, Indonesia ranked second amongst ASEAN Member States, behind only Singapore, in the number of secure internet servers.

## Figure 3.3. Number of Secure Internet Servers



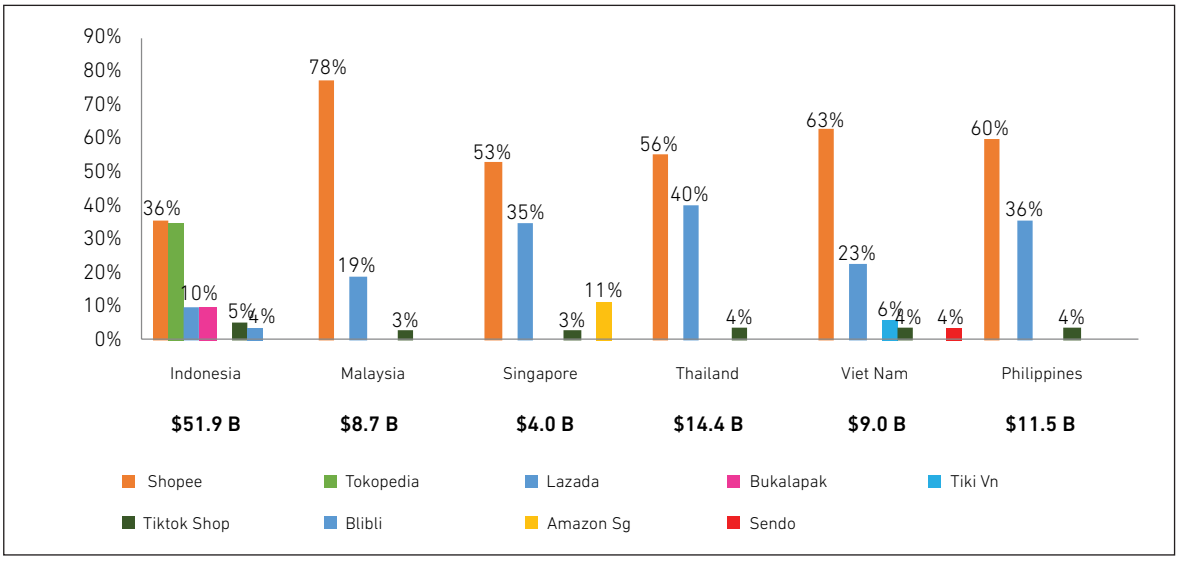

Lao PDR = Lao People's Democratic Republic, SSL/TLS = secure sockets layer and transport layer security.

Source: The World Bank (2020).

Another key aspect of Indonesia's digital economy is the active GMV in e-commerce and food delivery in 2022. Across Southeast Asia, numerous digital platforms have contributed to the convergence of the digital economy. E-commerce has been a major contributor, with platforms like Shopee, Lazada, Tokopedia, Bukalapak, TikTok Shop, BliBli, Tiki, Amazon, and Sendo leading the market. In 2022, Shopee dominated GMV across all Southeast Asian states, followed closely by Lazada in Malaysia, the Philippines, Singapore, Thailand, and Viet Nam. In Indonesia, Tokopedia's GMV stays close to that of Shopee (Figure 3.4).

Similarly, food-delivery service applications have witnessed a surge in demand due to the rapid adoption of technology and significant shifts in consumer behaviour. The total GMV of food-delivery platforms in Southeast Asia grew by a modest 5% year on year in 2022, reaching US$16.3 billion (Figure 3.5). Grab currently leads the market in most ASEAN Member States, although other food delivery platforms are beginning to expand their presence.

## Figure 3.4. E-Commerce Gross Merchandise Value in Southeast Asia, 2022

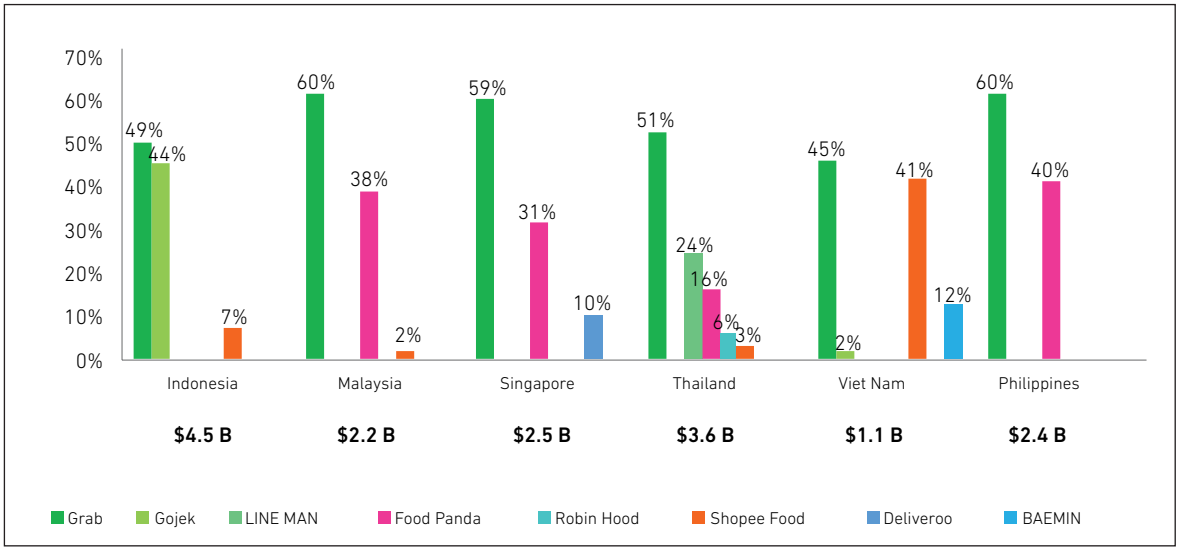



Notes: The 2022 GMV estimation by Momentum Works combines on-the-ground sources, including platforms, restaurants, delivery fleets, and other stakeholders. This estimate covers only food delivery orders from Grab, Foodpanda, Gojek, Deliveroo, LINE MAN, Baemin, ShopeeFood, and RobinHood. GMV includes all the orders made, including failed, canceled, and refunded orders. This estimate does not include food delivery orders not placed with any of the platforms, such as customers placing a phone / Whatsapp order directly with the restaurant, which in turn books Grab delivery / Lalamove to deliver the food.

$ = US dollar, B = billion.

Source: Momentum Works (2022).

## Figure 3.5. Food Delivery Gross Merchandise Value in Southeast Asia, 2022




Notes: The 2022 GMV estimation by Momentum Works combines on-the-ground sources, including platforms, restaurants, delivery fleets, and other stakeholders. This estimate covers only food delivery orders from Grab, Foodpanda, Gojek, Deliveroo, LINE MAN, Baemin, ShopeeFood, and RobinHood. GMV includes all the orders made, including failed, canceled, and refunded orders. This estimate does not include food delivery orders not placed with any of the platforms, such as customers placing a phone / Whatsapp order directly with the restaurant, which in turn books Grab delivery / Lalamove to deliver the food.

$ = US dollar, B = billion.

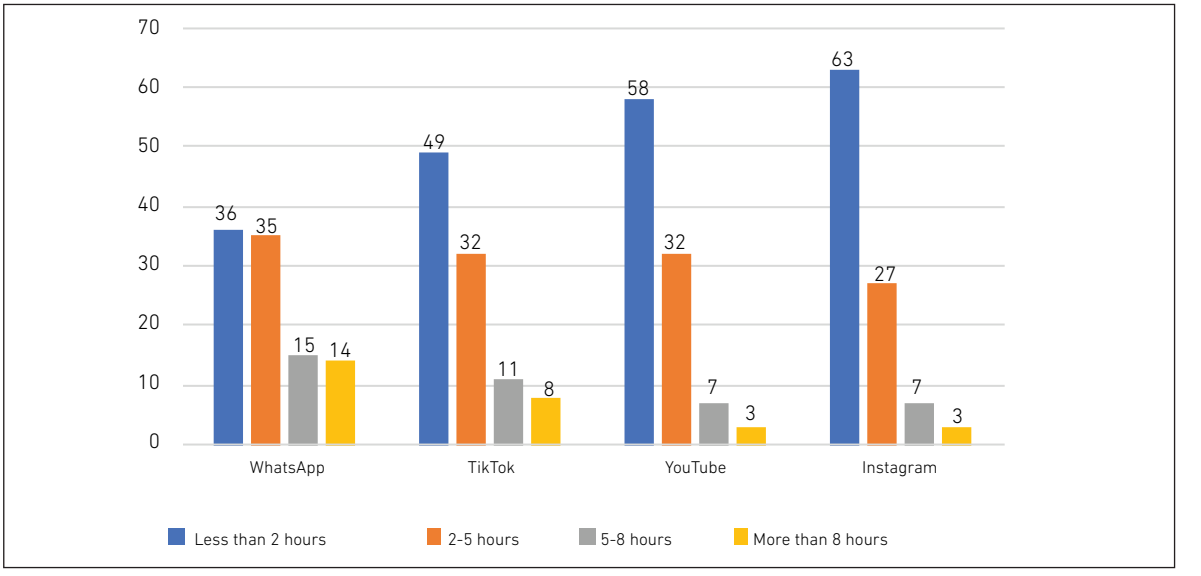
Source: Momentum Works (2023).

.

## 3. Challenges of Digitalisation

Indonesia faces challenges in its digital sector, primarily concerning human resources, network infrastructure, ecosystems, data management, and security. The use of the internet could be more productive and discerning. Many Indonesians use the internet primarily for socialising – such as communicating via messaging apps and social media – and for entertainment, including streaming video and music, browsing the internet, online shopping, and playing online games. According to the National Digital Literacy Index Report, 15% of respondents spend 5–8 hours daily on WhatsApp, followed by 11% on TikTok (Figure 3.6). Moreover, many respondents struggle to identify hoaxes, with 12% admitting to spreading false information (Kemenkominfo, 2023a). Indonesia must also improve its digital skills. In 2019, its ranking for digital skills dropped to 52nd out of 141 countries (Table 3.1).

**Figure 3.6. Duration of Social Media Access, 2022 (%)**




Source: Kemenkominfo (2023a).

## Table 3.1. Ranking of Digital Skills in the Population 2017–2019

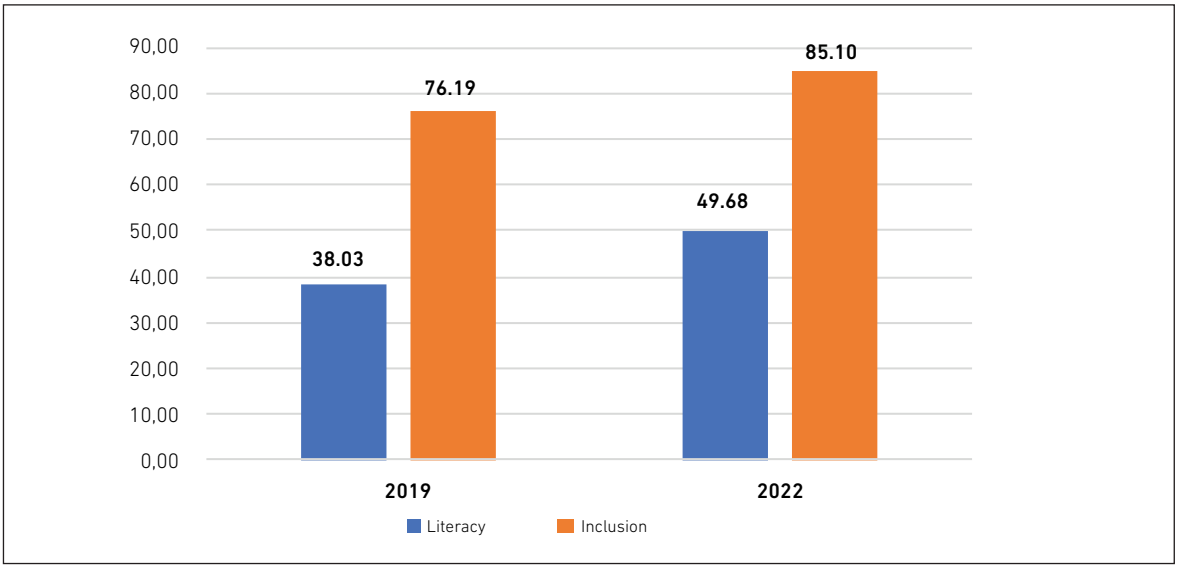
| Countries | 2017 | 2018 | 2019 |
|---|---|---|---|
| **Brunei Darussalam** | 47 | 46 | 35 |
| **Cambodia** | 109 | 107 | 112 |
| **Indonesia** | 34 | 39 | 52 |
| **Lao PDR** | 72 | 81 | 74 |
| **Malaysia** | 13 | 11 | 10 |
| **Philippines** | 48 | 24 | 22 |
| **Singapore** | 7 | 6 | 5 |
| **Thailand** | 57 | 61 | 66 |
| **Viet Nam** | 79 | 98 | 97 |
| **Number of Countries in the Ranking** | 131 | 139 | 141 |

Lao PDR = Lao People's Democratic Republic.

Source: World Economic Forum (2019).

Whilst Indonesia's financial inclusion reached 85.10% in 2022, it must be complemented by solid financial literacy to ensure safe and effective financial practices. Unfortunately, financial literacy lags behind financial inclusion (Figure 3.7), which has adverse effects on the economy, including low savings rates, a tendency to borrow from informal lenders, and excessive debt amongst low-income households (Askar, 2020).

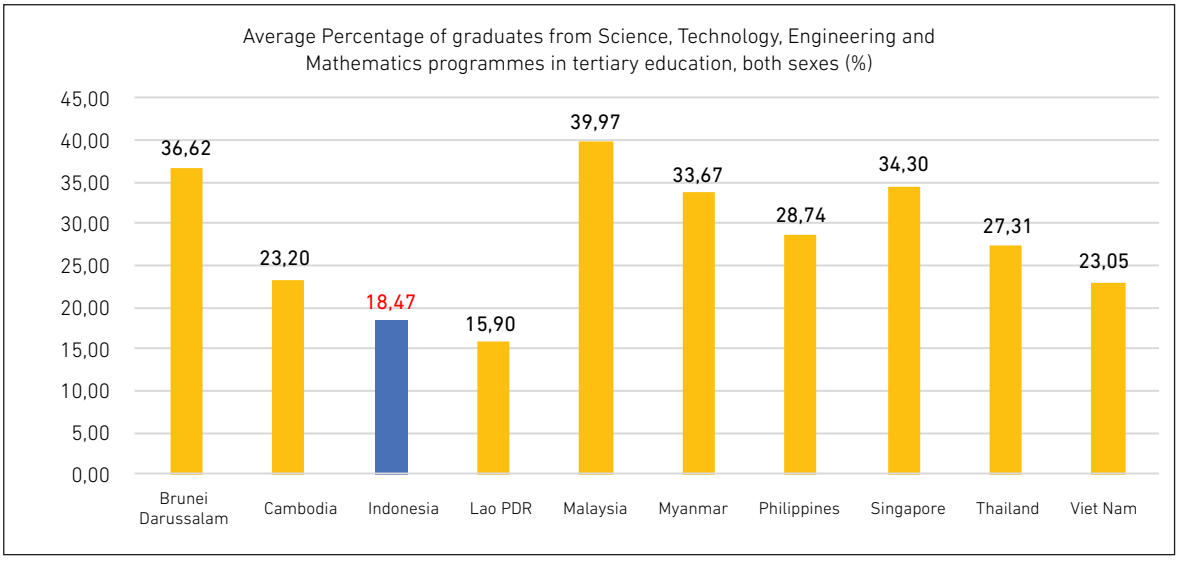
## Figure 3.7. Financial Literacy and Inclusion Indexes (%)




Note: Financial Inclusion by OJK (Financial Services Authority) is based on using financial services, not owning an account. It differs from the World Bank Financial Index (Findex), which is based on account ownership.

Source: Otoritas Jasa Keuangan (2022).

## Figure 3.8. Average Percentage of Graduates from STEM Programmes in Tertiary Education in ASEAN, 2015–2019




Lao PDR = Lao People's Democratic Republic.

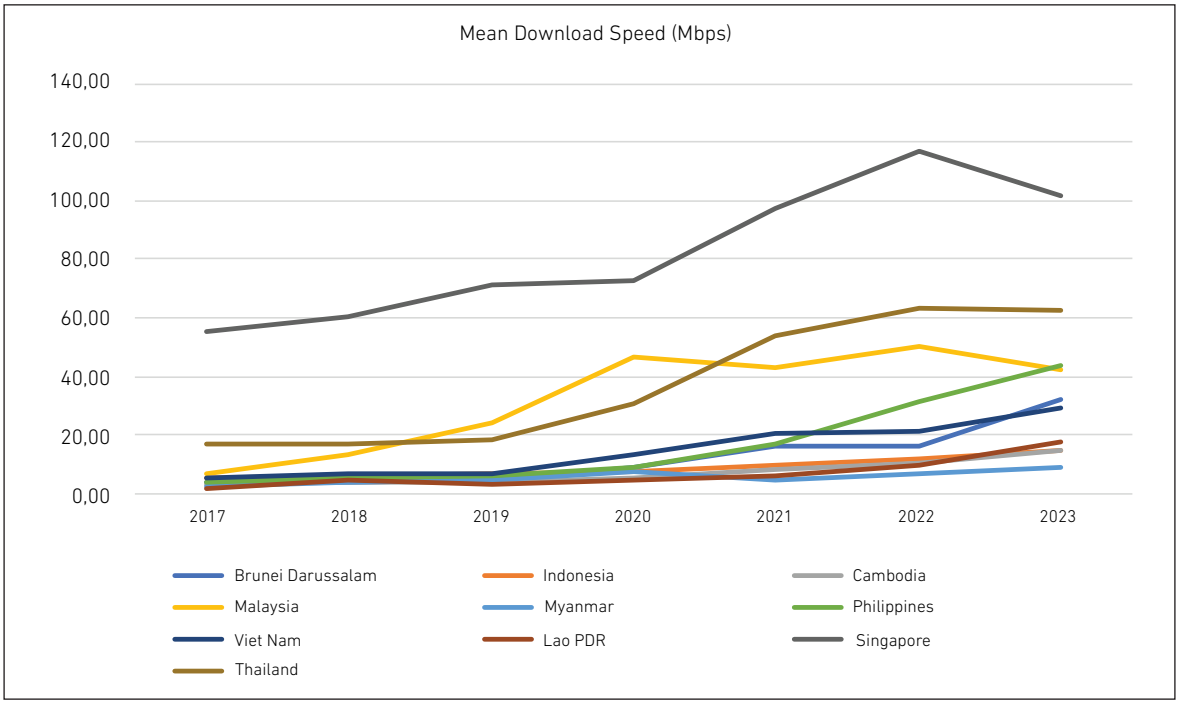
Source: World Bank (2023).

The World Bank (2018) projected that Indonesia would face a shortage of 9 million skilled and semi-skilled information and communication technology (ICT) workers in 2015–2030. However, in 2015–2019, Indonesia had the second-lowest number of STEM graduates in ASEAN (Figure 3.8). Despite the government's efforts over the past decades to create as many STEM jobs as possible (Chen, 2009, as cited in Shin et al., 2018), and even with increased financial incentives for STEM workers (Shin et al., 2018), the challenge persists.

Challenges related to the network infrastructure and ecosystems are exacerbated by Indonesia's archipelagic geography, which has led to a digital divide. The country requires more base transceiver stations (BTS) to provide widespread internet access. However, corruption cases related to the provision of 4G BTS in the 3T (frontier, outermost, underdeveloped) areas in 2022 have hindered the expansion of telecommunication infrastructure, thereby hampering equitable internet access. Indonesia's topography affects internet penetration; people living in hilly or mountainous areas are less likely to access the internet than those in lowland areas (Ardianti et al., 2023; Deng et al., 2019). This disparity is linked to the insufficient internet infrastructure in these challenging terrains (Deng et al., 2019, as cited in Ardianti et al., 2023).

The quality of telecommunication infrastructure needs improvement, as evidenced by internet speed. In 2023, Indonesia had the second-slowest average download speed in ASEAN (Figure 3.9). Although Indonesia's average download speed has increased nominally, it still lags the faster growth seen in other ASEAN countries.

## Figure 3.9. Average Download Speed in ASEAN, 2017–2023

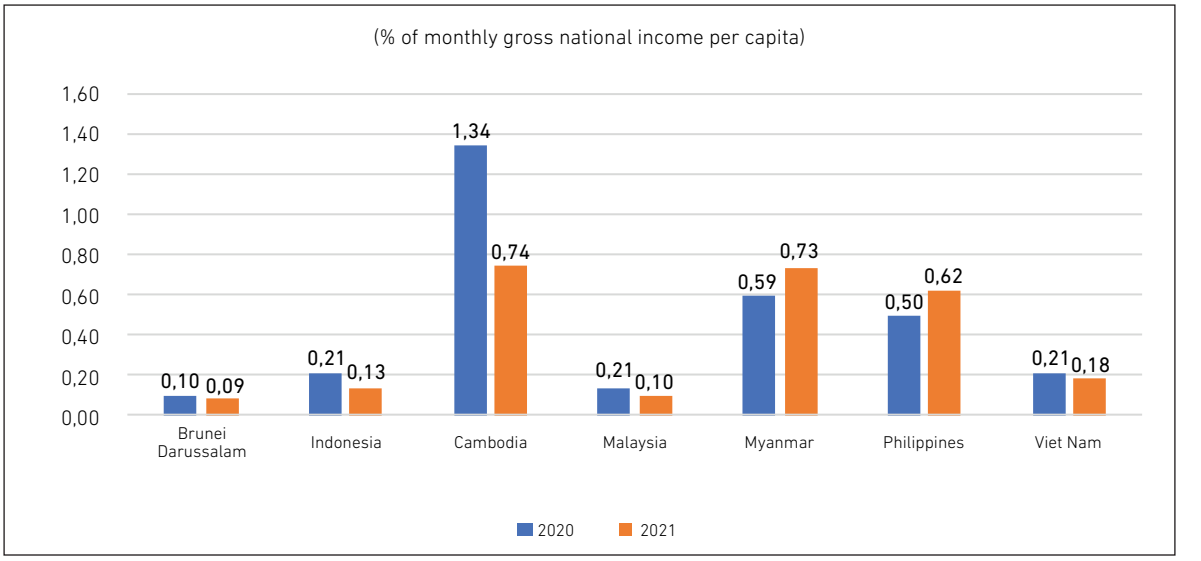



Lao PDR = Lao People's Democratic Republic.

Source: Cable (2023a).

This may be influenced by the low cost of internet services in Indonesia, which makes it challenging to improve the quality of telecommunication infrastructure. In 2021, Indonesia had the second most affordable internet tariff per 1 gigabyte amongst several ASEAN countries (Figure 3.10), and in 2020/2021, it had the fourth most affordable broadband cost in the region (Table 3.2).

## Figure 3.10. Internet Tariffs per 1 Gigabyte in Several ASEAN Countries, 2019–2021




Sources: Cable (2023b), World Bank (2022b).

## Table 3.2. Average Cost of Broadband per Month in Several ASEAN Countries, 2017–2021

(% of monthly gross national income per capita)

| Countries | 2017 | 2018 | 2019 | 2020/2021 |
|---|---|---|---|---|
| **Brunei Darussalam** | 12.70 | 5.44 | 6.04 | 5.40 |
| **Indonesia** | 24.42 | 9.08 | 9.55 | 9.35 |
| **Cambodia** | 51.33 | 30.48 | 28.50 | 29.49 |
| **Malaysia** | 5.31 | 3.56 | 3.48 | 3.69 |
| **Myanmar** | 63.06 | 18.87 | 28.86 | 22.89 |
| **Philippines** | 16.61 | 15.08 | 11.97 | 18.76 |
| **Viet Nam** | 27.13 | 4.53 | 4.33 | 4.21 |

Sources: Cable (2023c), World Bank (2022b).

Indonesia faces challenges related to data management and security, including national cybersecurity, data protection, and cross-border data flows. In terms of national cybersecurity, Indonesia has yet to secure patents for technological products. A Secure Code Warrior poll revealed that 86% of developers do not prioritise application security (Loviana, 2022). Despite the enactment of Law No. 27 of 2022 on Personal Data Protection, data breaches continued to occur in 2023, including the leakage of customer data from Sharia Bank (BSI) and the Directorate General of Population and Civil Registration (Dukcapil) under the Ministry of Home Affairs (DPR RI, 2023a; DPR RI, 2023b). From 1 January to 6 June 2023,

there were 19 reported cases of personal data protection failures (Kemenkominfo, 2023b). Cross-border data challenges are linked to a potential trilemma involving trade-offs between data mobility, personal privacy, security, and monetisation, with most countries able to achieve only two of these objectives (Rohman et al., 2022).

## 4. Digital Economy Policies and Regulations

The Ministry of Communication and Information, the Ministry of National Development Planning, and the Ministry of Industry are amongst the key institutions driving the core policies related to digitalisation. The Ministry of Communication and Informatics mainly aims to enhance digital connectivity and ensure universal access to high-quality networks and the Internet through efforts such as the development of telecommunication infrastructure. Specifically, the government, alongside the Ministry of Communication and Informatics, has implemented a strategic policy aimed at providing comprehensive internet coverage across Indonesia.

### Table 3.3. Policies on Internet Access

| Policy Issues | Regulations |
|---|---|
| Efforts to bridge the digital divide in areas lacking internet access have led to the implementation of various regulations. | • Presidential Regulation No. 96 of 2014 on Indonesian Broadband Plan 2014–2019<br>• Presidential Regulation No. 3 of 2016 on Accelerating the Implementation of National Strategic Projects<br>• Presidential Regulation No. 56 of 2018 on Second Amendment to Presidential Regulation No. 3 of 2016 on Accelerating the Implementation of National Strategic Projects<br>• Regulation of the Minister of Communication and Informatics No. 22 of 2015 on the Minister of Communication and Informatics Strategic Plan for 2015–2019<br>• Regulation of the Minister of Communication and Informatics No. 21 of 2016 on Amendment to Regulation of the Minister of Communication and Informatics No. 22 of 2015 on the Minister of Communication and Informatics Strategic Plan for 2015–2019 |
| Amendment to Law No. 32 of 2002 concerning Broadcasting (Broadcasting Law) and Law No. 36 of 1999 concerning Telecommunications (Telecommunications Law) are expected to increase the availability of frequencies for internet access in rural areas and increase efficiency.<br><br>Ultimately, these changes aim to make internet more affordable and improve its quality. | • Broadcasting Law<br>• Telecommunications Law |

Source: Bachtiar et al. (2020).

More specifically, digitalisation policies are supported by other ministries and institutions, including Bank Indonesia, the Financial Services Authority (OJK), the Agency for the Assessment and Application of Technology (BPPT), the National Cyber and Crypto Agency (BSSN), the Coordinating Ministry for Economic Affairs, the Ministry of Cooperatives and Small and Medium Enterprises, the Ministry of Industry, and the Ministry of Tourism and Creative Economy. Each institution has policies and regulations related to digitalisation tailored to its specific area of responsibility.

**Table 3.4. Specific Policies Regarding Digitalisation**

| Policy Issues | Regulations |
|---|---|
| National Data Center construction | Ministry of Communication and Informatics |
| Increasing people's digital literacy | |
| Creation of digital start-ups | |
| Policy and standardisation of competence in ICT | |
| | Ministry of Communication and Informatics<br>Ministry of Tourism and Creative Economy |
| BDE Incubation programme | Ministry of Tourism and Creative Economy |
| Development of innovation ecosystem, digital infrastructure, and industrial technology investment incentives 4.0 | Ministry of Industry |
| Harmonisation of Regulations and Industrial Policies 4.0 | Ministry of Industry |
| Formulation of Artificial Intelligence National Strategy | Agency for the Assessment and Application of Technology |
| Increasing digital literacy for micro, small, and medium-sized enterprises | Ministry of Tourism and Creative Economy,<br>Ministry of Cooperatives and Small and Medium Enterprises |
| Digitising cooperatives and micro, small, and medium-sized enterprises | Ministry of Cooperatives and Small and Medium Enterprises |
| Development and strengthening of the cybersecurity response team | National Cyber and Crypto Agency |
| Strengthening infrastructure, human resources, and cybersecurity regulations | |
| Banking digitalisation | Bank Indonesia |
| Indonesian payment system regulatory reform | |
| Increasing the capacity of human resources and the role of research in the financial services sector | Financial Services Authority |
| Development of digital financial sector ecosystem regulations | |
| Business process reengineering licensing, regulation, and supervision | |

Source: Rohman (2022).

However, the dispersion of these numerous policies and regulations across multiple institutions presents a significant challenge to the development of the digital economy. This issue is highlighted in Digital Indonesia Vision 2045, which underscores the need for greater integration and collaboration. Whilst Indonesia has developed various policies, regulations, road maps, and master plans in the digital sector initiated by multiple institutions, there has yet to be substantial progress in coordinating and synergising these efforts into a unified whole. For national digital development to succeed, the various pillars – digital infrastructure, digital economy, digital government, and digital society – must not be treated as separate entities with individual road maps.

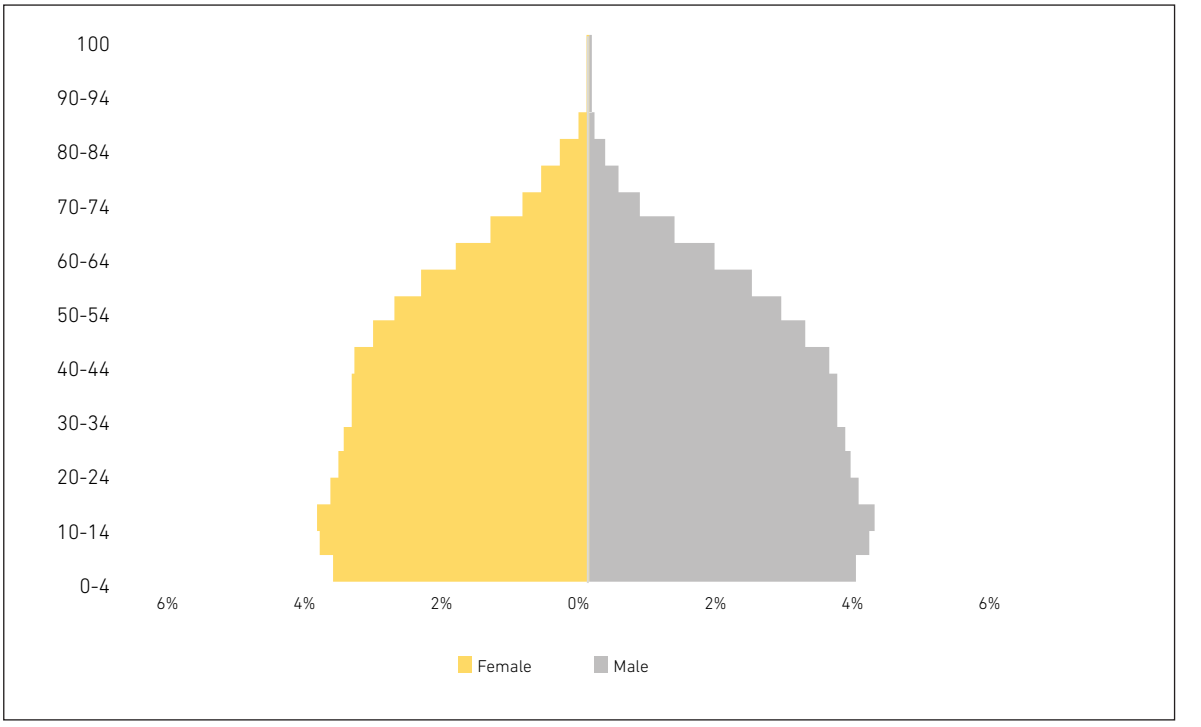
All ASEAN Member States, including Indonesia, may need to adopt regulations that strengthen the digital economy regionally. This could be achieved through initiatives such as the ASEAN Digital Community 2045, which would enable Member States to address regional challenges and fully realise their digital potential. Indonesia can play a key role in bringing ASEAN closer to a unified regional digital community by advocating for the ASEAN Digital Economy Framework Agreement. Singapore is the only ASEAN state to have implemented digital trade agreements, having signed the Digital Economic Partnership Agreement with Chile and New Zealand. Singapore has established several bilateral digital economy agreements with the Republic of Korea, Australia, and the United Kingdom.

## 5. Policy Recommendations

In 2022, Indonesia's population reached 275 million, with the demographic pyramid showing positive population growth (Figure 3.11). Younger people significantly outnumber the elderly, offering substantial potential. According to Ghoorah (2017), Gen Y is a highly digitally savvy group eager to adopt new technologies. It presents a valuable opportunity to enhance digital and financial literacy and increase the number of STEM graduates to bridge the digital talent gap. The government should prioritise training teachers in digital and financial literacy to ensure that these subjects are effectively taught. Improving critical thinking in teaching methods is essential to fostering innovation amongst students.

The vocational school curriculum could include a core area focused on several literacies, including tools and interfaces. This core area would cover computational basics, computer hardware, software and applications, networks, design, and augmentation. These skills involve understanding and using computer systems, hardware, applications, and elements of the created world. Such abilities relate to the fundamental principles of hardware and software in information technology, along with a basic understanding of computing design concepts and constraints.

**Figure 3.11. Indonesian Population Pyramid**




Source: Population Pyramid (2023).

Given Indonesia's archipelagic nature, satellite services offer a viable solution for improving network and internet access, providing an alternative for equitable telecommunication infrastructure deployment. The country has 17,508 islands, and satellite services are an efficient way to overcome geographical challenges and cover remote areas more effectively than fibre-based networks. However, the high costs associated with procuring satellites compared with land-based cellular networks cannot be overlooked. The Ministry of Communication and Information made a strategic move by launching the SATRIA-1 Satellite (Satelit Republik Indonesia) to bridge the digital divide. Opening the market for satellite internet services to foreign providers could prove more cost-effective than producing and launching state-owned satellites.

Indonesia must strengthen the enforcement of Law No. 27 of 2022 on Personal Data Protection. The government and developers should enhance the security of their applications, websites, and databases. Indonesians can improve personal protection measures by installing features such as Find My Device, anti-virus software, full disk encryption, data backups, and file shredding (Kemenkominfo, 2023a).

Finally, the various road maps, master plans, policies, and regulations governing the digital economy are spread across multiple institutions, underscoring a classic coordination issue. Establishing a single ministerial body, as Thailand has done, to orchestrate and synergise the digital economy could effectively address this challenge. Enhanced digital coordination in Indonesia could be achieved through the overarching vision of Digital Indonesia Vision 2045 under the supervision of the Ministry of Communication and Informatics. To further support the digital economy through international collaboration, the country could leverage the ASEAN Digital Community 2045, supervised by ASEAN. This programme would enable Indonesia to establish transparent coordination and traceability regarding the digital economy's status and development.

In addition to the ASEAN Digital Community 2045, Indonesia could strengthen international cooperation in the digital economy by adopting the Digital Economic Partnership Agreement framework. This framework aims to promote digital trade by regulating key aspects of the digital economy, including artificial intelligence, data flows and protection, and digital inclusion.

## References


Ardianti, D.M., D. Hartono, and P.A. Widyastaman (2023), 'Offline and hungry: the effect of internet use on the food insecurity of Indonesian agricultural households', *Agricultural and Food Economics*, 11(1), p.25.

Askar, M. W., B. Ouattara, and Y. F. Zhang (2020), 'Financial Literacy and Poverty Reduction: The Case of Indonesia (No. 1097)', *ADBI Working Paper Series.*

Bachtiar, P.P., R.A. Diningrat, A.Z.D. Kusuma, R.A. Izzati, and A. Diandra (2020), *Ekonomi Digital untuk Siapa? Menuju Ekonomi Digital yang Inklusif di Indonesia* [Digital Economy for Whom? Towards an Inclusive Digital Economy in Indonesia]. Smeru Research Institute. https://smeru. or. id/id/publication-id/ekonomi-digital-untuk-siapa-menuju-ekonomi-digital-yang-inklusif-di-indonesia (accessed 7 October 2023).

Cable (2023a), *Worldwide broadband speed league 2023*. https://www.cable.co.uk/broadband/speed/worldwide-speed-league/ (accessed 10 October 2023).

Cable (2023b), *Worldwide Mobile Data Pricing: The cost of 1GB of Mobile Data in 237 Countries Measured from June to September 2023*. https://www.cable.co.uk/mobiles/worldwide-data-pricing/ (accessed 10 October 2023).

Cable (2023c), *Global Broadband Pricing League Table 2023*. https://www.cable.co.uk/broadband/pricing/worldwide-comparison/ (accessed 10 October 2023).

Deng, X., D. Xu, M. Zeng, and Y. Qi, (2019), 'Does internet use help reduce rural cropland abandonment? Evidence from China', *Land Use Policy*, 89, 104243.

Dewan Perwakilan Rakyat Republik Indonesia [The House of Representatives of the Republic of Indonesia] (2023a). *Kebocoran Data BSI, OJK Diminta Jalankan Fungsi Akselerasi Digitalisasi Seluruh Bank* [BSI Data Leaked, OJK Asked to Run the Function of Accelerating Digitalization of All Banks]. https://www.dpr.go.id/berita/detail/id/44937/t/Kebocoran+Data+BSI%2C+OJK+Diminta+Jalankan+Fungsi+Akselerasi+Digitalisasi+Seluruh+Bank (accessed 29 October 2023).

Dewan Perwakilan Rakyat Republik Indonesia [The House of Representatives of the Republic of Indonesia] (2023b), *Perlu Dilakukan Upaya Luar Biasa Kebocoran Data Penduduk Terjadi Berulang Kali* [Extraordinary Efforts Needed, Population Data Leakage Occurs Repeatedly]. https://www.dpr.go.id/berita/detail/id/45612/t/Perlu%20Dilakukan%20Upaya%20Luar%20Biasa%20Kebocoran%20Data%20Penduduk%20Terjadi%20Berulang%20Kali (accessed 29 October 2023).

Ghoorah, T. (2017), Generation Y: Digital Slaves or Digitally Empowered?. Social Science Research Network.

Google, Temasek, Bain & Company (2023), Economy SEA 2022. *Country Spotlight: Indonesia*. https://services.google.com/fh/files/misc/e_conomy_sea_2023_report.pdf (accessed 19 October 2023).

International Telecommunication Union (2018), Measuring the Information Society Report 2018 (Vol 1), International Telecommunication Union.

Kemenkominfo [Ministry of Communication and Informatics] (2023a), *Status Literasi Digital di Indonesia 2022* [Digital Literacy Status in Indonesia 2022]. https://web.kominfo.go.id/sites/default/files/ReportSurveiStatusLiterasiDigitalIndonesia2022.pdf (accessed 9 October 2023).

Kemenkominfo [Ministry of Communication and Informatics] (2023b), *Perkembangan Penanganan Dugaan Kebocoran Data Paspor 34,9 Juta Warga Indonesia* [Progress in Handling Alleged Leakage of Passport Data of 34.9 Million Indonesians]. https://www.kominfo.go.id/content/detail/50065/siaran-pers-no-138hmkominfo072023-tentang-perkembangan-penanganan-dugaan-kebocoran-data-paspor-349-juta-warga-indonesia/0/siaran_pers (accessed 9 October 2023).

Kementerian PPN/Bappenas [Ministry of National Planning and Development] (2019), Indonesia 2045: Berdaulat, Maju, Adil, dan Makmur [Indonesia 2045: Sovereign, Developed, Equitable and Prosperous]. Kementerian Perencanaan Pembangunan Nasional / Badan Perencanaan Pembangunan Nasional.

Kementerian PPN/Bappenas [Ministry of National Planning and Development] (2022), *Rencana Induk Pengembangan Industri Digital Indonesia 2023–2045* [Indonesia Digital Industry Development Master Plan 2023–2045]. Kementerian Perencanaan Pembangunan Nasional / Badan Perencanaan Pembangunan Nasional.

Loviana, K. (2022), *Cybersecurity and Cyber Resilience in Indonesia: Challenges and Opportunities*. https://cfds.fisipol.ugm.ac.id/wp-content/uploads/sites/1423/2022/05/Commentaries-Cybersecurity-and-Cyber-Resilience-in-Indonesia-English-2.pdf (accessed 13 October 2023).

Momentum Works (2023a), *E-commerce in Southeast Asia 2023.* https://momentum.asia/product/ecommerce-in-southeast-asia-2023/ (accessed 15 September 2023).

Momentum Works (2023b), *Food Delivery Platforms in Southeast Asia 2023*. https://momentum.asia/product/food-delivery-platforms-in-southeast-asia-2023/ (accessed 15 September 2023).

Otoritas Jasa Keuangan [Financial Services Authority] (2022), *2022 National Financial Literacy and Inclusion Survey*. https://www.ojk.go.id/iru/policy/detailpolicy/9625/press-release-2022-national-financial-literacy-and-inclusion-survey (accessed 14 October 2023).

Population Pyramid (2023), *Population Pyramid Indonesia 2022*. https://www.populationpyramid.net/indonesia/2022/ (accessed 1 October 2023).

Rohman, I. K., R. R. Ronaldo, M. A. Prabowosunu, and R. Melati (2022), *G20: Indonesia's stand on cross-border data flow*. https://ifgprogress.id/g20-indonesias-stand-on-cross-border-data-flow/ (accessed 14 October 2023).

Statista (2022), *Indonesia: Total population from 2018 to 2028 (in million inhabitants)*. https://www.statista.com/statistics/294100/total-population-of-indonesia/ (accessed 1 October 2023).

Shin, S., A. Rachmatullah, F. Roshayanti, M. Ha, and J.K. Lee (2018), 'Career motivation of secondary students in STEM: a cross-cultural study between Korea and Indonesia', *International Journal for Educational and Vocational Guidance*, 18, pp.203–31.

World Bank (2018), *Preparing ICT Skills for Digital Economy: Indonesia within the ASEAN context*. https://blogs.worldbank.org/sites/default/files/preparing_ict_skills_for_digital_economy-revised_7mar2018.pdf (accessed 12 October 2023).

World Bank (2020), *Secure Internet Servers.* https://data.worldbank.org/indicator/IT.NET.SECR (accessed 1 October 2023).

World Bank (2022a), *Individuals using the Internet (% of population).* https://data.worldbank.org/indicator/IT.NET.USER.ZS (accessed 23 September 2023).

World Bank (2022b), *GNI per Capita (Constant 2015 US$)*. https://data.worldbank.org/indicator/NY.GNP.PCAP.KD (accessed 1 October 2023).

World Bank (2023), *Percentage of graduates from Science, Technology, Engineering and Mathematics programmes in tertiary education, both sexes (%).* https://databank.worldbank.org/US-STEM-(ISCED-and-Tertiary)/id/cd77ac48 (accessed 1 October 2023).

World Economic Forum (2019), *Global Competitiveness Index 4.0 (Digital skills among active population).* https://prosperitydata360.worldbank.org/en/indicator/WEF+GCI+EOSQ508 (accessed 17 October 2023).