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Digital Transformation Landscape in Indonesia

Digital
Transformation
Center Indonesia

Digital Transformation Landscape in Indonesia

Project Digital Transformation Center (DTC) and Make-IT Indonesia
On behalf of GIZ Indonesia and Bappenas

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Introduction to the DTC and the Make-IT Program

On behalf of the German Federal Ministry for Economic Cooperation and Development (BMZ), the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH implements the Global Digital Transformation Program to develop innovative BMZ flagship projects on a global scale. The digital ecosystems of partner countries are supported under the "Digital Transformation" flagship activities. The Digital Transformation Centre (DTC) and Make-IT Indonesia are part of this global initiative and support Indonesia's digital transformation efforts in conjunction with the Ministry of National Development Planning (*Kementerian Perencanaan Pembangunan Nasional*)/National Development Planning Agency (*Bappenas*). The project's overall goal is to reduce the digital divide, reduce inequalities, and provide all groups of people with equal opportunities to benefit from the prospects of digitalisation while allowing them to assess the risks independently.

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EXECUTIVE SUMMARY

1. Indonesia is one of the world's top 20 largest economies, with a gross domestic product (GDP) of Rp19,588.4 trillion in 2022 and an economic growth rate of 5.31% (2022). Indonesia's GDP is dominated by the processing industry (18.34%), the trade sector (12.85%), and the agricultural sector (12.4%). A deeper examination shows that the three business sectors that provide the most significant value to Indonesia's GDP are the agriculture, animal husbandry, hunting, and agricultural services sector (extractive agrarian businesses); the coal and lignite mining sector (extractive mining businesses); and the food and beverage industry (industries with low R&D and technology intensity). This indicates that **Indonesia's economic structure still relies on extractive industries (natural resource extraction) and products from low technology industries.**
2. **To realize the *Indonesia Emas 2045* vision, the country must rely on knowledge and innovation to shift its extraction-driven economy towards an inclusive and knowledge-based economy. Therefore, mastery of science and technology, especially digital technology, has become increasingly urgent.**
3. **Digital transformation has become an issue of concern and lies at the core of the economic transformation efforts launched by the Indonesian government.** For the past four years, the COVID-19 pandemic has accelerated digital transformation efforts not only in Indonesia but also worldwide. It has also highlighted the importance of digital technology in our daily lives. After the pandemic, digital transformation can potentially help return the economy to its "normal" state and encourage a more resilient, green, and inclusive economy to face long-term changes/problems.
4. **This study has two objectives:**(a) to provide a **portrait of the digital transformation efforts in Indonesia.** It examined three sectors to achieve this goal: Industry 4.0, digital agriculture, and clean/green technologies. Additionally, this study investigated digital transformation in three other countries, namely Nigeria, Türkiye, and Vietnam, to obtain an idea of Indonesia's position at the global level and b) **to provide input on the draft of the 2025-2029 National Medium-Term Development Plan/NMTDP (*Rencana Pembangunan Jangka Menengah Nasional/RPJMN*)** for the digital transformation field.
5. This study's central question is: **"To what extent does digital transformation has progressed in Indonesia?"**. To answer this question, this study adopted the World Bank's (2016) framework on digital transformation stages. The portrait of Indonesia's digital transformation can be seen from the interaction between digital technology and three analogue complements: **regulatory frameworks** (regulations), **institutional frameworks** (institutions), and **human capital.** Additionally, digital transformation progress is assessed by how a country ensures that **digital safeguards** components are available.
6. The general regulatory frameworks for digital transformation in Indonesia, Nigeria, Türkiye, and Vietnam have the common goal of **boosting economic productivity and encouraging bureaucratic transformation.**
7. **The regulatory framework for increasing economic productivity through digital transformation is primarily regulated through the 2020-2024 NMTDP, ratification of Law No. 11/2008 (UU ITE), and Regulation Implementation for Government Regulation No. 71/2019 (PP PSTE).** In the economic sector, digital transformation was directed to increase the value of e-commerce transactions from Rp 170 trillion in 2018 to Rp 600 trillion in 2024. The 2025-2045 NMTDP policy package is employed to increase national economic productivity and achieve the Golden Indonesia 2045 vision. One of the strategies in the package is to encourage the use of digital transformation in the country's most productive sectors and to increase its

accessibility to all communities. The steps to drive digital transformation include developing a digital super platform, achieving 100% quality digital access throughout Indonesia, improving digital literacy, and digitalising various fields, including modernising and digitalising agriculture, developing digital talent, and advancing digital research and development (R&D).

8. **Digitalisation in the public sector has also become the focus of the Indonesian government's bureaucratic reform.** This effort began with building a working mechanism for the Electronic-Based Government System/EBGS (*Sistem Pemerintahan Berbasis Elektronik/SPBE*) framework regulated through Presidential Regulation No. 95/2018. The main objective is to achieve clean, effective, transparent, and accountable governance, as well as provide high-quality and reliable public services. In addition, Regulation No. 132/2022 on the EBGS Architecture strengthens the implementation of the EBGS because it contains policy directions and strategies regarding data integration, supporting infrastructure, and EBGS security. Bureaucratic transformation is also encouraged through integrated policies disclosed in Presidential Regulation No. 39/2019 concerning the One Data Initiative and Presidential Regulation No. 23/2021 concerning the One Map Policy.
9. **In addition to regulatory frameworks applicable to multiple sectors, sector-specific regulatory frameworks are needed.** In the Industry 4.0 sector, the regulatory framework for digital technology adoption incentive schemes must be the focus of attention. In the digital agriculture sector, budget/investment alignment for digital technology development has yet to appear on the government's agenda. Meanwhile, in the clean/green technology sector, the regulatory framework relating to investment schemes for new and renewable energy development is still an issue. The application of digital technology for promoting clean/green technology is also yet to be addressed.
10. The main digital transformation policies in the Industry 4.0 sector are outlined in the **Making Indonesia 4.0 policy, which aims to develop seven manufacturing sectors: food and beverage, automotive, chemical, textile, textile products, electronics, pharmaceuticals, and medical devices.** Through this policy, the government has launched ten priority strategies to encourage Industry 4.0 and drive Indonesia to become one of the ten largest economies in the world. The government has also designed assistance schemes to encourage industries/companies to use Industry 4.0 technology in their business processes. The scheme includes subsidies, corporate tax breaks, and import tax exemptions. However, the **implementation of Making Indonesia 4.0 has faced several challenges**, such as, among others: 1) Only 6% of manufacturing industries have implemented Industry 4.0 technology. Meanwhile, 64% of industry players are still in the Industry 3.0 phase or digitisation stage; 2) The average readiness of large industries to transform towards Industry 4.0 is still at a moderate level. One of the reasons for this condition is that the investment in Industry 4.0 technology is considered too large and unsuitable for some companies.
11. **One of Indonesia's regulatory frameworks in the digital agriculture sector is the Ministry of Agriculture's 2020-2024 Strategic Plan document (*Renstra Kementerian Pertanian 2020-2024*).** Unfortunately, the implementation of these regulations has not been effective. After analysing the experiences of other countries, we found that agricultural digitalisation in Indonesia can be instigated by focusing on the digital technology research and development agenda, mapping priority technologies and allocating resources, creating digital agriculture pilot zones, and considering special budget allocations for agricultural digital technology development.
12. **In the clean/green technology sector, no regulatory framework has been found that specifically encourages the use of digital technology.** The regulations in this sector are still focused on two main agendas: energy conservation, regulated through Government Regulation No. 33/2023, and energy transition to new and renewable energy, regulated through Presidential Regulation No. 11/2022.

13. **Two aspects of institutional frameworks drive digital transformation efforts: (1) the key actors who play a role in digital transformation and (2) the physical infrastructure that supports digital technology usage in various sectors.** Six actors play a role in digital transformation: the government, business actors, development partners, education and training institutions, civil society, and the media. The collaborative role of multi-stakeholders is one of the determinants of the success rate of digital transformation.
14. **An institutional challenge in accelerating digital transformation efforts includes the prevalence of the silo mentality, which hinders cross-actor coordination,** especially in government entities. Digital transformation institutions in the government sector are built through three main architectures: the EBGs, the One Data Initiative, and the One Map Policy. Due to data alignment, these three architectures are expected to enable governance between the central and regional agencies to run in an integrated manner. The establishment of EBGs coordination teams at various levels of government is important to oversee and ensure the accuracy of the use of digital technology. So far, EBGs implementation has only been interpreted and implemented as creating applications. Thus, each government agency has developed its respective applications, amounting to 27,000 public service applications. Most of these have similarities and overlap with one another. Many of these applications also have implications on the issue of storing important public service data across various databases. Additionally, there is also budget waste because these applications were developed by third parties/vendors. The government's challenge in this case is to streamline the thousands of existing public service applications.
15. **Digital transformation will only happen when supported by physical infrastructure and digital infrastructure.** In terms of availability, the information technology infrastructure in Indonesia is considered competitive as it has three layers of primary infrastructure: the backbone network, which was built through the Palapa Ring project; the middle mile – through the launch of SATRIA-1; and the last mile through the construction of the BTS (Base Transceiver Station) or transmitting station. Nevertheless, there are still some challenges with accessibility, such as the issue of equalisation, especially in the 3T (Forefront, Outermost, and Disadvantaged) regions, and the issue of internet speed quality and network coverage.
16. **Indonesia also still faces challenges regarding the digital skills gap due to the country's lack of skilled and competitive workforce in the digital field.** Several capabilities are considered for measuring human resource capacity to adapt to digital transformation, such as innovation, competitiveness, research capabilities, and empowerment. Digital capacity or expertise is the ability to cope with digitalisation, determined by the capacity of the country's human resources or its existing digital talent. In this case, human resource capacity is defined as intellectual capital that creates a competitive advantage in digital transformation efforts that contribute to development.
17. For the **educational aspect**, Indonesia faces the following challenges: educators' perception of digitalisation is still too focused on technical capacity instead of also focusing on the social aspects of digitalisation, and the education system - especially vocational education – has been unable to address and anticipate digital technology development. Some of the efforts made by the government to improve aspects of education include improving digital literacy, increasing digitalisation in schools, revitalising vocational education and training, and providing scholarships for ICT education.
18. For the **training aspect**, there are already various training initiatives related to digital capabilities from various ministries. However, synergy between actors is still needed for initiatives from fellow government and non-government actors. The government's most developed training initiative is the EdTech platform, which provides online and offline training to increase the workforce's capabilities. In addition, the government has initiated start-up ecosystem-focused training

initiatives through a digital academy organised by the Ministry of Communication and Information (*Kementerian Komunikasi dan Informatika*).

19. For the **employment aspect**, the Indonesian National Work Competence Standard/INWCS (*Standar Kompetensi Kerja Nasional Indonesia/SKKNI*) is used to measure workers' competence. The government uses the INWCS as a foundation to map jobs required by sectoral needs in Indonesia. Only three INWCS can be used as a reference for professionals and industries (including professional certification bodies) in the communication, telecommunications, and information sectors. Unfortunately, the three INWCS focus on unskilled and semi-skilled workforce and do not target a workforce with more advanced skills.
20. For the **cultural aspect**, using digital technology can increase productivity and reduce social inequality through better access to public services. Digital technology can also improve well-being and potential by broadening human insight and cognition. Conversely, digital technology – especially concerning internet use behaviour – can have negative impacts on mental health, such as depression and anxiety disorders. Generally, responsible digital technology usage in Indonesia still needs to be improved. The country's high ICT capability has not been balanced with innovation, creativity, and wisdom in its usage. Some cultural challenges regarding digital technology usage include internet ethics issues (netiquette), community perspectives on digitalisation, the digital literacy gap, and issues regarding digitalisation and work culture.
21. In the country's efforts to drive digital transformation, **Indonesia must also prepare digital safeguards**. There are three things to consider in digital safeguards: 1) privacy policies, 2) social protection, and 3) antitrust policies.
22. **Privacy policy issues are often raised because they relate to security and data protection**. The currently enforced regulation concerning data privacy in Indonesia is the Personal Data Protection Law, passed in 2022. However, there is still much work to do to ensure that the law is implemented well. Each actor, from governments and private companies to individuals, has its share in realising effective privacy policies regarding regulation, compliance, and knowledge about digital security.
23. **Another problem that arises from technology adoption is social protection, especially labour issues due to the loss of certain types of jobs, job cuts, and the emergence of new work models**. There are three types of impacts on employment: direct, indirect, and induced. Due to these impacts, there is an urgency for the government to provide a safety net for people affected by this digital transition. So far, the Indonesian government has provided two programs to address this issue: Job Loss Insurance and the Pre-employment Card. Both programs offer assistance through incentives, guidance, and training for the targeted workforce.
24. **Another issue highlighted in digital safeguards is business competition, as digitalisation allows digital-based companies to dominate the market with their extensive and multifaceted networks**. Digital economy platforms are also more likely to conduct unhealthy business activities. An example would be transportation platforms and e-commerce and their impact on conventional businesses. Unfortunately, Indonesia - and many other countries - still cannot accommodate healthy business competition amid a changing digital economy. Thus, countries must find a balance so that antitrust policies can encourage technological development without damaging conventional markets.
25. This study produced **three recommendations for improving Indonesia's regulatory, institutional, and funding frameworks in promoting digital transformation**. First, for the regulatory framework, this study recommends that the government 1) encourage a healthy and conducive business and investment climate and 2) optimise the potential of digital technology toward social, economic, and bureaucratic transformation. Second, for the institutional framework, this study proposes that the government 1) align digital transformation efforts, 2) foster digital leadership, 3) foster a healthy digital culture and a climate of multi-stakeholder

collaboration, 4) increase digital capacity, and 5) ensure a social safety net for those affected by digitalisation. Lastly, for the funding framework, this study suggests that the government 1) foster an investment climate conducive to digitalisation and 2) expand funding schemes for digital capacity building.

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GLOSSARY

AI	<i>Artificial Intelligence</i>
BSSN	<i>Badan Siber dan Sandi Nasional/National Cyber and Crypto Agency</i>
Iptek	<i>Ilmu pengetahuan dan teknologi/Science and Technology</i>
Kemendikbudristek	<i>Kementerian Pendidikan, Kebudayaan, Riset, dan Teknologi/Ministry of Research, Technology, and Higher Education Indonesia</i>
Kemenkes	<i>Kementerian Kesehatan/Ministry of Health</i>
Kemenkeu	<i>Kementerian Keuangan/Ministry of Finance</i>
Kemenperin	<i>Kementerian Perindustrian/Ministry of Industry</i>
Kementan	<i>Kementerian Pertanian/Ministry of Agriculture</i>
Ministry of National Development Planning/Bappenas	<i>Kementerian Perencanaan Pembangunan Nasional/Badan Perencanaan Pembangunan Nasional/Ministry of National Development Planning/National Development Planning Agency</i>
Kemkominfo	<i>Kementerian Komunikasi dan Informatika/Ministry of Communication and Informatics</i>
Kemnaker	<i>Kementerian Ketenagakerjaan/Ministry of Manpower</i>
Litbang	<i>Penelitian dan pengembangan/Research and Development</i>
Permenkes	<i>Peraturan Menteri Kesehatan/Ministry of Health Regulation</i>
Permenkeu	<i>Peraturan Menteri Keuangan/Ministry of Finance Regulation</i>
Perpres	<i>Peraturan Presiden/Presidential Regulation</i>
PP	<i>Peraturan Pemerintah/Government Regulation</i>
RPJMN	<i>Rencana Pembangunan Jangka Menengah Nasional/National Medium-Term Development Plan</i>
RPJPN	<i>Rencana Pembangunan Jangka Panjang Nasional/National Long-Term Development Plan</i>
UU	<i>Undang-Undang/Law</i>

The background is split diagonally from the top-left to the bottom-right. The upper-left portion is a solid dark blue, while the lower-right portion is a vibrant red. In the red area, there is a faint, semi-transparent image of a globe showing the continents of Asia and Australia. Overlaid on the globe and extending into the blue area are subtle, light-colored geometric patterns, including a network of interconnected dots and lines, and a hexagonal grid structure.

THE URGENCY OF DIGITAL TRANSFORMATION IN INDONESIA: INTRODUCTION

1. THE URGENCY OF DIGITAL TRANSFORMATION IN INDONESIA: INTRODUCTION

1.1 Background

1.1.1 A general context of Indonesia

Various indicators revealed that in 2023, Indonesia is a developing country with the potential to become a developed country. However, in its effort to become a developed country, Indonesia still faces challenges in various fields. In terms of population, Indonesia currently has the fourth largest population in the world¹. The nation's labour force is projected to be the largest in Asia in 2050 as the number of people in the productive age group (15-64 years) continues to increase and is expected to peak in 2050.² However, dependency rates have also increased along with the rising elderly population (65+ years).³ Demographic bonuses can turn into demographic curses if issues related to the quality of life, such as unequal access to education and health, extreme poverty, and basic needs are not addressed immediately.



Figure 1 Indonesia's Gross Domestic Product (GDP) in 2022 by business sector (%)

Source: Processed from (Badan Pusat Statistik, 2023d)

¹ After India, China, and the United States, with a population of 278,696 million people (Badan Pusat Statistik, 2023a).

² (Badan Pusat Statistik, 2023b).

³ Idem.

Indonesia is one of the top 20 largest economies in the world with a gross domestic product (GDP) at current prices of Rp19,588.4 trillion in 2022. Its economic growth is also 5.31% (2022), which is an increase from the previous year (3.7%).⁴ Indonesia's GDP is dominated by the manufacturing industry (18.34%), the trade sector (12.85%), and the agricultural sector (12.4%) (see Figure 1). A deeper examination shows that the three business sectors that provide the greatest added value to Indonesia's GDP are the agriculture, animal husbandry, hunting, and agricultural services sector (extractive agrarian businesses); the coal and lignite mining sector (extractive mining businesses); and the food and beverage industry (industries with low R&D and technology intensity⁵).^{6 7} This indicates that Indonesia's economic structure still relies on extractive industries (natural resource extraction) and products from low technology industries. In addition, Indonesia's GDP per capita in 2022 is 4,580 US dollars⁸, only about 30% of the world's average GDP per capita⁹. Although Indonesia was once declared an upper-middle-income country¹⁰, this status is still vulnerable to change (as what occurred during the COVID-19 pandemic) if Indonesia does not take advantage of opportunities and maintain its economic resilience. Therefore, it is becoming increasingly important for Indonesia to shift from a natural resource-based economy to a knowledge-based economy.¹¹

Furthermore, Indonesia needs to take an active role in tackling the climate crisis. Currently, Indonesia has committed to achieving Net-Zero Emissions (NZE) in 2060 or sooner.¹² However, the road to NZE in 2060 is not easy. In 2023 alone, there is still the ongoing issue of air pollution and forest and land fires. During the first half of 2023, 90 thousand hectares of land was affected by forest and land fires area in Indonesia, which produced more than 5.9 million tons of carbon dioxide equivalent (CO₂) emissions.¹³ Indonesia is also one of the top six countries that contribute to global air pollution.¹⁴ This air pollution issue has also had an impact on the increase in the top six respiratory disorders in Indonesia, resulting in a burden on the state budget worth IDR 10 trillion.¹⁵ Additionally, Indonesia is the world's 12th largest user of energy, most of which is sourced from coal and petroleum. Consistent with the coal and lignite mining sector being the second largest contributor to Indonesia's GDP, the country is also the largest exporter of coal in the world.¹⁶

⁴ (Badan Pusat Statistik, 2023c).

⁵ Product classification based on R&D intensity refers to the (OECD, 2016) classification. Meanwhile, the classification of manufacturing industries by technology refers to the (UNIDO, 2023) classification.

⁶ The agriculture, livestock, hunting, and agricultural services sectors contributed to 9.22% of the country's GDP in 2022. Specifically, the plantation sector contributed 3.76%, the coal and lignite mining sector 6.62%, and the food and beverage industry 6.32%.

⁷ (Badan Pusat Statistik, 2023d).

⁸ (Portal Informasi Indonesia, 2023)

⁹ The average world GDP per capita in 2022 will be 12,647.5 US dollars (World Bank, 2023).

¹⁰ Indonesia obtained the UMIC (upper-middle-income country) status in July 2020. However, the country dropped to becoming an LMIC (lower-middle-income country) again in 2021 due to the COVID-19 pandemic (Bloomberg, 2023).

¹¹ (Kementerian Ristek-BRIN, Kementerian PPN/Bappenas, & Kementerian PAN-RB, 2021).

¹² (Republic of Indonesia, 2022). The government of Indonesia submitted the Enhanced NDC document to the UNFCCC secretariat on September 23, 2023 (Reference Number S. 335/PPI/MPI/KLN019 /2022) in response to the mandate of the Paris Agreement. The adjusted achievement targets include increasing the unconditional target (by the country's own efforts) of emission reduction from 29% (as stated in the First NDF and Updated NDC Indonesia documents) to 31.89% and the conditional target (with international support) from 41% to 43.2%.

¹³ (CNBC Indonesia, 2023).

¹⁴ (BBC News Indonesia, 2023).

¹⁵ This figure indicates the costs incurred by the Healthcare and Social Security Agency due to six respiratory diseases – pneumonia, acute respiratory infections (Ari), asthma, tuberculosis, lung cancer, and chronic obstructive pulmonary disease (COPD) – in 2022. In 2023, the trend of these six diseases has increased. Consequently, the projected burden of the Healthcare and Social Security Agency (which is financed by the state budget) has also increased. (Sekretariat Kabinet RI, 2023).

¹⁶ (IEA, 2022).

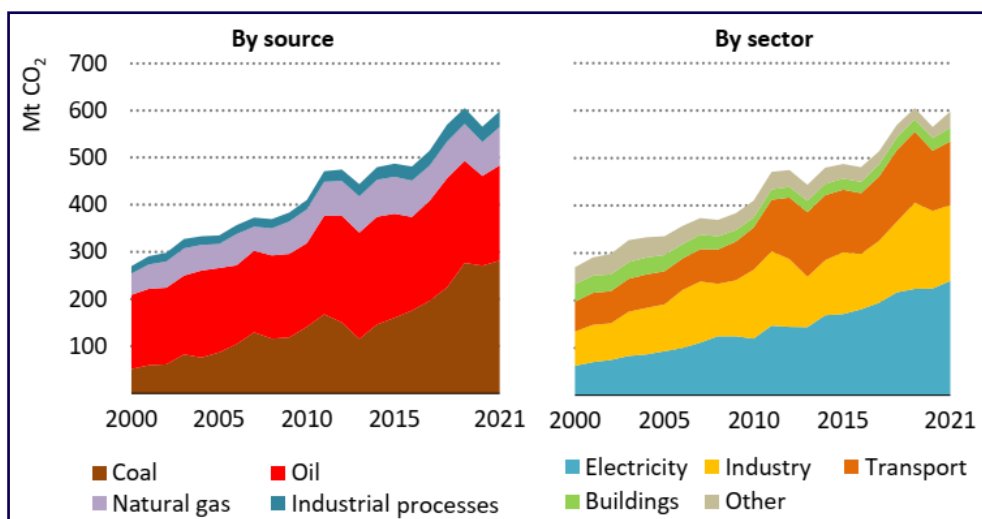


Figure 2 CO₂ emissions in Indonesia from the energy sector, 2000 – 2021

Source: (IEA, 2022)

The next two years (2024-2025) will be a period filled with critical moments for Indonesia as the country will hold democratic elections in 2024.¹⁷ Moreover, this period – which started in 2023 – is a post-COVID-19 pandemic recovery period.¹⁸ For the government, this is also a planning period.¹⁹ Therefore, various strategic plans formulated in this period will be a lever of change for the future of Indonesia for at least the next 20 years.

To achieve the *Indonesia Emas 2045* vision, Indonesia needs to rely on knowledge and innovation to shift its extractive-driven economy towards an inclusive and knowledge-based economy.²⁰ Thus, mastery of science and technology, especially digital technology, has become increasingly urgent.

1.1.2 The potential of digital technology

Along with the emergence of development challenges, science, and technology (and its implications) continue to develop at an even much faster pace. The development of science and technology is often an influential lever or enabler in societal changes, as seen with the agrarian revolution, the industrial revolution, and the information or digital revolution. The digital revolution is driven by the development of digital technologies, ranging from data processing and information technology to technologies that can transform and give rise to new business processes.

The difference between the digital revolution era and other eras is that technological developments occur much more rapidly. The following are some of the roles of digital technology in three sectors: industry, agriculture, and clean energy.

¹⁷ General elections for the president, members of the House of Representatives (DPR), members of the Regional Representative Council (DPD), and members of the Regional Legislative Council (DPRD) Levels I and II will be held on February 14, 2024. Regional head elections at the provincial and city/regency levels will be held simultaneously on November 27, 2024. The 2024 election implementation period started in 2023, making 2023 and 2024, as political years in Indonesia.

¹⁸ The COVID-19 pandemic status in Indonesia was officially revoked, and Indonesia was declared to have switched from a pandemic to an endemic period on June 21, 2023. (Presiden Joko Widodo, 2023).

¹⁹ 2024 is the end of the 2005-2024 NLTDP period and the 2020-2024 National Medium-Term Development Plan (NMTDP). The drafting process of the 2025-2045 NLTDP and 2025-2029 NMTDP began in 2023.

²⁰ (Kementerian Ristek-BRIN, Kementerian PPN/Bappenas, & Kementerian PAN-RB, 2021)

1) The industrial sector

The development of digital technology has driven the growth of Industry 4.0. Industry 4.0 is a term that describes the recent trends in automation and data communication technologies used by the manufacturing industry. Some of these technologies include big data, cloud computing, additive manufacturing (3D printing), robotics, blockchain, artificial intelligence, cyber-physical systems, and simulation & visualisation models.²¹

Industry 4.0 technologies can also be divided into two different layers depending on their objectives (see Figure 3). The first layer consists of front-end technologies. In this layer, technology interacts directly with operational and market needs. Manufacturing processes are transformed by emerging technologies (Smart Manufacturing) and changes are made in the product offering process (Smart Products), the process of sending raw materials and products (Smart Supply Chain), and new work processes through activities that utilise emerging technologies (Smart Working). Front-end technologies also use base technologies to provide it with the connectivity and intelligence it needs. These base technologies, such as the Internet of Things, Cloud, Big Data, and Analytics, are at the core of Industry 4.0.²²

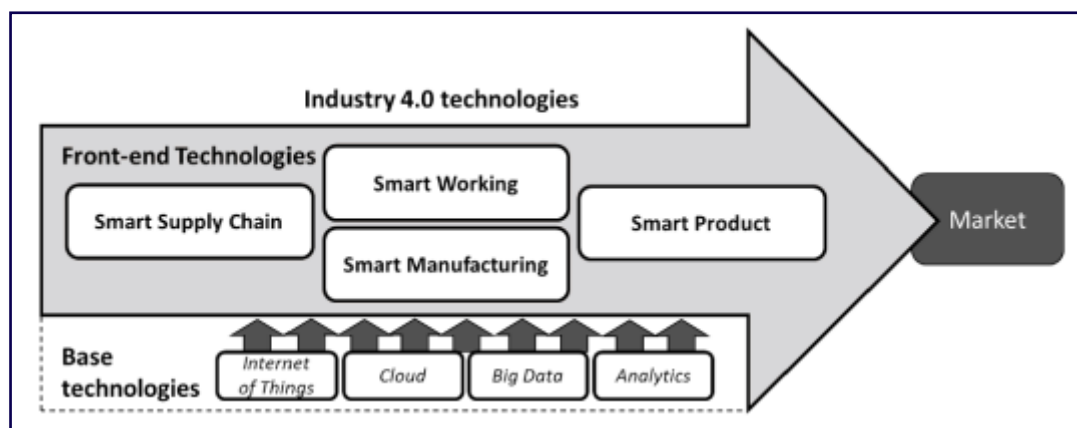


Figure 3 Theoretical framework of the Industry 4.0 technology

Source: (Frank, Dalenogare, & Ayala, 2019)

The following are three core technologies and nine fundamental technologies needed for successful Industry 4.0 implementation.²³

- a. Adaptive robotics
Adaptive and flexible use of robots combined with artificial intelligence will simplify the manufacturing process in producing a variety of products and components with higher specifications and greater detail.
- b. Embedded systems (Cyber-physical infrastructure)
Supporting technology is required to manage and coordinate between the network system's physical infrastructure and computational capabilities. Embedded systems integrate a physical reality into innovative functions, including computing and communications infrastructure.
- c. Additive manufacturing
Additive manufacturing comprises a set of technologies that produce three-dimensional objects directly from digital models through additive processes, primarily through the storage and incorporation of products with polymers, ceramics, or metals.

²¹ (UNIDO, 2023)

²² (Frank, Dalenogare, & Ayala, 2019)

²³ (Salkin, Oner, Ustundag, & Cevikcan, 2018)

- d. Cloud Technology
Cloud-based manufacturing (cloud manufacturing) can increase efficiency by reducing the costs caused by the production cycle and encouraging resource utilization in activities that are more focused on customer demand.
- e. Virtualisation technology (Virtual Reality (VR) & Augmented Reality (AR))
Virtualisation technologies based on AR and VR devices can integrate elements of real-world environments with augmented objects and provide useful additional information. Virtual information can help present other aspects of the real world and enrich the human perspective of reality through augmented objects and elements.
- f. Simulation
A variety of simulation models, including simulations of discrete events and 3D motion, can be run on various case studies to improve product or process planning. Simulation can be a tool that supports the visualisation of various parameter changes and decision-making processes.
- g. Data analytics & Artificial Intelligence (AI)
Due to the adoption of high-level knowledge and information technologies, enormous amounts of manufacturing data can be collected from various sources. This raises the need for rapid processing of large amounts of data from various sources and of various formats. Therefore, data analytics and AI can be used to help manufacturing companies process such data.
- h. Communication and Networks (Industrial Internet)
Communication and networks are described as the relationships between physical systems. The Industrial Internet of Things (IIoT) requires smart objects and networks. It also requires integrating physical objects and networks into manufacturing and service processes. The goal of IIoT is to give computers and machines the ability to view and run real-world applications to generate connectivity anytime, from anywhere, and for anyone and anything.
- i. RLTS and RFID Technology
Radio-frequency identification (RFID) and real-time location systems (RLTS) can provide added value to manufacturing and logistics processes. They add value because Smart Factories have various critical operations processes, such as logistics, transportation, and smart storage, that use logistics information and the efficient coordination of embedded systems. Auto-ID technology is used in the identification, location detection, and monitoring of objects and resources in the organisation and enterprise.
- j. Cyber security
Industry 4.0 requires intensive data collection and processing activities. Therefore, the security of the data storage and transfer process is critical for companies.
- k. Sensors and actuators
Embedded systems in Industry 4.0 use a variety of sensors and actuators connected to the control unit.
- l. Mobile technology
Mobile devices are useful for companies to monitor their manufacturing system in a mobile way through Wi-Fi technology.

2) The agricultural sector

Digital technology in the agricultural sector enables farmers and fishermen to have better control over the implementation of effective and efficient production processes. In agriculture, the adoption of digital technology has been developed through the smart farming programme, which relies on automating production activities. One example of the use of digital technology in agriculture is the development of Smart Farming Technology for young farmers managing the Grand Sakina Farm in Subang Regency, West Java Province.²⁴ Digital technology enables the watering and fertilising processes to be controlled

²⁴ (Hasanah, 2022)

directly with a device and the timing and doses can be set more precisely based on the crops' needs. In addition, drone technology has been used to photograph the plants' conditions so that intensive control can be performed to determine which plants lack nutrients and are affected by disease.

In the fisheries sector, the adoption of digital technology has been introduced through a digital village pilot project in Krimun and Puntang Villages, Indramayu, West Java Province.²⁵ The fishermen in these two villages used automatic feeders in their freshwater fish farming systems for more efficient feeding practices and reduced production costs. In addition to automation in the feeding process, digital technology helped fishermen or fish farmers access more competitive sales markets through digital markets. The following six digital technologies are needed to encourage the development of digital agriculture²⁶:

- a. Sensing technology or intelligent sensors
This technology helps farmers to know the condition of their land without having to go directly to the field. Intelligent sensors can provide farmers with important information about the real soil content in their land, such as its nutrients, moisture levels, water content, and temperature levels. Sensing technology is also useful for fishermen to understand the condition of the water and the fish they are farming.
- b. Software applications
This technology plays a role in managing and processing data generated from intelligent sensor devices to make it easier to read and understand by farmers.
- c. Communication technology
Basic mobile telecommunications devices can be used to transmit information about the condition of agricultural land or cultivation and as a reminder of agricultural activities.
- d. GPS technology
GPS devices can be used to map land and determine its productivity.
- e. Hardware
Hardware such as drones can help automate work to improve the efficiency and effectiveness of the production process.
- f. Data Analysis
The system will analyse the data and information collected and the resulting analysis can be used as a reference for decision-making and predictions.

However, it is difficult to accelerate the adoption of digital technology in the agricultural sector. The first challenge is with human resources capacity, as most farmers or fishermen in Indonesia are of a generation that is unfamiliar with digital technology. In addition, as most of them are primary school graduates, this impacts their digital literacy – the ability needed to optimise the technology.²⁷ Therefore, extra effort is needed to introduce the use of digital technologies that can help the agricultural production process among farmers and fishermen. The second challenge is the weak digital infrastructure, especially in rural areas where agriculture and fishing are the main fields of employment. Additionally, not all farmers or fishermen have access to a device or smartphone as a tool to support digital agriculture.

3) The energy sector

The influence of the energy sector is cross-sectoral. Consequently, digitalisation in the energy sector will affect other sectors. There are at least three sectors that will be affected by changes in the energy sector: transportation, buildings and structures, and industry. Figure 4 demonstrates some of the

²⁵ (Ambari, 2019)

²⁶ (Anugrah, 2022)

²⁷ (Ma'unah, 2022)

potential impacts of digitalising the energy sector on these three sectors.²⁸ Nevertheless, different digital technologies face different levels of adoption and use challenges, and their impact varies by sector.²⁹

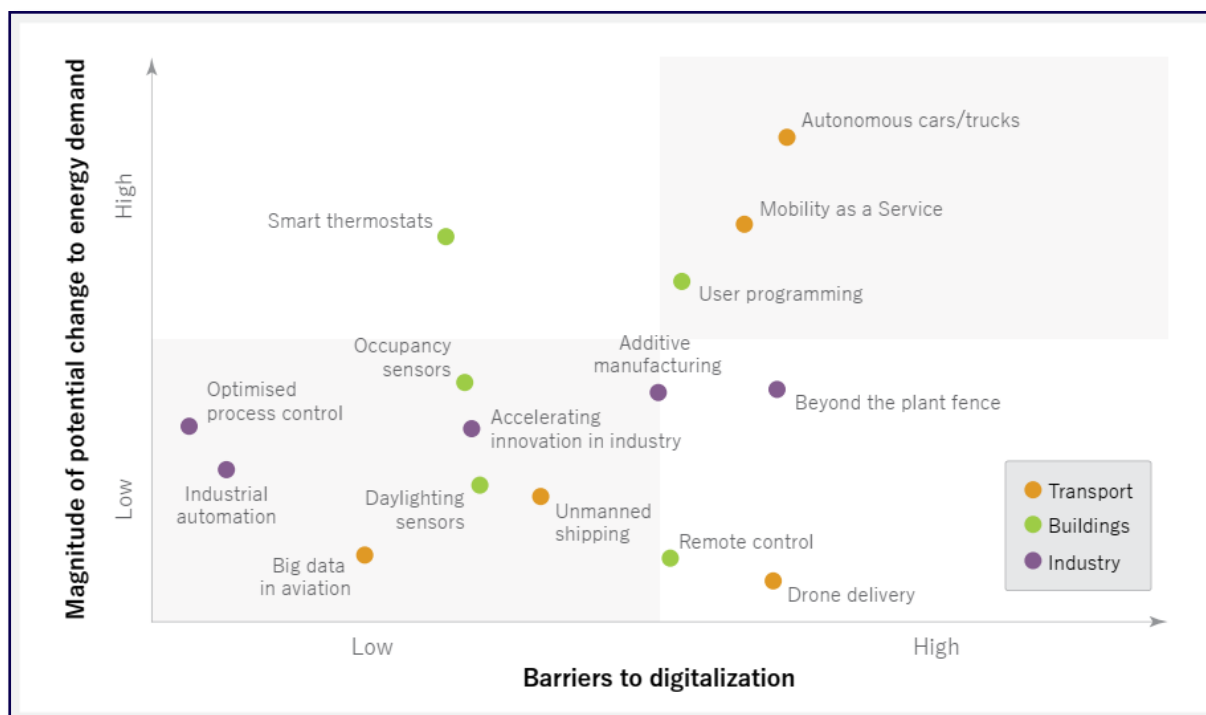


Figure 4 The potential impact of digitalisation on transportation, buildings and structures, and industries

Source: (IEA, 2017)

In general, the energy sector uses digital technology to improve energy efficiency. The following are some digital technologies used by the energy sector that have potential benefits in other sectors:

a. The transportation sector

The digitalisation of the transport sector (especially land transport) can affect energy needs. The combination of the vehicle's automation and shared mobility can improve the ratio between vehicle size and utility, thereby reducing energy use and emissions.

- **Sensors**
Digital technologies in the transport sector can help improve energy efficiency. Commercial aircraft and ships are now equipped with various sensors that generate large volumes of data. Big Data is used to help the pilot or crew to determine the most optimal travel route.
- **Global Positioning System (GPS)**
GPS technology allows shared mobility between vehicles (cars, motorcycles, bicycles) and benefits its users. This digital technology paved the way for the development of ride-hailing applications such as GoJek and Grab.
- **Automated driving technologies**
Automated driving technology uses a combination of sensors and high-level decision-making capabilities to drive vehicles. The higher the vehicle's level of automation, the lower the driver's stress level, thereby increasing the productivity level of the journey, which in turn increases energy efficiency.

²⁸ The figure is an illustration that aims to exhibit the potential of digitalisation in the energy sector. The "Magnitude of potential change to energy demand" axis indicates the scale of the impact of adopting a particular digital technology, be it positive or negative. Meanwhile, the "Barriers to digitalisation" axis indicates the technological, regulatory, and public perceptions that are constraints toward digital technology.

²⁹ (IEA, 2017)

- Teleworking
The teleworking or remote work culture - reinforced by the presence of an internet connection - also reduces the need for transportation, thereby reducing energy needs.
- b. The building and structures sector
Like the transport sector, digitalisation can help with smart energy governance in buildings and structures to lower energy requirements and increase user comfort.
 - Smart HVAC
Smart heating, ventilation, and air conditioning (HVAC) systems are one of the energy management systems in buildings and structures that are promising for energy efficiency efforts. Smart HVAC systems connect sensor technology, thermostats, and microcontrollers with the energy management system. Thus, energy use can be optimised according to various needs. Additionally, using smart meters in HVAC can help capture external signals, such as weather and price.
 - Smart meters
Smart meters can also be used to regulate various household electronic devices, such as washing machines, refrigerators, dishwashers, or water heaters.
 - Sensors
Sensors can also be used to help regulate the use of various electronic devices in the home, such as lighting systems and electronic cooking appliances. These sensors can help turn these devices off automatically when not in use.
- c. The industrial sector
The impact of digitalisation in the industrial sector will vary depending on the activity or digitalisation phase of the industry being automated. However, in general, the combination of various digital technologies will give rise to a wide range of potential energy efficiency methods in the industrial sector. Some of the digital technologies that can potentially be used in the industrial sector have been described [above](#).

1.1.3 Digital transformation for the *Indonesia Emas 2045* Vision

In the inauguration speech of the launch of the 2025-2045 National Long-Term Development Plan/NLTDP (*Rencana Pembangunan Jangka Panjang Nasional/RPJPN*) draft in Jakarta on June 15, 2023, President Joko Widodo conveyed the country's common goal of achieving the *Indonesia Emas 2045* Vision. Through the NLTDP draft's 8 development missions, 17 development directions, and 45 main development indicators (17-8-45), the president hopes that the drafted plan can “bring Indonesia to reach the *Indonesia Emas 2045* goal of becoming one of the five largest economies in the world”.³⁰

Digital transformation has become an issue of concern. It lies at the core of the economic transformation efforts launched by the Indonesian government.³¹ For the past four years, the COVID-19 pandemic has accelerated digital transformation efforts not only in Indonesia but also worldwide³². The COVID-19 pandemic has also highlighted the importance of digital technology in our lives. After the pandemic, digital transformation can potentially help return the economy to “normal” and encourage a more resilient, green, and inclusive economy to long-term changes/problems.³³

³⁰ (Presiden Joko Widodo, 2023)

³¹ (Widyasanti, 2023a)

³² (UNDP, 2020)

³³ (UNDP, 2020)

1.2 Overview of the “Digital Transformation Landscape in Indonesia” study

1.2.1 Research objectives

This study has two objectives:

- To provide a portrait of Indonesia’s digital transformation efforts. The study examined three sectors to achieve this goal: Industry 4.0, digital agriculture, and clean/green technologies. Additionally, this study investigated digital transformation in three other countries, namely Nigeria, Türkiye, and Vietnam to obtain an idea of Indonesia's position at the global level.
- To provide input on the 2025-2029 National Medium Term Development Plan (NMTDP) draft for the field of digital transformation.

1.2.2 Research questions

The following is the main question addressed in this study:

“To what extent has digital transformation progressed in Indonesia?”

This study adopted the World Bank’s (2016) framework on digital transformation stages to answer the main question above. The World Bank states that a country's digital transformation progress can be determined by analysing the interactions between digital technology and three analogue complements: regulatory frameworks (regulations), human capital, and institutional frameworks (institutions).³⁴ Additionally, digital transformation progress is assessed by how a country ensures that digital safeguards components are in place. Further explanations of each analogue complement in digital transformation can be found in Chapters 2, 1, and 1, while an explanation of digital safeguards aspects can be found in Chapter 1. The World Bank framework above is used as a reference in providing a portrait of digital transformation efforts in Indonesia. Thus, this study's results can be used as input for policymakers on aspects that need to be developed and improved to encourage digital transformation in general and in Industry 4.0, digital agriculture, and clean/green technology sectors.

1.2.3 Research methodology and limitations

This study employs a qualitative approach. Secondary data were obtained through literature studies on documents released by the government, international development partners, and other relevant non-governmental research institutions and national media articles. Secondary data includes literature on digital transformation, Industry 4.0, digital agriculture, and clean/green technology for the Indonesian context and the context of the three comparison countries (Nigeria, Türkiye, and Vietnam). The retrieval of primary data related to Indonesia was performed through a series of in-depth interviews with government and non-government sources. The primary data and secondary data were then analysed with a thematic approach in accordance with the digital transformation framework. The research design is described in the following table:

³⁴ (World Bank, 2016)

Table 1 Research design

Aspect	Guiding questions	Investigation Area	Instruments
Regulatory framework (rules)	How do the enforced rules/structures (regulatory framework) align with the development of digital technology?	Policies and regulations related to the business climate, such as ease of opening/closing a business, investment policies, business competition rules, sector-related policies, etc.	<ul style="list-style-type: none"> ▪ Literature study ▪ In-depth interviews
Human capital (skills)	How is the country's HR capacity currently adapting to the presence of automation and digital technology?	<ul style="list-style-type: none"> ▪ The education and training systems in effect ▪ Job market demand and supply ▪ Education policy ▪ Vocational policy ▪ Literacy, especially digital literacy 	
Institutional framework (institutions)	How can existing institutional arrangements encourage the adoption of digital technology?	<ul style="list-style-type: none"> ▪ Relevant stakeholders ▪ Infrastructure ▪ Accountability mechanisms regarding government policies ▪ Public service 	
Digital safeguards	How are the risks of digital technology adoption anticipated?	<ul style="list-style-type: none"> ▪ Privacy Policy ▪ Social protection ▪ Competition policy 	

Source: Adapted from (World Bank, 2016)

This study also analysed digital transformation in Nigeria, Türkiye, and Vietnam, specifically in the three focus sectors. The portraits of the three countries are used to compare and provide an overview of Indonesia's position at the global level, especially regarding digital transformation. The three countries were selected based on various considerations, such as their large populations, similar economic and adoption levels of digital technology, and attitudes regarding climate change. A comparative recapitulation of the four countries is exhibited in the following table:

Table 2 Comparative recapitulation of Indonesia, Nigeria, Türkiye, and Vietnam

	Indonesia	Nigeria	Türkiye	Vietnam
Population (number of lives)	276,400,000	211,400,000	85,040,000	98,186,000
Economic level	Upper-middle-income	Lower-middle-income	Upper-middle-income	Lower-middle-income
Region	Southeast Asia	West Africa	West Asia	Southeast Asia
Gross Domestic Product (2022)	1.319 trillion US dollars	477.4 billion US dollars	905.9 billion US dollars	408.8 billion US dollars
Level of adoption of Advanced Digital Production (ADP) technologies (2020)	Followers-as users	Latecomers-as producers	Followers-as users	Followers-as users
Green Future Index Status (2023)	Climate laggards (ranked 49/76)	Climate laggards (ranked 51/76)	Climate abstainers (ranked 63/76)	Climate laggards (ranked 53/76)

Source: World Bank; (United Nations Industrial Development Organization, 2019); (MIT Technology Review Insights, 2023)

1.3 How to read this report

This report can be used as a reference for stakeholders in the field of digital transformation in Indonesia. The discussion of this study's findings is divided into five chapters. The first chapter offers an introduction and will also explain this study's objectives, methodology, frameworks, and limits. Chapters two, three, and four will explain the interactions between digital technology and each analogue complement: regulatory framework, institutional framework, and human capital. Next, chapter five will describe the country's efforts in setting up digital safeguards. Finally, suggestions for improvements to digital transformation efforts in Indonesia - macro and sector-specific - will be discussed in chapter six.



**COMPLEMENT OF
DIGITAL TRANSFORMATION:
REGULATORY FRAMEWORK**

2. COMPLEMENT OF DIGITAL TRANSFORMATION: REGULATORY FRAMEWORK

The first aspect that needs to be considered when analysing digital transformation efforts is the interaction between digital technology and applicable rules or structures. According to the (World Bank, 2016) framework, the rules/structures in question are all rules/structures related to the business climate. In this study, the rules/structures addressed are understood as **regulatory frameworks that influence the business climate in the adoption of digital technologies**. This definition includes regulatory frameworks that encourage adoption, inhibit adoption, rules that still need to be improved, and rules that do not yet exist. This section begins with a discussion of general digital transformation policies. It then continues with digital transformation sectoral policies, which are policies that specifically affect digital transformation in the Industry 4.0 sector, digital agriculture, and clean/green technology in Indonesia.

2.1 General policies

The regulatory frameworks related to the digital transformation efforts in Indonesia, Nigeria, Türkiye, and Vietnam are dominated by two main objectives: **boosting economic productivity** and encouraging **bureaucratic transformation**. These four countries already have policies in place to accelerate digital transformation (see Table 3).

One of the Nigerian government's efforts to accelerate digital transformation in the economic sector is by harmonising frameworks and creating regulations.³⁵ In the 2020-2030 National Digital Economy Policy and Strategy (NDEPS) document, the Nigerian government's political will for accelerating digital transformation is seen from the adjustment made to the institutions that oversee digital transformation efforts, as the nomenclature of the Ministry of Communications was changed to the Federal Ministry of Communications and Digital Economy. This change aimed to expand the responsibilities and mandate of the Ministry of Communications in the development of the digital economy and its role as a coordinator for ensuring the implementation of the eight NDEPS pillars. Additionally, developing and adopting of local content is also one of the strategies pursued through digital transformation to make Nigeria an active player in the global economic landscape.

Meanwhile, the 2019-2023 Eleventh Development Plan document³⁶ states that building a Digital Transformation Platform in Industry, which also involves private sector technology suppliers, will increase the productivity and competitiveness in Türkiye and develop the country's digital infrastructure. In addition, the document mentioned the Turkish government's effort in formulating a methodology for measuring the level of digital maturity in the industry, which could be used as a reference for evaluating policies related to digital transformation efforts.

In Vietnam, the regulatory efforts undertaken by the country's government comprise having the Ministry of Planning and Investment issue digital transformation documents and guidelines for business actors and increasing cooperation with related agencies. The country's strategic policies include the provision of production facilities and a 50% reduction in consulting costs for industry players, cooperatives, and home businesses.³⁷

³⁵ (Federal Ministry of Communications and Digital Economy Nigeria, 2020)

³⁶ (Presidency of Strategy and Budget Turkey, 2019)

³⁷ (Samuel, 2021)

Table 3 Digital transformation policies in Indonesia, Nigeria, Türkiye, and Vietnam

Country	Indonesia	Nigeria	Türkiye	Vietnam
Policy	Digital Transformation Roadmap 2021-2024	The National Digital Economy Policy and Strategy (NDEPS)	The Eleventh Development Plan (2019-2023)	National Digital Transformation Programme by 2025
Description	<p>The roadmap comprises of steps to accelerate digital transformation:</p> <ul style="list-style-type: none"> a) build an inclusive, secure, and reliable digital infrastructure and connectivity that provides high-quality services. b) build an open and integrated digital government to improve public services. c) make Indonesia a technology-producing country through investments in various platforms. d) harmonise regulations and increase funding to advance innovation. e) enhance the digital capabilities of priority sectors to strengthen geocentric competitiveness and promote quality growth. 	<p>A strategy to make Nigeria an active player in the digital economy on a global level.</p> <p>The eight NDEPS pillars:</p> <ul style="list-style-type: none"> a) Developmental Regulations b) Digital literacy and skills c) Solid infrastructure d) Service Infrastructure e) Digital Services Development and Promotion f) Software infrastructure g) Digital Society and Technology h) Indigenous Content Development and Adoption 	<p>There is no strategic policy that specifically regulates digital transformation in Türkiye. However, digital transformation is discussed in the country's five-year development plan.</p> <p>The development plan discloses that digital transformation is an instrument that can be used to increase productivity and competitiveness in priority sectors and stated several policy measures, including:</p> <ul style="list-style-type: none"> a) Building a Digital Transformation Platform in Industry to guide the digital transformation process and ensure inter-stakeholder coordination; b) Developing a digital maturity measurement methodology (digital maturity); c) Encouraging technology suppliers to develop applications and services, such as artificial intelligence, advanced data analytics, and production management systems. 	<p>The programme consists of policies that aim to accelerate digital transformation through changes in awareness, corporate strategies, and incentive schemes towards the digitalisation of business, administration, and production activities.</p> <p>Six cornerstones of digital transformation:</p> <ul style="list-style-type: none"> a) cognitive transformation b) institutional creation c) digital infrastructure development d) digital platform development e) building trust and ensuring cybersecurity f) international cooperation, research, development, and innovation in the digital ecosystem <p>The targeted priority sectors include finance and banking, health, education, agriculture, transportation, logistics, energy, natural resources, and the environment and manufacturing sectors.</p>
Institution	Ministry of Communication and Informatics	Federal Ministry of Communications and Digital Economy	Digital Transformation Office	Ministry of Planning and Investment

Source: Author, compiled from various sources.

For the Indonesian context, the portrait of the country's regulatory framework concerning digital transformation will be elaborated in terms of economic productivity and bureaucratic transformation.

2.1.1 Increased economic productivity.

The 2020-2024 National Medium-Term Development Plan (NMTDP) disclosed the plan to increase economic productivity through digital transformation. According to the NMTDP, digital transformation is used to increase the value of e-commerce transactions from Rp170 trillion in 2018 to Rp600 trillion in 2024.³⁸ The government's sensitivity to digital technology changes has also started since the promulgation of Law No. 11/2008 on Electronic Information and Transactions (EIT Law). The regulation aims to provide legal protection for parties conducting information technology-based transactions. Implementation rules have also been passed to provide certainty. Moreover, Government Regulation No. 71/2019 on the Implementation of Electronic Systems and Transactions, encourages the creation of a stable business climate as it clearly discloses the obligations of all electronic system operators (public and private) in managing, processing, and storing data.

Furthermore, one of the country's long-term goals is to increase national economic productivity to achieve the *Indonesia Emas 2045* Vision. The vision is documented in the policy package of the 2025-2045 National Long-Term Development Plan (NLTPD). The *Indonesia Emas 2045* Vision is one of the strategies implemented to encourage digital transformation in the country's most productive sectors and improve its accessibility to all communities. The steps taken to drive digital transformation include developing a super digital platform, achieving 100% quality digital access throughout Indonesia, improving digital literacy and digitalisation in various fields, including modernising and digitalising agriculture, and developing digital talent and research and development (R&D).³⁹

However, the country is facing several challenges in its efforts to increase economic productivity, such as the constantly evolving business climate, the complexity of the investment climate, and the impact of implementing domestic component-level policies (DCL).

1) The constantly evolving business climate

Although the EIT Law regulates how electronic transactions are organised, it has been unable to optimise the ease of business, especially in terms of notarial deed administration. The adoption of digital technology in managing notarial deed documents (cyber notary) is not yet applicable in Indonesia because according to EIT Law, Article 5, Paragraph 4, electronically created notarial deeds do not qualify as valid legal evidence. Meanwhile, the need to conduct long-distance business transactions efficiently is necessary in the current era of technological disruption. Thus, cyber notary policies are crucial because notary affairs are a supporting aspect in improving a country's ease of doing business.

Cyber notary has been implemented in several countries. Türkiye has adopted cyber notaries since 2016 as the Official Gazette No. 29413 reported that the Ministry of Justice has published rules regarding Conducting Notarial Acts in the Electronic Environment.⁴⁰ Therefore, all forms of administrative matters that require legality from a notary can be conducted electronically and are considered valid documents. Vietnam has also started implementing the cyber notary concept by launching the e-notary in 2020. However, its implementation is not optimal due to the absence of a regulatory framework to regulate it.⁴¹ Such regulations only appeared in 2023 through the Prime Minister Decree 13/ND-CP on the Protection of Personal Data of April 21, 2023, where the e-notary policy was also regulated.

³⁸ Perpres No. 18/2020 on the 2020-2024 National Medium-Term Development Plan

³⁹ (Widyasanti, Konsultasi Publik dalam Rangka Penyusunan RPJPN 2025-2045, 2023)

⁴⁰ (Arseven, 2015)

⁴¹ (Khanh & Linh, 2022)

Another issue in Indonesia is the implementation of Government Regulation No. 80/2019 on Trading Through Electronic Systems (TTES) and its technical regulations in Ministry of Trade Regulation No. 50/2020 concerning Provisions on Business Licensing, Advertising, Guidance, and Supervision of Business Actors in Trading through Electronic Systems⁴². Both regulations aim to encourage e-commerce growth, increase trade in domestic products, and encourage increased online exporting. However, at the implementation level, there are still differences in perception among business actors, especially regarding their obligation to prioritise trade and improve the competitiveness of domestic products. Business actors have stated their need for more detailed rules regarding the minimum number of domestic product sales in e-commerce platforms, logistical incentive mechanisms, and supervision of product standards for better competitiveness and a more stable digital business environment.⁴³

The electronic commerce regulation above has also not accommodated economic activities on social media. The extensive transactions of goods and services that use social commerce platforms as a medium among the public have not been accompanied by policies or regulations that can optimise its potential and anticipate its risks. Unlike e-commerce platforms, which tend to be more established regarding consumer protection, taxes, and healthy business competition, these aspects have not yet been considered for social commerce platforms. Therefore, the market ecosystem is still free and can potentially bring losses to consumers and businesses.⁴⁴ Hence, social commerce regulations that regulate transaction security and consumer data protection⁴⁵ are essential, given the economic potential of the social commerce industry in Indonesia, which continues to grow by 55% yearly. Moreover, the industry reached 8,675 million US dollars in 2022 and is expected to reach 86,750 million US dollars in 2028, further highlighting the urgency for regulations and policies⁴⁶.

2) The complexity of the investment climate

Increasing the adoption of digital technology in any sector requires investment. However, foreign investors still view the investment climate in Indonesia's digital sector as challenging. Indonesia's Foreign Direct Investment (FDI) score for its digital trade sector is 0.66.⁴⁷ This score indicates that the economic ecosystem in Indonesia has highly complex investment policies that affect digital commerce and its supporting industries. Some of the issues raised by investors are the mechanism of obtaining permits (investment approval), high technology prices, product restrictions, and rules that overlap at the central and regional levels.⁴⁸

In Indonesia, the number of regulations at the ministry and regional levels is extensive, and it is not uncommon for them to conflict with one another. There are approximately 15 thousand ministerial regulations in Indonesia, of which 95% have been issued since 2010. If regulations at the local government level are considered, the number of existing regulations will reach more than 30 thousand.⁴⁹ Although the Indonesian government seeks to simplify conflicting regulations through the Job Creation Law, the regulation does not necessarily solve the problem because other technical regulations are needed. Consequently, investors will consider the impact of the regulatory transition of each new technical rule.

⁴² This regulation was later revoked in 2023 through the Ministry of Trade Regulation No. 31/2023. The Ministry of Trade issued Regulation No. 31/2023, which is a revision of Regulation No. 50/2020. The new regulations recognise six domestic Trading Through Electronic Systems (TTES) business models, among which are marketplaces, online retail platforms, classifieds, price comparison platforms, daily deals, and social commerce. Especially for social commerce platforms, this regulation regulates business process limits by prohibiting social commerce platforms from acting as a manufacturer and allowing payment transactions.

⁴³ (Wicaksana, 2022)

⁴⁴ (Fadilah, 2023)

⁴⁵ (Media Indonesia, 2023)

⁴⁶ (Research and Markets, 2022)

⁴⁷ (ESCAP-ECA-ECLAC, 2023)

⁴⁸ (CNBC Indonesia, 2020)

⁴⁹ (Patunru & Surianta, 2020)

Vietnam also obtained an FDI digital trade score similar to Indonesia, with a value of 0.68⁵⁰. The score is obtained by considering the composition of policies, such as foreign equity limits, joint venture requirements, nationality or residency requirements, and commercial presence requirements. The Vietnamese government is currently trying to attract investors by making regulatory adjustments to make investments easier. One such effort is the ratification of the Securities Law, which officially removed foreign ownership restrictions (foreign equity limits) for investments in most industries.⁵¹

3) Domestic Component Level Policy (DCLP)

Indonesia enacts the Local Content Requirements (LCR) or Domestic Component Level (DCL) policy to develop the domestic industry. One element of the DCL policy for the electronics and telecommunications industry is the Ministry of Communication and Information Regulation (*Permenkominfo*) No. 13/2021, which stipulates the fulfilment of DCL to increase to 35% from 30% for 4G and 5G Subscriber Station devices. However, DCL policies need to be implemented and monitored more carefully. On the one hand, this policy can encourage technology transfer, local skills upgrades, and domestic industrial growth. On the other hand, some foreign companies, especially the United States, rate the DCL policy as one of the most significant challenges faced when doing business in Indonesia. According to their perspective, the DCL was initially intended exclusively for the oil and gas sector. However, it was then applied to other sectors of the economy and has become more widespread.⁵² Therefore, the effectiveness of its implementation rests on Indonesia's commitment to free trade agreements, especially regarding the National Treatment principles and Prohibitions on Performance Requirements (Fernando & Ing, 2022).

Nigeria also experiences a similar issue with DLC policies. In 2013, the National Information Technology Development Agency/NITDA prepared Guidelines for Nigerian Content Development in the ICT sector, which contains requirements for using local content for this sector's development. These guidelines are opposed by many ICT companies from the USA operating in Nigeria, and they provided recommendations for revising such local content requirements (trade.gov, 2021).

2.1.2 Digital transformation for bureaucratic transformation

The Indonesian government's bureaucratic reform has also focused on the digitalisation of the public sector. This effort began with building a working mechanism for the electronic-based government system (EBGS) framework regulated through Presidential Regulation No. 95/2018. The main objective of this system is to realise clean, effective, transparent, and accountable governance, as well as provide high-quality and reliable public services. Currently, the EBGS is the central architecture of the government's digital transformation efforts that is comprehensive enough to ensure that all public services are digitised based on data accuracy.⁵³ The system regulates four government administrative services: electronic-based planning and budgeting services (e-budgeting), electronic-based staffing services, service script administration (e-office), and electronic-based public complaint services.

Presidential Regulation No. 132/2022 on the EBGS Architecture also strengthens the idea of implementing the EBGS because it contains policy directions and strategies regarding data integration, supporting infrastructure, and EBGS security. Moreover, bureaucratic transformation is encouraged in parallel with these regulations through integrated policies disclosed in Presidential Regulation

⁵⁰ (ESCAP-ECA-ECLAC, 2023)

⁵¹ Based on a written interview with DTC Vietnam

⁵² (International Trade Administration, 2022)

⁵³ (Nugroho, 2023)

No. 39/2019 concerning the One Data Initiative and Presidential Regulation No. 23/2021 concerning the One Map Policy⁵⁴.

Table 4 The E-Government Development Index (EDGI)

	Indonesia	Nigeria	Türkiye	Vietnam
Ranking	77	140	48	86
Score	0.7160	0.4525	0.7983	0.6787

Source: (United Nations Department of Economic and Social Affairs, 2022)

The United Nations' assessment of Indonesia's e-government is ranked 77th out of 193 countries in 2022. Indonesia's ranking increased from the 2020 assessment, which placed the country in 88th place. Meanwhile, Türkiye obtained a high rank at 48 and was included in the Very High EDGI category. The EDGI assessment is based on a composite index consisting of the Online Service Index (OSI), Human Capital Index (HCI), and Telecommunications Infrastructure Index (TII). Compared to Indonesia, Türkiye is superior in terms of OSI and HCI components, indicating that most public services in Türkiye are digitally available. Türkiye's strategy for promoting digital governance is outlined in the 2016-2019 National E-Government Action Plan, which also contains strategic steps to increase public participation and capacity to access digital services (European Commission, 2019).

Indonesia's challenge in improving the digitalisation of public services lies in three issues. First, a bureaucratic culture that prioritises sectoral egos, such that the implementation of digital transformation often overlaps between agencies, leading to data alignment issues.⁵⁵ The government then attempted to solve this issue through Presidential Regulation No. 39/2019 concerning the One Data Initiative. However, its implementation in the field is still hampered by several problems, such as sub-standard data, lack of coordination between data owner agencies, and inconsistent and scattered data in various public institutions.⁵⁶ Therefore, digital leaders - as one of the enablers for change - with the mindset and ability to innovate with a fast and cross-hierarchical approach are needed to oversee the implementation of the regulation.

Second is the digital literacy levels of civil servants and the general public. According to the National Civil Service Agency (*Badan Kepegawaian Negara*), only 0.17% of civil servants have specialised skills regarding digital technology.⁵⁷ Meanwhile, a survey conducted by the Ministry of Communications and Informatics (*Kementerian Komunikasi dan Informatika*) together with the Katadata Insight Centre (KIC) revealed that Indonesia's digital literacy index in 2022 was at 3.54 points on a scale of 1-5. This score indicates that the community's level of digital literacy is generally in the "medium" category.⁵⁸ The third challenge is the uneven digital infrastructure, such that digital public services have not been fully implemented at the regional level of government.

In terms of regulation, Indonesia is on the right track for boosting economic productivity and bureaucratic transformation through digital transformation, as the country has some regulations that support these efforts. However, its implementation needs to be improved, and there are still challenges regarding ease of investment or funding schemes. These problems are also found in digital transformation efforts at the sectoral level.

⁵⁴ Amendment to Presidential Regulation No. 9 of 2016 concerning the acceleration of the implementation of the One Map Policy at the level of accuracy of 1:50,000 scale

⁵⁵ (Nugroho, 2023)

⁵⁶ (Islami, 2021)

⁵⁷ (Harmawan, 2023)

⁵⁸ (Katadata, 2023)

Box 1. Digital transformation for social transformation

In addition to encouraging economic productivity, digital transformation should be directed to impact social transformation. However, this idea has yet to be addressed by the current regulatory construction because its creation is still dominated by an economic perspective. Meanwhile, digital transformation can influence conditions across different dimensions. An example would be when the COVID-19 pandemic emerged, and there were limited physical interactions. As an external factor, the pandemic forced the public to be familiar with digital technology to support their activities. Digitalisation and the COVID-19 pandemic are the two main disruptors that gave rise to social transformation, as most people had to adapt and put aside conventional methods for new ones.

At least two sectors of six essential services have undergone social transformation because of digital transformation and the pandemic: the health and education sectors. Both sectors can be used as examples of how related regulations can adapt to situational changes and encourage social change at the community level.

For example, the health sector has a series of regulations that facilitate telemedicine services. The development of regulations can be seen from how it initially only regulated telemedicine between healthcare facilities to telemedicine to then regulating the interactions between patients and medical personnel. Telemedicine services were initially regulated through the Ministry of Health Regulation (*Permenkes*) No. 20/2019. The subjects regulated in this regulation were limited only to healthcare facilities. However, the massive use of telemedicine by the public during the pandemic made the Ministry of Health issue a new regulation through the Ministry of Health Decree (*Kepmenkes*) No. HK.01.07/MENKES/4829/2021. The decree regulates the telemedicine services between patients and medical personnel. However, it is only limited to the COVID-19 pandemic. Currently, Law No. 17/2023 concerning Health, strengthens telemedicine rules by regulating patients and medical personnel without specific time limits.

Meanwhile, the distance learning model has been increasingly applied in the education sector. In addition, the emergence of edutech and its spread has disrupted the public's way of accessing knowledge as it now no longer relies on formal institutions. The high demand for access to knowledge through digital technology media supported the proliferation of educational technology start-ups (edutech) during the pandemic. The service range of edutech is not only intended for individuals within the age range of school students but also for anyone in the general public who wants to improve their skills and knowledge through the programs offered. Additionally, Statista projects the revenue of this industry to reach 1.8 billion US dollars in 2023.

The phenomena in these two sectors can be a lesson for building digital transformation regulation frameworks that go beyond a purely economic perspective.

2.2 Sectoral policy

In addition to regulatory frameworks that are applicable to multiple sectors, specific regulatory frameworks are required for certain sectors. In the Industry 4.0 sector, the regulatory framework regarding digital technology adoption incentive schemes must be the focus of attention. In the digital agriculture sector, budget/investment alignment for digital technology development has not yet appeared on the government's agenda. Meanwhile, in the clean/green technology sector, the regulatory framework relating to new and renewable energy development investment schemes is still an unresolved issue. In addition, the application of digital technology for promoting clean/green technology is not yet addressed.

2.2.1 Industry 4.0

The Indonesian government has supported the Industry 4.0 sector since 2018 through the Making Indonesia 4.0 policy. The programme focuses on developing seven manufacturing sectors: food and beverages, automotive, chemical, textile and textile products, electronics, pharmaceuticals, and medical devices.⁵⁹ Through this policy, the government has launched ten priority strategies to encourage Industry 4.0 and drive Indonesia to become one of the ten largest economies in the world.⁶⁰ The government has also designed assistance schemes encouraging industries/companies to use Industry 4.0 technology in their business processes. The scheme includes subsidies, corporate tax breaks, and import tax exemptions.⁶¹ However, the programme's implementation has faced several challenges.

For example, in Indonesia, only 6% of manufacturing industries have implemented Industry 4.0 technologies, such as advanced robotics, cloud, big data, artificial intelligence, and 3D printing. Meanwhile, 64% of industry players are still in the Industry 3.0 phase or the digitisation stage⁶². Based on the INDI 4.0 – The Indonesian Industry 4.0 Readiness Index as measured by the Ministry of Industry (*Kementerian Perindustrian*) in 2018 – the average readiness of large industries to transform towards Industry 4.0 is still at a moderate level of readiness. One of the factors for this condition is the assumption of the company's management that investments in Industry 4.0 technology are considered too large and unsuitable for their company.⁶³

The government has tried to overcome this obstacle by issuing several tax reduction incentive policies for the industrial sector. This effort began by revising Government Regulation No. 94/2010 concerning the Calculation of Taxable Income and Repayment of Income Tax in the Current Year to become Government Regulation No. 45/2019. Article 29 of Government Regulation No. 45/2019 regulates the exemption or reduction of Income Tax for taxpayers who invest in pioneering industries, including those that introduce new technologies. In line with the above regulation, the derivative rules in Ministry of Finance Regulation (*Permenkeu*) No. 128/PMK.010/2019 also provide a gross income reduction of a maximum of 200% for industries that implement practical work activities, apprenticeships, and other learning activities.

Although these regulations do not directly target the provision of incentives/investment assistance for adopting digital technology, such a tax incentive scheme is expected to provide leeway for the industry to allocate its budget for digital technology investments. Similarly, the incentive scheme regulated

⁵⁹ The program initially covered five priority sectors. It then increased to seven with the addition of the pharmaceutical and medical device sectors (Kementerian Perindustrian, 2021).

⁶⁰ Ten prioritised strategies: improving material flow, redesigning industrial zones, accommodating sustainable standards, empowering MSMEs, building digital infrastructure, attracting foreign investment, improving human resources quality, establishing innovative ecosystems, implementing technology investment incentives, and harmonising rules and policies. (Kementerian Perindustrian, 2023b)

⁶¹ (Chen, Ramli, Hastiadi, & Suryanegara, 2023)

⁶² (Asian Development Bank, 2020)

⁶³ (Hamsani, 2023)

through the Ministry of Finance Regulation (*Permenkeu*) No. 153/PMK.010/2020 concerning the opportunity to obtain a Super Tax Deduction of 300% for industries implementing specific research and development activities (R&D) is expected to encourage companies to innovate and adopt digital technologies. Unfortunately, implementing such rules is difficult, especially from the industry's perspective. For example, according to the Ministry of Finance Regulation (*Permenkeu*) No. 153/2020, the process improvements conducted by industries cannot be claimed as part of R&D to obtain the super tax deduction. Additionally, many industries in Indonesia are not engaged in research and development.⁶⁴

Table 5 Industry 4.0 incentive schemes in Indonesia and Vietnam

Indonesia	Vietnam
<ul style="list-style-type: none"> ▪ Super tax deduction of 300% for industries that conduct R&D activities. ▪ A maximum 200% gross income reduction for industries implementing practical work activities, apprenticeships, and other learning activities. 	<ul style="list-style-type: none"> ▪ Reimbursement of up to 50% of the value of advisory contracts used for the digitalisation of the companies' business processes, administrative processes, manufacturing processes, technological processes, and business model conversion. ▪ Reimbursement of up to 50% of the cost of consulting services used for the companies' digitalisation and automation, increased efficiency of business processes, administrative processes, manufacturing processes, technological processes, and the conversion of business models. ▪ Reimbursement of up to 50% of the value of the advisory contract for the appropriate technology transfer for the company.

Source: Decree No. 80/2021/ND-CP

Unlike Indonesia, the Vietnamese government provides incentive support that directly targets the adoption of digital technology. One of these incentives is through the Vietnamese government's decision⁶⁵ to have the Ministry of Planning and Investment provide assistance schemes to support large, small, and medium businesses (SMEs) in adopting digital technology. The support given is in the form of a 50% reimbursement of the costs incurred by business actors, ranging from the consultation stage to the application of technology in business processes. The decision also supports human resource development for SMEs, SME consulting services, and information assistance related to adopting digital technology.

1) The Start-up Ecosystem

Financial barriers are not only felt by large-scale businesses as they also cause challenges for start-ups to grow. In Indonesia, of the 1400 alumni of the 1000 Start-Up programme by the Ministry of Communication and Informatics (*Kemkominfo*), only 10% - 15% survived after the programme. The remaining start-ups failed to survive due to funding problems.⁶⁶ According to a report by CB Insight (2022), the lack of funds is the dominant reason (38%) behind the failure of start-ups in Indonesia. The second reason is that there is no market need for the business model offered (35%).⁶⁷

Meanwhile, the development of start-ups has caught the attention of the Vietnamese government. Since 2016, the Vietnamese government has supported and promoted innovation ecosystems by implementing "Program 844", supported by the Ministry of Science and Technology, and establishing a law for SME support in 2017. The Vietnamese government also designated 2016 as the National Start-

⁶⁴ Idem.

⁶⁵ Decree of the Socialist Republic of Vietnam No. 80/2021/ND-CP

⁶⁶ (Pudjianto, 2023)

⁶⁷ (Katadata, 2022)

Up Nation Year. From that moment, the country began to create a significantly new wave of start-ups and support programmes. Currently, Vietnam has four start-ups with the Unicorn status that are engaged in the field of games, media, and financial technology (fintech). These start-ups are Axie Infinity, MoMo, VNPAY, and VNG.

Meanwhile, the Turkish government established the Manufacturing Reform Package policy through the Turkish Ministry of Science, Industry, and Technology, which contains important regulations for eliminating barriers faced by industry players and encourages production, export, innovation, and R&D (Ozlu, 2017). This policy is implemented by (i) developing competencies both at the corporate institute level and the individual/professional level to ensure that Türkiye can produce technology and use it effectively, (ii) financing the transformation to ensure that advanced digital technologies and manufacturing technologies are developed, by providing more focused support for R&D and innovation and conducting digital transformation mentoring for small industrial organizations such as SMEs, and (iii) strengthening infrastructure for the development and use of technology.⁶⁸

For Nigeria, the development of start-ups is regulated specifically through the Nigerian Start-up Act. This regulation aims to support entrepreneurship through legal and institutional frameworks that support the operation of start-ups. Nevertheless, Nigeria still faces some major challenges, including a shortage of financing options and low purchasing power.⁶⁹

Table 6 Start-up Rankings for Indonesia, Nigeria, Türkiye, and Vietnam

Country	Indonesia	Nigeria	Türkiye	Vietnam
Global Ranking	41	64	45	58

Source: Global Start-up Ecosystem Index (2023)

Despite funding challenges, Indonesia can still outperform the three comparison countries for the start-up ecosystem aspect. The current start-up ecosystem in Indonesia is ranked 41st globally and 2nd in Southeast Asia.⁷⁰ One of the policies that could continue to encourage the conduciveness of the start-up ecosystem in Indonesia is a programme run by the Ministry of Communication and Informatics (*Kemkominfo*) called the "Start-up Studio", which facilitates start-up actors to reach product-market fit.

2.2.2 Digital agriculture

The use of digital technology in Indonesia's agricultural sector was first discussed in the Ministry of Agriculture's Strategic Plan Document (*Rencana Strategis Kementerian Pertanian*) for 2020-2024. The document contains the objectives for achieving food security and increasing the added value and competitiveness of the agriculture sector. One of these strategies includes harnessing the potential of technology. However, the strategic plan has not clearly defined the role of digital technology in increasing agricultural productivity.⁷¹ Consequently, agricultural digital technology development programmes could not be implemented optimally and appropriately.

⁶⁸ (Ozlu, 2017)

⁶⁹ (StartupBlink, 2023a)

⁷⁰ (StartupBlink, 2023b)

⁷¹ (Mercy Corps Agrifin & Rabo Foundation, 2020)

Table 7 Digital transformation policies in Indonesia, Nigeria, Türkiye, and Vietnam

Country	Indonesia	Nigeria	Türkiye	Vietnam
Policy	National E-Agriculture Strategy ⁷²	Nigeria Digital Agriculture Strategy (NDAS) 2020-2030	N / A	Decision 1837/QD-BNN-CDS 2023
Description	<p>Cooperation between the Ministry of Agriculture and the FAO to utilise agricultural data and information sources so that smallholders can use them.</p> <p>This strategy focuses on data integration of data collected in real-time.</p> <p>One solution is to develop a web-based and mobile Digital Collection Platform (DCP) that is connected to the Agriculture War Room of the Ministry of Agriculture.</p> <p>Data in the DCP is expected to help stakeholders in making decisions to increase agricultural productivity.</p>	<p>The NDAS contains comprehensive strategic objectives and initiatives.</p> <p>Aims:</p> <ol style="list-style-type: none"> 1. To enhance the research and development of digital technologies throughout the agricultural value chain. This strategy is pursued through cooperating with research institutions, businesses, and educational institutions. 2. To create sustainable business models, opportunities, and 10 million jobs across the agricultural value chain. This strategy is pursued by creating a digital agriculture platform and developing digital agriculture programmes that can attract young talents. 3. To ensure that every farmer has access to quality inputs, international standard agricultural products, and has equal access to local and global markets. 	<p>Türkiye has no specific policy on Digital Agriculture.⁷³ However, since 2020, digital technology has been adopted in the agricultural sector by farmers, breeders, and fishermen.</p> <p>This has driven the Turkish government to prepare a national e-agriculture strategy.</p> <p>The preparation begins with identifying 3 strategic aspects:</p> <ol style="list-style-type: none"> 1. Determining how to integrate ICT into agriculture; 2. Mapping the type of technology to be prioritised; 3. Determining the digital technology category that will be allocated with resources to maximise production. 	<p>The Ministry of Agriculture and Rural Development (MARD) has an annual action plan for digital transformation, in which the digital agricultural economy is one of five specific targets.</p> <p>The five specific targets are translated into 10 missions. The MARD also has the Digital Transformation and Agriculture Statistics Centre, which is a permanent unit of the Steering Committee.</p>

Source: Author, compiled from various sources.

⁷² At the time of writing, the author could not find a National E-Agriculture Strategy document that the public can access. Information on the digital agriculture objectives and strategies written in this report refers to [news \(press releases\)](#) from the [FAO](#).

⁷³ (Ministry of Agriculture and Forestry Republic of Turkey, 2020)

A more specific strategy to digitalise the agricultural sector was then created by the Indonesian Ministry of Agriculture in collaboration with The Food and Agriculture Organization (FAO) in the 'National E-Agriculture Strategy' at the beginning of 2023. Through this strategy, the government seeks to provide instruments to accelerate the development of digital agriculture in the upstream, on-the-farm, and post-harvest stages. It also aims to strengthen the position of farmers in the agricultural industry. In addition, it is targeted that by 2027, Indonesia will have an integrated database of agricultural and farmer data, including cultivated land area, distribution channels, and early warning system data, which can potentially affect agricultural productivity. Such data is important to help formulate agricultural policies that aim to achieve national food security.

The table above describes the strategic policies enacted by each country to accelerate digital agriculture. Several of the strategic measures from the comparison countries can be adopted by the Indonesian government to optimise and complement existing policies. One of these measures is the Nigerian government's commitment to the digital technology research and development agenda in all agricultural chains. Implementing this strategy will enable digital technology innovations to be developed according to the needs of different agricultural stages, ranging from upstream and on-the-farm to the post-harvest and distribution stages. Next, the Turkish government's strategy for mapping priority technology types and allocating resources to develop them could also be adopted in Indonesia. Each sub-sector of agriculture and the stages of its business processes will require different types of digital technology. Thus, technology mapping can streamline digital agriculture development efforts, especially in the early stages of adoption. Another strategy that Indonesia can learn from is the Vietnamese government's establishment of a pilot zone of digital agriculture in six regions: Bac Ninh, Lam Dong, Ho Chi Minh, Ninh Phuc, Thai Nguyen, and the Mekong Delta. Establishing the pilot zone allowed the development of digital agriculture to be focused according to the commodities and characteristics of each region. In addition, the success stories from the pilot region can be used as an instrument to accelerate digital agriculture in other regions.

Furthermore, the role of financial support is critical in accelerating digital agriculture. Given that digital infrastructure is still a challenge in all sectors, especially access by farmers, the Indonesian government must allocate a budget that is specifically used for developing digital technology in the agricultural sector. The Turkish government, through the Ministry of Agriculture and Forestry, allocated a budget of 26.5 million US dollars (3% of the total investment fund) for the development of digital agriculture. The ministry also provided support for research conducted by Türkiye's largest defence electronics company, ASELSAN, to adopt several of their electronic devices and automation systems for the agricultural sector (FAO, 2021).⁷⁴ The Vietnamese government also pursued the same goals through Decree No. 57/2018/ND-CP, which provides financial support for rural development programmes to advance agricultural research and technology transfer.

2.2.3 Clean/green technology - The energy sector

Indonesia is committed to achieving net zero emissions by 2060. The country aims to gradually achieve the emission reduction targets of 31.89% (by its own efforts) and 43.2% (with international assistance) by 2030. The operational steps to realise this commitment are pursued through energy sector policies that aim to reduce greenhouse gases. In this sector, no policy formulation explicitly alludes to the digital transformation agenda in the energy sector. However, digital technology has been utilised to help accelerate carbon emission reduction efforts and to monitor energy efficiency endeavours (although not at all levels).

There are at least two policies that are closely related to the above commitments. First is the Government Regulation No. 33/2023 on Energy Conservation, which stipulates the obligation to conduct energy management in the industrial, transportation, building, and household sectors. The

⁷⁴ (FAO, CIAT, and The World Bank, 2021a)

regulation also regulates energy audits for industry players and buildings that utilise energy resources equivalent to 6000 tons of oil per year. The results of energy audits can show the amount of energy used by the auditee and its level of efficiency. Suggestions and recommendations will be given when the industry and buildings/structures are found to waste energy. Unfortunately, to date, there are no rules regarding sanctions that can provide a deterring effect for industries or buildings/structures that still waste energy in their business processes.⁷⁵

Second, is a policy on transitioning to new and renewable energies. This effort is regulated through Presidential Regulation No. 112/2022 on Accelerating the Development of Renewable Energy for Electricity Supply. In general, the policy regulates the tariff setting that is expected to support the ecosystem of New and Renewable Energy (NRE) power plants. The policy grants PT Perusahaan Listrik Negara (Persero) to conduct intensive negotiations with NRE producers with the highest benchmark electricity purchase price. However, this scheme has its challenges as some investors prefer the Feed in Tariff (FIT)⁷⁶ scheme over negotiating business-to-business (B2B) with PT PLN.

In contrast to Indonesia, the Vietnamese government has imposed the Feed-in-tariff (FIT) policy to make investments in renewable energy development more attractive and profitable for investors. The FIT policy is valid for 20 years for renewable energy sourced from wind, biomass, solar, and solid waste. Vietnam's total investment in renewable energy in 2016 was 682 million US dollars, with a percentage increase of 143% compared to the previous year. If calculated from the 2011-2016 period, Vietnam's total investment in renewable energy has reached 2,355.73 million US dollars.⁷⁷

Meanwhile, the FIT policy has also been implemented in Nigeria since 2016. It was aimed to stimulate renewable energy potential through investments. Although the FIT contract is valid for 20 years, the Nigerian government enforces regulations for evaluations to be conducted every 3 years during the span of the contract. However, the implementation of the evaluations has not run optimally.⁷⁸

The application of FIT in Indonesia is still debated because it poses a long-term burden to the state budget, and the incentives tend to only benefit independent power producers. Fluctuating energy prices also make the pricing scheme at the beginning of the contract not ideal. Therefore, the abolition of the FIT scheme can be considered as the government's effort to uphold justice in energy management as mandated in Law No. 30/2007 concerning Energy.

In terms of the electrification ratio, Indonesia's electricity supply has reached 99.6%.⁷⁹ This figure means that almost all households in Indonesia have access to electricity. However, efforts to generate the 35,000 MW set in the Nawacita policy in 2015 have not been met. To date, the country has generated 16,596 MW of electricity.⁸⁰ As the supply of electricity in the current figure has met the national electrification ratio, the Indonesian government needs to be wary of the oversupply of electric power, especially for industrial and household needs.

Meanwhile, Nigeria still experiences constraints regarding the utilisation of green technology for electricity supply. Nigeria's Renewable Energy Master Plan projected that by 2020, the country will need at least 45,490 MW to guarantee a stable electricity supply. However, in 2020, the realisation was far from the declared target as the total installed electricity capacity had only reached 12,522 MW. This failure is due to the lack of integration between sustainable policies and the efforts made to encourage renewable energy programmes, and the absence of a coordinating government agency that oversees the renewable energy subsector. Currently, Nigeria is unable to develop green technology that supports

⁷⁵ (Balai Besar Survei dan Pengujian, 2023)

⁷⁶ The *Feed in Tariff* (FIT) is a policy for New and Renewable Energy for a fixed price to be determined at the beginning of the contract that is paid over a certain period and is not negotiable.

⁷⁷ (Bloomberg New Energy Finance, 2017)

⁷⁸ (Global Data, 2023)

⁷⁹ (Humas EBTKE, 2023)

⁸⁰ (Wahyudi, 2023)

renewable energy targets. This weakness is aggravated by weak incentive schemes to attract foreign investments.⁸¹

In terms of funding, foreign investments have an important role in encouraging the use of green technology. An example would be the international financial assistance Türkiye received from the Climate Investment Fund, which has two main focuses: the Clean Technology Fund (CTF) and the Strategic Climate Fund (SCF). The CTF investment in Türkiye is worth US\$390 million and is used to support wind power expansion, smart grid upgrades, and complementary programmes to increase renewable energy investments and energy efficiency. In addition, Türkiye's export capabilities in climate change mitigation technologies, such as wind power, solar energy, and green transportation, have grown by 18% annually over the past 12 years. This figure is much higher than the country's overall growth in exports.⁸²

⁸¹ (Nwozor, et al., 2020)

⁸² (World Bank, 2022)



**COMPLEMENT OF
DIGITAL TRANSFORMATION:
INSTITUTIONAL FRAMEWORK**

3. COMPLEMENT OF DIGITAL TRANSFORMATION: INSTITUTIONAL FRAMEWORK

Two essential aspects of the institutional framework are involved in driving digital transformation efforts: the key actors that play a role in digital transformation and the physical infrastructure that supports the use of digital technology in various sectors. This sub-chapter will explain how the conditions of these two aspects shape the institutional framework of digital transformation in Indonesia.

3.1 Digital transformation actors in Indonesia

The role of stakeholder involvement is critical to the digital transformation efforts. Based on a previous report⁸³ that examined the impact of digitalisation on employment, there are at least five actor entities that play a role in digital transformation. However, this study identified an additional actor who also contributed to the acceleration of digital transformation. Overall, the six actor entities consist of the government, business circles, development partners, education and training institutions, civil society, and the media. A brief description of the role of each of these entities is shown below:

- a) The government
The government's role in driving digital transformation is embodied through a series of policies. In its implementation, cross-agency coordination is often required both at the central and regional levels. The involvement of local governments is vital in improving and harnessing the potential of local economies through digital technology.
- b) The private sector (businesses)
Business actors are important entities that need to be involved as they can provide a real-world perspective on digital transformation efforts. As actors who implement digital technology in their business processes, they can provide strategic input on supporting policies that facilitate the adoption of digital technology by industry players. In addition, business actors or the private sector can become government partners in implementing Government Cooperation with Business Entity schemes to encourage the development of digital infrastructure.
- c) Development Partners
Development partners can strengthen the digital transformation development agenda by providing financial and non-financial support. One example is the cooperation between the Ministry of Agriculture and the FAO as development partners in the digital agriculture sector.
- d) Educational and training institutions
Educational and training institutions play a role in ensuring the individuals' and communities' skills fit the needs of the digital ecosystem. This capacity becomes a form of capital, enabling digital transformation efforts also to be driven by the community and actualised through productive activities.
- e) Civil society
Civil society, consisting of academics and professional organisations, plays a role in helping develop digital transformation policies based on scientific principles. This role can enhance policy creation that reflects society's real needs.
- f) The media
Another digital transformation actor is the media. The media can disseminate information on digital transformation matters to raise public awareness about the changing conditions due to digital technology.

⁸³ (Pawennei I. , Filaili, Novianda, & Farhan, 2021)

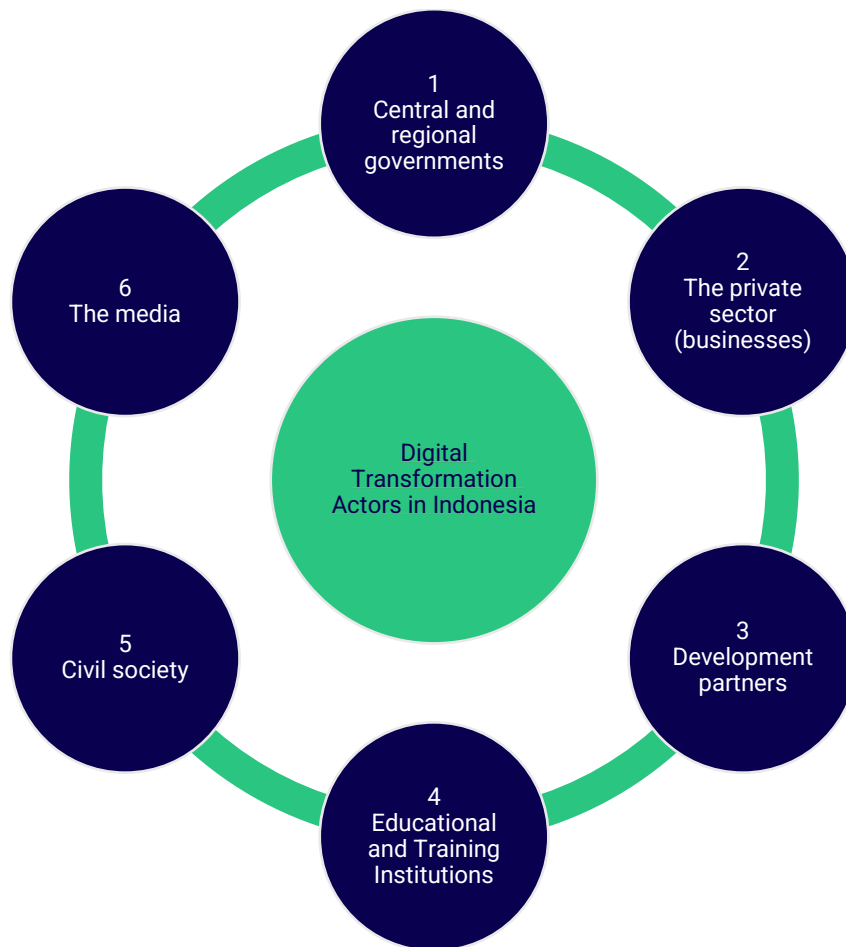


Figure 5 Digital transformation actors in Indonesia

Source: The Author.

Digital transformation institutions in the government sector comprise three main architectures: EBGs, One Data Initiative, and One Map Policy. As these three architectures support data alignment, they are expected to enable governance between central and regional agencies to run in an integrated manner. Efforts to strengthen the EBGs institutional framework have been conducted through several strategies, including (a) establishing and strengthening EBGs coordination teams in central and regional government agencies, (b) building National EBGs Architecture, Central Agency EBGs Architecture, and Local Government EBGs Architecture, and (c) simplifying the integrated business processes within and between central and regional government agencies.

The establishment of EBGs coordination teams at various levels of government is important to oversee and ensure the accuracy of digital technology usage. To date, EBGs implementation has only been interpreted as creating applications. Thus, each government agency has developed its respective applications, amounting to 27,000 public service applications.⁸⁴ Most of these applications have similarities and overlap with one another. They also have implications for the issue of storing important public service data across various databases. Budget utilisation is also an issue because the creation of applications is left to third parties/vendors. Therefore, in this case, the government's challenge is with streamlining the thousands of existing public service applications and stopping the development of other applications for the EBGs. Existing applications must also be evaluated and ensured of their data interoperability.

⁸⁴ (Kompas.com, 2023)

The EBS is strengthened through the Circular Letter of the Minister of State Apparatus Utilisation and Bureaucratic Reform (*Menteri PAN-RB*) No. 18/2022 on integrating National Digital Services through the EBS architecture and mapping. The Circular Letter provided targets that require central and regional agencies to prepare their EBS architecture and mapping as of December 2022. The successful implementation of the EBS architecture can allow governance to run more effectively and efficiently because it can (a) eliminate overlapping government business processes; (b) eliminate the duplication of ICT applications and infrastructure and strengthen information security; (c) implement ICT standardisation and standardise national digital service quality; (d) share data and information according to Indonesia's One Data Policy; (e) facilitate the integration of government services; and (f) improve the alignment of EBS planning and budgeting to increase the efficiency and effectiveness of EBS implementation. However, not all regions have EBS-derived rules at the local government level. At the provincial level, six provinces do not have EBS derivative regulations: the Riau Islands, Gorontalo, North Sulawesi, South Sulawesi, West Papua, and Papua. Four new provinces: central Papua, Highland Papua, South Papua, and Southwest Papua also do not have such regulations.⁸⁵

In addition to EBS issues, a common challenge at the institutional level in efforts to accelerate digital transformation is the heavy silo mentality, which hinders coordination across actors, particularly in government entities. One example of this challenge is when the Digital Transformation Roadmap 2021-2024 – which can ideally be used as a common guideline in preparing the digital transformation agenda - does not appear to be officially known by ministries/institutions outside the Ministry of Communication and Informatics (*Kemkominfo*). The obstacle lies in two possibilities. First, is that the roadmap has not been documented in the form of statutory regulations. Thus, it does not instil enough pressure or urgency to create an integrated joint work plan across ministries/institutions. Second is the lack of socialisation to ministries/institutions outside the Ministry of Communication and Informatics (*Kemkominfo*) on the Digital Transformation Roadmap 2021-2024 regarding strategies, achievement efforts, and involvement and forms of collaboration between agencies in the digital transformation agenda.

In general, the Ministry of Communication and Informatics (*Kemkominfo*) has an important role in accelerating digital transformation. One of the efforts made by the ministry is the formation of a digital transformation roadmap for six priority sectors and the implementation of a pilot programme in each of these sectors. The sectors in question include the agricultural, maritime, logistics, education, health, and tourism sectors. In the "Digital Transformation Roadmap in 6 Strategic Sectors: Agriculture" document, the Ministry of Communication and Informatics (*Kemkominfo*) identified that this sector's readiness to adopt digital technologies falls into the nascent category. The nascent category indicates the sector's limited digital infrastructure and supporters, inadequate levels of digital literacy, and the absence of systematic government encouragement/incentives.⁸⁶

Additionally, despite the policies outlined in the E-Agriculture⁸⁷ National Strategy, the alignment of agendas between institutions is still unclear. The strategy focuses on developing a database that small farmers can use to make decisions. Such a strategy stresses on the Ministry of Communication and Informatics (*Kemkominfo*)'s statement in its roadmap document, which states that the government does not yet have a strategic focus to target the ability of farmers to adopt digital technology directly. Developing a database can be useful, but it is also important to ensure that existing data is accessible to farmers and can be used to increase agricultural productivity.

The Ministry of Communication and Informatics (*Kemkominfo*) roadmap has formulated a collaboration plan with the Ministry of Agriculture (*Kementan*) as a technical ministry in the agricultural sector. However, when the Ministry of Communication and Informatics (*Kemkominfo*) completed the pilot

⁸⁵ A more complete list of regional rules in Level II regions can be seen in the appendix.

⁸⁶ (Direktorat Jenderal Aplikasi Informatika, 2022)

⁸⁷ (FAO, 2023)

programme, the relevant technical ministry could not replicate these activities due to several obstacles, such as differences in prioritising specific programmes in the technical ministry and budget support issues. Thus, the issue of cross-sectoral coordination remains a challenge for today's bureaucratic culture.⁸⁸

One important prerequisite for conducting cross-sectoral coordination for digital transformation is strong internal institutions. The Ministry of Research, Technology and Higher Education (*Kemendibudristek*) and the Ministry of Health (*Kemenkes*) have initiated efforts to achieve this prerequisite. The Ministry of Research, Technology, and Higher Education (*Kemendibudristek*) has a working unit called GovTech Edu, which provides high-tech support for education services.

*“We now have 400 product managers, software engineers, and data scientists working as a team (shadow organisation) attached to the ministry. This team is not a vendor for the ministry; all product managers and team leaders are almost on par with the General Director. They are positioned as brainstorming partners in designing our products.”*⁸⁹

Meanwhile, the Ministry of Health (*Kemenkes*) formed the Digital Transformation Office (DTO) in March 2021 based on the decree of the Ministry of Health No. HK.01.07/MENKES/3605/2021 concerning the Central Bureaucratic Reform and Institutional Transformation Acceleration Team (Central Transformation Office) of the Ministry of Health in 2021. The DTO focuses on data integration and interoperability. Their mission is to transform healthcare in Indonesia through data and technology. The institution has three priorities: compiling electronic medical records (to be accessible to every individual and in all health facilities in Indonesia (with user consent); simplifying health service applications (to focus more on saving lives than administrative matters); creating regulatory support for the health innovation ecosystem (policy innovation to strengthen the health technology ecosystem).

⁸⁸ (Adhiarna, 2023)

⁸⁹ This message was conveyed by the Minister of Research, Technology and Higher Education, Nadiem Makarim, at the United Nations Transforming Education Summit in 2022 at the UN headquarters.

Table 8 The potential roles of ministries in supporting digital transformation

Number	Sector	Ministry	Potential role
1	General	Ministry of Communication and Informatics (<i>Kementerian Komunikasi dan Informatika</i>)	Develop physical and non-physical infrastructure (digital talent) to be evenly distributed in all regions.
2	General	The Ministry of National Development Planning/National Development Planning Agency (<i>Kementerian PPN/Bappenas</i>)	Coordinate and align digital transformation programmes with the Indonesia 2045 vision.
3	General	Ministry of Finance (<i>Kementerian Keuangan</i>)	Provide supporting policies, such as tax incentives and import tariffs.
4	Industry 4.0	Ministry of Industry (<i>Kementerian Perindustrian</i>)	Support policy and infrastructure capacity for large, small, and medium-scale industry players to adopt digital technology in their business processes.
5	Industry 4.0	Ministry of Trade (<i>Kementerian Perdagangan</i>)	Increase the number of new export destination markets for the processing industry.
6	Digital agriculture	Ministry of Agriculture (<i>Kementerian Pertanian</i>)	Set up supporting infrastructure for digital agriculture and provide large-scale training sessions to agriculture actors.
7	Digital agriculture	Ministry of Marine Affairs and Fisheries (<i>Kementerian Kelautan dan Perikanan</i>)	Set up supporting infrastructure for digital fisheries and provide large-scale training sessions to actors in the fishing sector.
8	Digital agriculture	Ministry of Villages, Development of Disadvantaged Regions, and Transmigration (<i>Kementerian Desa, Pembangunan Daerah Tertinggal, dan Transmigrasi</i>)	Empower the agricultural sector in rural areas through the Smart Farming 4.0 programme.
9	Clean/green technology	The Ministry of Energy and Mineral Resources (<i>Kementerian ESDM</i>)	Strengthen energy transition efforts through adopting green technology and digital technology.
10	Clean/green technology	Ministry of Transportation (<i>Kementerian Perhubungan</i>)	Strengthen transportation infrastructure with environmentally friendly fuel.

Source: The Author.

Digital transformation will be successful when its ecosystem is built by integrating all stakeholders. Some of the potential roles of each relevant agency in supporting digital transformation efforts can be seen in the table above. Nevertheless, the roles need to be optimised in a coordinated and mutually sustainable method.

Table 9 The studied countries' institutional score and rankings in the Global Innovation Index 2022

Aspect		Indonesia	Nigeria	Türkiye	Vietnam
Institution	Score	55.1	43.5	46.8	60.6
	Ranking	71	112	101	51

Source: (World Intellectual Property Organization (WIPO), 2022)

The map of actors who play a role in Vietnam also includes government entities, businesses, and civil society. However, the interesting thing about Vietnam is that important government actors are orchestrated by the National Steering Committee for Digital Transformation, which is directly led by the Prime Minister. Each of these ministries has its duties and functions, as illustrated in the figure below. For example, the Ministry of Science and Technology has a funding programme for the research, development, and application of Industry 4.0 technology. Meanwhile, the Ministry of Information and Communications oversee data governance and security. The committee also has an action plan every year for the National Digital Transformation Strategy agenda.



Figure 6 Key digital actors in Vietnam's government

Source: Redrawn from the results of Vietnam's Digital Transformation Centre (DTC).

Institutional orchestration, such as that of the Vietnamese government, is important to ensure that policies can be integrated without overlapping programmes between institutions. Vietnam has a

relatively high score with a ranking for the institutional aspect, which is ahead of Indonesia and the other two comparison countries (see Figure 6).

3.1.1 Industry 4.0

The Ministry of Industry's (*Kemenperin*) role in the Industry 4.0 sector is to create an ecosystem that encourages industries to adopt digital technology in their business processes. Some of the agendas under the Making Indonesia 4.0 programme include performing INDI 4.0 assessments, providing training and assistance for Industry 4.0 technologies, and intensifying e-smart SMEs. In addition, the Ministry of Industry (*Kemenperin*) developed the Indonesian Digital Industry Centre (PIDI 4.0) to support the manufacturing industry in Indonesia by facilitating the showcase centre, capability centre, industry 4.0 ecosystem, delivery centre, and engineering and AI centre.⁹⁰ Through this policy, Indonesia currently has 76 companies that are Champions of INDI 4.0, of which 13 companies have the national lighthouse Industry 4.0 status and 2 companies have the global lighthouse Industry 4.0 status.⁹¹

Industry 4.0 institutions were also strengthened by inaugurating and confirming the board of the Indonesian Industrial Digital Transformation Council/IIDTC (*Dewan Transformasi Digital Industri Indonesia/WANTRII*). The IIDTC acts as a bridge between the government and industry players. This organisation is an official forum that allows for information and experience exchange between practitioners and academics who drive digital transformation in the Indonesian industry. The IIDTC is professionally managed and has a strategic role in driving digital transformation efforts - Industry 4.0 - in the industrial sector, as it can bring together experts and technology providers and voice the needs, interests, and aspirations of stakeholders in the industrial ecosystem.⁹²

In addition to targeting large-scale industries, digital transformation aims to control the economic potential of start-ups. The main institutional challenge for this issue is that initiatives related to the development and growth of start-ups in Indonesia are still spread across several ministries without a central entity to orchestrate them. For example, the Ministry of Industry (*Kemenperin*) has a training programme called Startup4Industry, which aims to accelerate start-ups that focus on using technology to solve industrial and societal problems. The programme's alumni then formed the Indonesian Start-up for Industry Association (Starfindo), which acts as a forum for strengthening the start-up business ecosystem and acts as a government partner in developing start-up technology programmes in Indonesia. Starfindo also acts as a facilitator between the private sector, ministries/institutions, and other organisations.⁹³

The Ministry of Communication (*Kemkominfo*) and Informatics also provided training for start-ups through the National Movement of 1000 Digital Start-ups. This movement has goals in common with the Startup4Industry programme from the Ministry of Industry (*Kemenperin*), which is to create solutions to social problems by using digital technology. This training programme has been attended by at least 1,400 alumni with diverse business ideas. The programme is comprised of several stages, from the initiation stage to the Start-up Studio programme, which brings start-ups together with potential investors.⁹⁴

The start-up development initiatives are not limited to the two ministries above. The Ministry of Tourism and Creative Economy/Tourism and Creative Economy Agency (*Kemenparekraf/Baparekraf*) developed an online platform for food business start-ups with the name FoodStartup Indonesia (FSI). They also have the BEKUP 2023 programme (Tourism and Creative Economy Agency for Start-ups), which has a similar purpose to the start-up coaching programmes in other institutions. The programme's

⁹⁰ (Kementerian Perindustrian, 2023a)

⁹¹ (Kementerian Komunikasi dan Informatika, 2023)

⁹² (Cyberthreat, 2023)

⁹³ (Pudjianto, 2023) (Kementerian Perindustrian, 2022)

⁹⁴ (Pudjianto, 2023)

specific aim is to develop digital start-ups and provide intensive guidance to improve the businesses' readiness regarding their Minimum Viable Product (MVP), product-market fit, and pre-seeding in Indonesia.⁹⁵

The main problem with the institutional framework for start-ups in Indonesia is the fact that no ministry/institution or sector is taking the leadership role. Many start-up development programmes in various ministries have similar programme characteristics, indicating the ineffectiveness of institutional governance in the start-up business sector.

On the other hand, the Vietnamese government has the National Innovation Centre/NIC as a sub-unit of the Ministry of Planning and Investment, which orchestrates Vietnam's start-up ecosystem (see **Error! Reference source not found.**). The NIC supports and develops the start-up climate and innovations through practical contributions towards policy strengthening, ecosystem development, and business empowerment. This level of orchestration is needed to build an ecosystem that brings start-up actors and investors together and build a business model that can maintain sustainable funding.

3.1.2 Digital agriculture

Data integration and digital technology investments are important aspects of the development of the digital agriculture sector. Data and information can help agricultural actors in making decisions at all stages of the agriculture process, from the input, on-the-farm, and post-harvest stages. Meanwhile, digital technology investment is used to support the development and use of technology to improve agricultural efficiency and productivity.

The Ministry of Agriculture (*Kementerian Pertanian*) began to build agricultural data institutions by establishing the Strategic Command for Agricultural Development, regulated in the Ministry of Agriculture Regulation (*Permentan*) No. 49/2019. The Strategic Command for Agricultural Development collects agricultural data and information from the sub-district level to the centre level. The data collected consists of planting areas and food crop production, population data and livestock commodity production, export commodity data, commodity prices, and data on human resources in the agricultural sector.⁹⁶

Data and information are then delivered in real-time and managed in a centralised system in the AWR (Agriculture War Room). Currently, the AWR has been connected to 5,700 Agricultural Development Agencies at the sub-district level and has become a national data and information management centre.⁹⁷ Farmers in the AWR can read and analyse rainfall intensity, wind movement direction, harvest calendar, allocation of fertiliser use, machine monitoring, flood risk, and others.⁹⁸ The latest agenda to improve data accessibility in the agricultural sector is to develop a website-based and mobile-based **Digital Collection Platform** so that data that can help with decision-making can be used by stakeholders in the government and farmers and fishermen.

Apart from the government, the private sector also uses digital technology to build agricultural data, one of which is a start-up called HARA. By utilising blockchain technology, HARA collects and shares important agricultural data with farmers and other stakeholders. The data and information managed by HARA are also used in market research to provide reliable information on rice production in Indonesia.⁹⁹

Meanwhile, the Vietnamese government is also working on developing agricultural data through the Ministry of Agriculture and Rural Development's programme called the "Vietnam Sustainable Agriculture Transformation Project". The programme aims to develop a digital database that can be used to improve

⁹⁵ (Kementerian Pariwisata dan Ekonomi Kreatif/Badan Pariwisata dan Ekonomi Kreatif, 2023)

⁹⁶ (Nursyamsi, 2023)

⁹⁷ Idem.

⁹⁸ (Mercy Corps Agrifin & Rabo Foundation, 2020)

⁹⁹ (Sirait, 2023)

the traceability of coffee beans and the management of natural resources. In 2019, the Department of Plant Protection also introduced a mobile application called Thuoc BVTV to improve pesticide use efficiency and provide information on non-chemical alternatives.¹⁰⁰ However, as in Indonesia, automation efforts in Vietnam's agricultural sector still face human resource challenges. Building awareness and farmers' abilities to use digital technology in the agricultural production process is a process that will require considerable time.

In Nigeria, the acceleration of digital agriculture is developed through an institutional framework that is measurable in terms of time and actor involvement. The three main targets outlined in the Nigerian Digital Agriculture Strategy document are implemented based on a timeline and executed based on the collaboration between the NITDA (National Information Technology Development Agency - an institution that since 2001 has orchestrated the implementation and development of information technology policies) and related actors. For example, the NITDA, the federal government, and local governments in Nigeria will facilitate open data for agriculture by cooperating with the private sector to develop a digital platform that contains open agricultural data.

Meanwhile, the Turkish government is investing in the development of digital technologies for the agricultural sector to solve supply chain problems. The length of the supply chain enables intermediary parties to make a much larger income than the farmers. Therefore, the Turkish government created a digital agricultural market, the Digital Marketplace/Farming Market (DiTAP), to bridge sellers to buyers online. This digital market approach is believed to benefit producers by generating more revenue. The platform also provides an opportunity for financial support and a place to share data and information, which helps to prevent market fluctuations.¹⁰¹

Indonesia also has a digital agricultural market that brings together producers directly with consumers. However, this digital market is generally driven by the private sector through start-ups such as SayurBox and TaniHub. As these digital markets are managed by the start-up model, they are potentially unstable when faced with declining business climate conditions.

In addition to the digital market, some examples of digital technology usage in the agricultural sector are the initiatives created by young farmers. One of them is the application of smart irrigation systems in the Tabalong area of South Kalimantan. These smart irrigation systems enable farmers to utilise sensor technology to see the required moisture content in their farmland. Smart irrigation systems began to be applied in several regions as it was introduced in vocational education materials at the Polytechnic of Agricultural Development.¹⁰²

In Indonesia, digital agriculture institutions are also encouraged at the regional level. Support at the regional level is important, considering that the agricultural sector is generally located in rural areas where local governments can play a role and have authority in accelerating the agenda. One example is the initiation conducted by the West Java provincial government, where they developed a millennial farmer programme that utilises technological innovation. The form of institutional support implemented by the West Java provincial government was by cooperating with BJB Bank to provide credit for young farmers for financing assistance ranging from Rp5 million to Rp500 million. The programme succeeded in attracting 8,314 young farmers who positively contributed to food security in West Java. Therefore, the contribution of local governments in accelerating digital agriculture needs to continue to be amplified in many regions.¹⁰³

¹⁰⁰ (FAO, CIAT, and The World Bank, 2021b)

¹⁰¹ (Demiryurek, Kawamorita, & Koksall, 2021)

¹⁰² (Nursyamsi, 2023)

¹⁰³ (Herlambang, 2023)

3.1.3 Clean/green technology - The energy sector

Energy transition efforts require the participation and collaboration of various stakeholders, such as the government, industrial actors, business actors, and members of the community. In terms of clean/green technology, the Ministry of Energy and Mineral Resources (*Kementerian ESDM*), as a government representative, oversees the efforts taken to accelerate the achievement of energy transition targets. Digital technology has also been used to accelerate these efforts through an online reporting system for energy management. Thus, energy users who are obligated to conduct energy management can easily report their implementation to the government.¹⁰⁴

In addition, digital technology has been applied in the form of sensors in the Ministry of Energy and Mineral Resources (*Kementerian ESDM*) building. These sensors control the building's energy use to be more efficient. Unfortunately, this technology has not been implemented thoroughly in other government buildings. Despite the long-term economic benefits resulting from energy efficiency, budget issues are an obstacle to implementing sensor technology in government buildings.¹⁰⁵

The industrial sector also experiences financial problems in implementing sensor systems in its buildings. For the industrial sector, cost and benefit considerations are the main factors in deciding to adopt such high-cost technologies.¹⁰⁶ Therefore, it is difficult to encourage them to willingly implement such technology.

The Ministry of Energy and Mineral Resources' (*Kementerian ESDM*) efforts to encourage stakeholders to conduct efficiency and energy conservation include providing non-monetary incentives through the Subroto Award for Energy Efficiency. The award is given to industry players, buildings, and government agencies that have implemented energy efficiency and conservation efforts in their business environment or organisation. The award is expected to increase the awareness and participation of stakeholders and produce industrial models and buildings that implement efficient energy management.¹⁰⁷

Furthermore, stakeholders other than the Ministry of Energy and Mineral Resources (*Kementerian ESDM*) also encourage these energy transition efforts. PT PLN (Persero), as a state electricity provider for the public, has developed an Electric Power Supply Business Plan (EPSBP) for 2021-2030. The EPSBP was endorsed by the Minister of Energy and Mineral Resources and stipulated that 23% of electricity generation must be from a mixture of new and renewable energy and that it must be achieved by the end of 2025.¹⁰⁸ To date, 12% of the target set has been achieved, coming from three energy sources: hydropower, geothermal, and solar.¹⁰⁹

In addition, efforts to use new and renewable energy are also targeted at the transportation sector. PT PLN (Persero) is mandated to provide infrastructure in the form of Public Electric Vehicle Charging Stations (PEVCS). Currently, there are 62 charging units available in 37 locations in Indonesia. This figure is still far from the target because the roadmap compiled by PT PLN targeted building 182 PEVCS units in 2020 (Marciano, 2021).¹¹⁰

¹⁰⁴ (Direktorat Konservasi Energi, 2023)

¹⁰⁵ Idem.

¹⁰⁶ Idem.

¹⁰⁷ (Direktorat Jenderal Energi Baru Terbarukan dan Konservasi Energi (EBTKE), n.d.)

¹⁰⁸ Ministry of Energy and Mineral Resources Decree No. 188.K/HK.02/MEM.L/2021

¹⁰⁹ (Direktorat Konservasi Energi, 2023)

¹¹⁰ (Marciano, 2021)

3.2 Digital infrastructure

Strengthening digital infrastructure is instrumental for the digital transformation agenda. There are at least two aspects that must be considered when determining the efforts made to provide infrastructure: **availability** and **accessibility**.

In terms of the **availability** of physical infrastructure, digital infrastructure requires at least three layers of physical infrastructure: backbone, middle mile, and last mile networks. First, the government has built a backbone network through the Palapa Ring programme. The range of the fibre optic cable networks stretches 12,300 km, and it is planned to be developed by the Palapa Ring Integration project, which will extend the network for another 11,610 km. Doing so will enable the total stretch of optical fibre to exceed 23,000 km on land and sea by 2025.¹¹¹

Second, the government has built a middle-mile network layer by strengthening fibre link network connectivity, microwave links, and satellites. In June 2023, the satellite of the Republic of Indonesia (SATRIA-1) was launched to provide equitable internet access throughout Indonesia, especially in remote, disadvantaged, and underdeveloped (3T) regions. The satellite aims to support digital transformation efforts by providing internet coverage to 150,000 public service points, such as providing internet access for 3,700 community health centres and hospitals, providing internet access to 3,900 community security services in the 3T region, and covering 47,400 village, sub-district, and other local government offices.¹¹²

Third, the last mile layer comprises the construction of the BTS (Base Transceiver Station) or transmitting station. Currently, the 4G signal infrastructure covers 82% of Indonesia.¹¹³ The 4G BTS have been available in 70,670 rural areas out of a total of 83,218 villages in Indonesia.¹¹⁴ Meanwhile, as of 2020, the country has six internet service provider operators, with Telkomsel having the largest market share at 51.7%, followed by Indosat (17.9%), XL Axiata (17.1%), Hutchison 3 Indonesia (9.2%), Smartfren Telecom (4.0%), and Sampoerna Telekomunikasi Indonesia (0.1%).

Table 10 ICT infrastructure component scores and download speeds of Indonesia, Nigeria, Türkiye, and Vietnam

GII 2022 (from 132 countries)	Indonesia	Nigeria	Türkiye	Vietnam
ICT infrastructure component score	72.5 (rank 66)	47.1 (rank 110)	82.2 (rank 38)	72.1 (rank 70)
Download speed	25.59 Mbps (rank 120)	14.46 Mbps (rank 143)	33.32 Mbps (rank 110)	91.24 Mbps (rank 40)

Source: (World Intellectual Property Organization (WIPO), 2022)

The availability of Indonesia's information technology infrastructure is competitive when compared to the other three studied countries (see Table 10). Indonesia's score of 72.5 and ranking of 66 outperformed the scores of Nigeria and Vietnam. However, Indonesia lags far behind Türkiye. Interestingly, although Indonesia obtained almost the same value as Vietnam, the development of 5G infrastructure in Vietnam appears to be more advanced than Indonesia.

Pilot projects for 5G commercialisation in Vietnam have started since December 2020 and have covered 40 of the 63 provinces and cities in the country. The Vietnamese government has targeted that 25% of the total population will use the service in 2025. The Vietnamese government is working with three mobile operators, Viettel, Mobifone, and VNPT, to reach this target. Each operator has targets for

¹¹¹ (detikJatim, 2022)

¹¹² (Septiani, 2023)

¹¹³ According to data from the Ministry of Communications and Informatics (2018) in (Chen, Ramli, Hastiadi, & Suryanegara, 2023)

¹¹⁴ (Antaranews.com, 2022)

building 5G BTS stations in several regions.¹¹⁵ Vietnam ranked 10th among countries with the most 5G-connected devices worldwide in the third quarter of 2022.¹¹⁶

In terms of developing technological infrastructure, Indonesia's challenges are very different from the other three countries. One of the striking differences is from a geographical aspect. Indonesia is an archipelago with an area of 1,905 million square km. Meanwhile, the other three countries are landlocked countries with an area of under 1 million square km.

Although the availability of digital technology infrastructure has been relatively evenly distributed in all regions of Indonesia, there is still room for improvement in terms of **accessibility**. First, the quality of internet speed can be improved. The tests conducted through Speedtest put Indonesia in 120th place with an average download speed of 25.59 Mbps. In this matter, Vietnam has a much higher speed quality than Indonesia, with an average speed of 91.24 Mbps.

Second, network coverage. According to data from the Telecommunications and Information Accessibility Agency of the Ministry of Communication and Informatics, there are still 12,548 villages without 4G coverage. Of these villages, about 72% fall into the 3T (Forefront, Outermost and Disadvantaged) category.¹¹⁷ This issue is attempted to be resolved through the Ministry of Communication and Informatics Regulation No. 2/2021 concerning the Strategic Plan of the Ministry of Communication and Informatics for 2020-2024, which sets the priorities for information technology development through the efforts mentioned above, such as (a) the provision of 4G base stations in 3T areas in 5,053 locations, (b) increasing satellite capacity for the provision of internet access in 12,377 public service locations, and (c) the construction of a National Data Centre with a target of 20% physical construction.

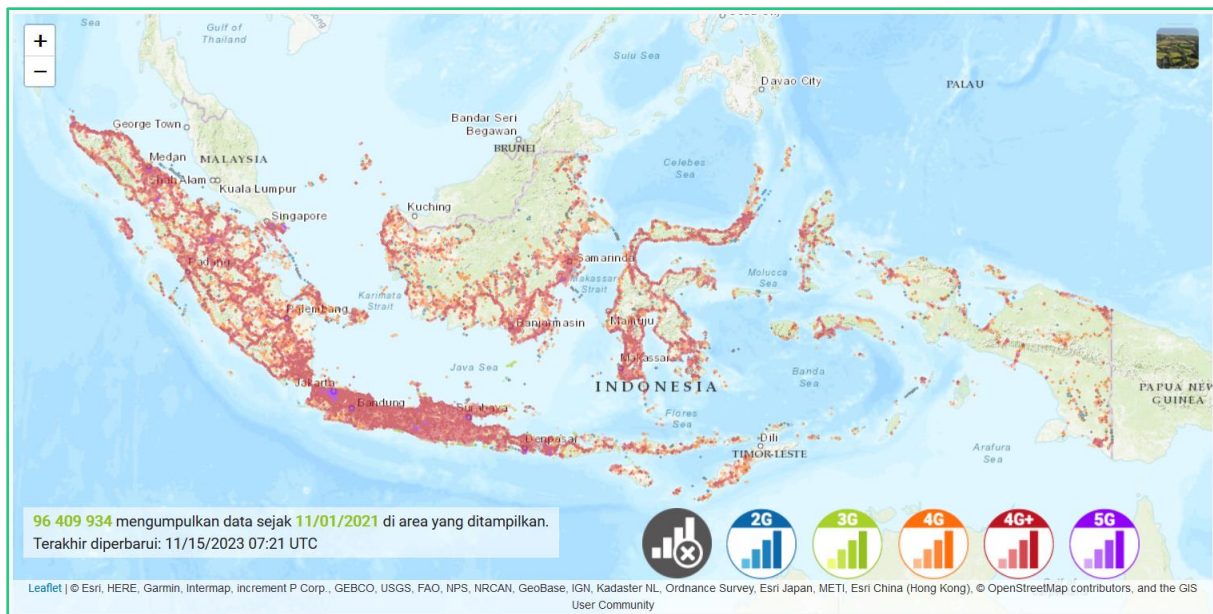


Figure 7 Telkomsel 3G/4G/5G network coverage map in Indonesia

Source: (nPerf, 2023)

Indonesia's unequal 4G access is depicted visually in Figure 7, where Telkomsel's coverage (as the operator that controls the market share) is concentrated in Java and Sumatra.¹¹⁸ This challenge is quite complex due to the uneven distribution of basic infrastructure that supports digital technology usage. Many areas do not have a 24-hour connection to the electricity network. Meanwhile, a stable electricity

¹¹⁵ Based on a written interview with DTC Vietnam.

¹¹⁶ (Nguyen, 2023)

¹¹⁷ (Primantoro, 2023)

¹¹⁸ Network coverage of other operators (IM3, Smartfren, and XL Axiata) showed a similar trend with Telkomsel.

network plays an important role to optimise the use of digital technology. In addition, there are issues regarding road access and transportation for logistics delivery in areas with steep terrain.¹¹⁹

Table 11 The adoption and use of telecommunication devices and services in Indonesia, Nigeria, Türkiye, and Vietnam

Digital infrastructure	Indonesia	Nigeria	Türkiye	Vietnam
Internet Penetration	77% (212.9 million users)	n/a	83.4% (71.38 million users)	79.1% (77.93 million users)
Social Media	60.4% (167 million users)	n/a	73.1% (62.55 million users)	71.0% (70 million users)
Mobile phone subscribers	128% (353.8 million)	n/a	95.4% (81.68 million)	164% (161.6 million)

Source: (We Are Social & Meltwater, 2023)

Furthermore, affordability issues could lead to digital inequality (digital divide), where there will be citizens left behind who are unable to harness the potential of digital technology to sustain activities and increase individual productivity. Compared to Türkiye and Vietnam, internet penetration in Indonesia has only reached 77% of the total population (see Table 11). Indonesia's digital inequality is evident through the ratio of cell phone use, which reached 128%, which is equivalent to 353.8 million users. This figure exceeds the number of Indonesia's population of 277.43 million people. It suggests that there are groups of people who can easily have access to use digital technology. However, at the same time there are groups of people who do not have the same opportunity to optimise digital technology.

¹¹⁹ (Direktorat Telekomunikasi, 2023)



**COMPLEMENT OF
DIGITAL TRANSFORMATION:
HUMAN CAPITAL**

4. COMPLEMENT OF DIGITAL TRANSFORMATION: HUMAN CAPITAL

The achievement of a country's desired digital transformation efforts is affected by the relationship between digital technology usage and the digital capacity or expertise (digital skills) that exist in the country. Indonesia's digital expertise - although much better than Nigeria, Türkiye, and Vietnam (see Table 12) - needs to be improved. Based on several indicators on the Digital Skills Gap Index (DSGI), Indonesia's score is 5.2 (on a scale of 10) and ranks 47th out of 134 countries. These figures indicate the strength, resilience, and responsiveness of Indonesia's digital power. Nevertheless, although the country's standing is considered adequate, it can still be improved along with the pace of digitalisation.

Table 12 The Digital Skills Gap Index for Indonesia, Nigeria, Türkiye, and Vietnam

The Digital Skills Gap Index (2021)¹²⁰ - scores are on a scale of 10, and rankings are out of 134 countries	Indonesia	Nigeria	Türkiye	Vietnam
Overall score	5.2 (rank 47)	3.6 (rank 103)	4.5 (rank 79)	5.0 (rank 53)
Digital Skills Institution Score	4.7 (rank 61)	3.3 (rank 106)	3.6 (rank 94)	4.0 (rank 84)
Digital Responsiveness Score	4.6 (rank 71)	1.4 (rank 125)	2.1 (rank 114)	4.3 (rank 76)
Government Support Score	4.5 (rank 57)	3.0 (rank 103)	4.2 (rank 65)	5.2 (rank 42)
Supply, Demand, and Competitiveness Score	6.9 (rank 21)	4.9 (rank 88)	5.3 (rank 77)	6.1 (rank 43)

Source: (Wiley, 2021)

Indonesia still faces digital skills gap due to the lack of a skilled and competitive workforce in the digital field. Several capabilities are considered for measuring the capacity of human resources to adapt to digital transformation, such as innovation, competitiveness, research capabilities, and empowerment.

Digital capacity or expertise is the ability to cope with digitalisation, and it is determined by the capacity or skills of the human resources or the existing digital talent. In this case, human resource capacity is defined as a form of intellectual capital that creates a competitive advantage in digital transformation efforts and contributes to development.

There are three channels to develop digital skills and improve digital literacy and competence: education, training, and employment.¹²¹ However, in this study, another channel is considered in identifying the capacity of human resources: culture. The cultural aspect is included because digital culture is essential in connecting humans to using the internet. Digital culture can explain how digital

¹²⁰ *The Digital Skills Gap Index* identifies and evaluates the factors that underpin the pillars of digital *strength*, *resilience*, and *responsiveness* of a country. This chapter will focus on pillars related to *digital skills*, such as Pillar 1, *digital skills institutions*, considers the institutional frameworks available for building *digital skills*, the 2nd pillar, *digital responsiveness*, evaluates a country's ability to respond to digitalisation, Pillar 3, *government support*, measures the government's support in building the country's *digital skills*, and Pillar 4, *supply, demand, and competitiveness*, measures the inequality of supply, demand, and the level of competitiveness of a country in terms of its *digital skills*.

¹²¹ (The SMERU Research Institute, Digital Pathways at University of Oxford, and UNESCAP, 2022)

media and technology can shape people's daily interactions and behaviours when socialising or working.¹²²

4.1 Educational aspects

The prevailing education system will affect the pace of digital transformation in a country. One of the methods to prepare the Indonesian workforce to adapt to technological developments, especially digital technology, is through ensuring that the applicable education curriculum can also adapt to such developments. The Ministry of Education, Culture, Research, and Technology (*Kemendikbudristek*) is responsible for regulating and monitoring the preparation and implementation of primary, secondary, and higher education curricula in Indonesia. Currently, primary and secondary education institutions in Indonesia refer to the Freedom Curriculum (*Kurikulum Merdeka*).

The Freedom Curriculum is one of the solutions used to overcome the challenges of digital technology and demonstrates the government's readiness to implement digital education. The COVID-19 pandemic also accelerated digitalisation in the education sector. Additionally, as offline learning was hampered, it brought about the challenge of learning loss. Meanwhile, the Freedom Curriculum encourages participants and educators to keep up with new developments, such as by utilising technology as a learning medium. Digital education has also become a priority due to its long-term benefits. For example, the integration of the Industrial Revolution 4.0 into the world of education resulted in an improved curriculum which focuses on improving 1) critical thinking, 2) creativity and innovation, 3) interpersonal skills and communication, 4) teamwork and collaboration, and 5) self-confidence.¹²³

In Vietnam, Information and Communication Technology (ICT) education begins at the secondary school level. One of the objectives of ICT education in Vietnam is to apply cognitive aspects to the prevailing curriculum. Thus, the curriculum focuses on basic skills, digital skills, and improving the students' thinking skills. However, the ICT education curriculum in Vietnam only focuses on several aspects, such as legal, social, and industrial aspects. Unfortunately, it does not include the ethical aspects of ICT.¹²⁴ Meanwhile, in Türkiye, since 1980, education on digital technology has been integrated into the country's educational curricula and programmes, directly affecting the improvement of education quality¹²⁵. The ICT education curriculum in Türkiye aims to increase the implementation of digital technologies in several areas. The Turkish ICT Curriculum is provided to students in middle school (grades 5 - 8) and high school (grades 9 - 12). In addition, Türkiye also adopted the DigComp framework issued by the European Union. The framework focuses on the following five competency areas:

1. Data and information literacy
2. Communication and collaboration
3. Digital content creation
4. Safety
5. Problem-solving

In Indonesia, a group of higher education science, technology, engineering, arts, and math (STEAM) programmes have integrated digital technology into their learning curriculum¹²⁶. However, although

¹²² (Digital Sociology, 2023)

¹²³ According to the Coordinating Minister for Human Development and Culture, Muhadjir Effendy in (Nastiti, 2020)

¹²⁴ (Tran & Stoilescu, 2016)

¹²⁵ Some of the programs introduced include *Computer Assisted Education (1989 - 1991)*, *the Computer Laboratory Schools Project (1993 - 1997)*, *the Basic Education Project (1997 - 2007)*, *the Secondary Education Project (2006 - 2010)*, and *the Movement of Enhancing Opportunities and Improving Technologies (FATIH) Project (2010)*.

¹²⁶ (Gayatri, 2022) mapped out a list of courses relevant to digitalisation and observed the needs for a *digital workforce* and the growth of ICT jobs in the 2021-2025 period. The list of STEAM study programs relevant to digitalisation can be seen in Appendix B.

many STEAM courses have integrated digital technologies into their curricula, this has yet to be applied to the educational curriculum in general. An example would be in vocational education, as the current vocational education system has not integrated much digital capacity building or expertise into its curriculum. Currently, the government of Indonesia recognises 146 skills within the spectrum of vocational education skills.¹²⁷ Unfortunately, these 146 Vocational/Islamic Vocational skills are yet to address the needs of the business world, the industrial world, and the working world in preparing a work-ready workforce. Therefore, skill mismatches still occur between what is expected by the business world, industrial world, and working world and what is offered by vocational education graduates. In addition, the prevailing spectrum of vocational skills is still focused on conventional skills, such as skills that are vulnerable to automation.

4.1.1 The challenges of digital transformation efforts in education systems

Education systems face the following challenges in their efforts to improve human resource capacity:

1) The perception of educators of higher education institutions

Some educational institutions stated that many of their educators are not ready to implement teaching methods and curricula that can address the capacity needs for digital technology and Industry 4.0. In 2021, the Centre for Digital Society (CfDS) surveyed 19 higher education institutions. The educators from 13 of these institutions perceived digital transformation in the industry (Industry 4.0) as something more associated with technical aspects, such as industry changes due to technological updates. Through this perspective, the main digital skills that require focus are technical skills, such as the ability to process big data, cloud computing, artificial intelligence (AI), Internet of Things (IoT), and algorithms. Meanwhile, the educators from five of these institutions looked at Industry 4.0 from a social perspective, where soft skills and social change control Industry 4.0. Through this perspective, the main abilities that require focus are those related to social order, social behaviour, creativity, and changes in job competence. The remaining educators from one institution viewed Industry 4.0 through a socio-technical perspective, where technological changes in the industry occur due to changes in employment and social behaviour. Therefore, this survey indicates that educators' perceptions towards digital transformation are still more focused on technical aspects than social aspects.¹²⁸

2) Vocational education systems that have not adapted to technological development

In Indonesia, one of the main indicators of success in vocational education is the link-and-match programme. The programme links and matches vocational graduates with the industry through partnerships. These partnerships are expected to help students and vocational graduates gain access to employment. However, in its implementation, the partnership is still supply-oriented. It has not been mutually beneficial for both parties (the business world, the industrial world, the working world, and vocational education institutions). The study programmes/skills expertise programmes in vocational education and training institutions have not been able to harness the region's potential and meet the needs of the business world, the industrial world, and the working world. This issue has resulted in vertical and horizontal mismatches, especially due to technological development and digitalisation.

Meanwhile, Vietnam's vocational education system has implemented a work-based curriculum. However, in its implementation, practical cooperation between stakeholders is still limited. The lack of cooperation between vocational education institutions and business actors is also still a problem in Vietnam. In addition, one of the biggest challenges of vocational education and training institutions in Vietnam is the lack of ability of the institutions and their workers to integrate technological developments

¹²⁷ Based on the regulation of the Director General of Primary and Secondary Education of the Ministry of Education and Culture No. 6/2018 concerning the Spectrum of Vocational/Islamic Vocational Skills.

¹²⁸ (Mantovani, Duanaiko, Haryanto, Putri, & Angendari, 2021)

– especially digital technology – into the vocational learning system. Meanwhile, in Nigeria, there are still a limited number of educators with ICT expertise. Thus, vocational education and training institutions in Nigeria still find it challenging to improve their teaching quality and learning outcomes. Finally, in Türkiye, digitalisation in vocational education and training institutions is already underway. Therefore, their next challenge is ensuring sustainability.

4.1.2 Efforts to improve the education system to encourage digital transformation

The following are some of the efforts made to encourage digital transformation in the educational system:

1) The Digital Literacy Movement

The Digital Literacy Movement is a programme of the Ministry of Communication and Informatics (*Kemkominfo*) in collaboration with a non-governmental organisation, Digital Guide: Indonesian Digital School Network, whose duty is to provide enrichment related to the equitable distribution of digital literacy. This programme aims to increase knowledge and contribute to developing a curriculum related to digital literacy. This is done through increasing the index of four pillars of digital literacy: digital skill, digital ethics, digital safety, and digital culture. In its implementation, the government strives to increase the value of all pillars, especially the digital ethics and digital safety pillars. Digital safety has become the main focus because of the current rampant phenomenon of digital crime in society.

2) The School Digitalisation Program

The Ministry of Communication and Informatics (*Kemkominfo*) launched a School Digitalisation Program to utilise Information and Communication Technology (ICT) developments in schools. The digitalisation programme utilised funds from the School Operational Assistance Fund Program. In its implementation, the government facilitated learning by providing tablet computers. The main target areas of this programme are the 3T (Forefront, Outermost and Disadvantaged) areas. The Ministry of Communication and Informatics (*Kemkominfo*) also stressed that this programme will not eliminate the face-to-face learning process. Face-to-face learning in the classroom remains important and irreplaceable and will be enriched with digital content.

3) The Revitalisation of Vocational Education and Vocational Training (VEVT)

In the scope of vocational education, Presidential Regulation No. 68/2022 concerning the Revitalisation of Vocational Education and Vocational Training (VEVT) regulates the efforts conducted for VEVT to produce output/workforce that meets with the industry's needs and can overcome digital challenges. As a derivative rule of the Presidential Regulation, the Coordinating Ministry for Human Development and Cultural Affairs Regulation No. 6/2022 concerning the National Strategy for Vocational Education and Vocational Training discloses the efforts needed to support digitalisation in the vocational education and training system as follows:

1. Re-designing job profiles to consider digital transformation as a workplace requirement;
2. designing training programmes that prepare participants to be aligned with an increasingly digitalised work environment in which the programme is expected to develop industry and technology-specific competencies, such as curriculum development, applying learning design principles in teaching, increasing the access and adoption of vocational education systems; and
3. upskilling the teaching and managing staff of VEVT institutions regarding digitalisation requirements, such as providing further training for VEVT personnel in education units, training institutions, the business world, the industrial world, and the working world.

4. In addition, the government affirms its efforts to improve digital skills by supporting the “Making Industry 4.0” policy. Their support is evidenced by their revision of the education curriculum to provide greater emphasis on STEAM (Science, Technology, Engineering, the Arts, and Mathematics) and aligning national education with the industry's future needs. The government is also committed to working with industry players and foreign governments to improve the quality of vocational schools and improve global labour mobility programmes to accelerate the skills transfer from foreign to domestic workers.

4) Scholarships for ICT education

Scholarships can help citizens increase their capacity. The following are some of the scholarships issued by the government of Indonesia and the other three studied countries to improve the digital capabilities of their human resources:

Table 13 Scholarship programmes for ICT education in Indonesia, Nigeria, Türkiye¹²⁹, and Vietnam

	Indonesia	Nigeria	Türkiye ¹²⁹	Vietnam
Name	The Ministry of Communication and Informatics (<i>Kemkominfo</i>) Scholarship	The NITDA Postgraduate Scholarship	No available data	Grow with Google – Accelerate Vietnam Digital Talent
Description	This scholarship is intended for Indonesian citizens to study ICT at the master's level.	This scholarship aims to promote the information technology field at the master's and doctoral levels.	No available data	This scholarship programme collaborates with Google and aims to support human resource quality improvement and digital talent development.
System	Full funding	Partial funding	No available data	Full funding with a time span of 12 months
Scholarship Provider	The Ministry of Communications and Informatics	The NITDA	No available data	The National Innovation Centre

Source: Author, compiled from various sources.

4.2 Training aspects

Efforts to improve the quality of the training system organised by the government are generally conducted in conjunction with the improvement of the vocational education system, such as through the implementation of Presidential Regulation No. 68/2022 (see Section 4.1). Specifically for digital talent training, the government, through the Ministry of Communication and Informatics (*Kemkominfo*), is committed to accelerating the digital competence of the nation's human resources with a target of having 300,000 workers trained and certified in the field of ICT by 2024. A Professional Certification Body (PCB) in ICT was established to reach this target. In Indonesia, the PCB in the field of ICT is

¹²⁹ No data found.

located in Surabaya. It provides 90 certification schemes of expertise in the field of ICT, with the cost of these certifications ranging from Rp500,000 to Rp3,000,000. Furthermore, the government provides Indonesian National Competency Standard certifications in the field of ICT. Various ministries also have special training programmes related to the adoption of digital technologies. One example is the Ministry of Industry's (*Kementerian Perindustrian*) development of the Centre for Digital Industry 4.0 (CDI 4.0). The CDI 4.0 was built to help the Indonesian industry transform towards Industry 4.0. Some of the trainings held include:

1. The Operation of the Internet of Things (IoT)
2. Pneumatic and Hydraulic Training – Equipment and Systems Assembly
3. PLC-based Electronic Equipment Operations Training
4. Lean Manufacturing for Making Indonesia (LeMMI) 4.0 Training
5. Basic Training of Industrial Robots (4 Axis Robots)
6. Data Analyst Training
7. PLC-based Electronic Equipment Operations Training
8. Data Scientist Training
9. Cloud Computing Engineer Training
10. Equipment and Systems Assembly Operator Training
11. Welding Inspector Training
12. Project Management Training
13. Microsoft Project Training
14. Internet of Things Application Engineering Training
15. Arduino Microcontrollers Training
16. Digital Technology Solutions for Manufacturing Training
17. Maintenance 4.0 to Optimise Rotating Equipment Performance Training
18. Industrial Transformation 4.0 Engineering Training

In addition to the Ministry of Industry (*Kementerian Perindustrian*), the Ministry of Agriculture (*Kementerian Pertanian*) also has the One Million Farmers and Adopters Training Program. This programme aims to improve the competence of human resources in the agriculture field in adapting and mitigating their agriculture practices to climate change. It also integrates digital technology solutions in its syllabus. Nevertheless, the government's efforts are not without its challenges. The Ministry of Manpower (*Kemnaker*), as the supervisor of Job Training Centres (JTC) throughout Indonesia, understands that the current curriculum or training syllabus in various JTCs is still unable to help achieve digital training needs¹³⁰.

The government is not the only actor that provides and organises job training. Private parties also organise ICT or digitalisation training programmes. For example, in the clean technology sector, PT. Perusahaan Gas Negara Tbk (PGN) has collaborated with several well-known universities in developing human resources capacity to contribute to the achievement of national goals.¹³¹

4.2.1 The development of EdTech platforms

In the start-up ecosystem, many private parties - especially EdTech platforms, as companies that provides technology-based education industry solutions for consumers and other businesses - provide training programmes related to digitalisation through online and offline methods. EdTech platforms in Indonesia especially grew during the COVID-19 pandemic.

¹³⁰ (Kustiati, 2023)

¹³¹ (Udin, 2020)

Table 14 The total number of EdTech start-ups in Indonesia, Nigeria, Türkiye, and Vietnam

	Indonesia	Nigeria	Türkiye	Vietnam
Total number of EdTech start-ups	560	273	423	377

Sources: (Tracxn, 2023a); (Tracxn, 2023b); (Tracxn, 2023c); (Tracxn, 2023d)

Furthermore, the EdTech platforms in the four countries above (Table 14) have great investment value and generate profit. For example, Ruangguru is an EdTech start-up with the largest funding value in Indonesia because it obtained 205 million US dollars in funding.¹³² Meanwhile, in Vietnam, the projected value of EdTech start-up investments will reach 3 billion US dollars by the end of 2023. This value is due to the high demand for online education in Vietnam.¹³³ In Türkiye, income from online learning platforms is projected to reach 148 million US dollars by the end of 2023. Meanwhile, in Nigeria, EdTech start-ups have become one of the government's most preferred platforms, as they can adapt to new technologies and provide innovative learning methods. Thus, the budget allocation for education by the Nigerian government for 2021 increased by 26% compared to 2020.¹³⁴

Nevertheless, despite the proliferation of EdTech platforms, this growing industry still faces several challenges. The World Bank divides these challenges into two categories: the supply side and the demand side.¹³⁵ The challenges of EdTech platforms from the supply side are 1) limited access to funding because EdTech platforms are generally less attractive to investors than start-ups in other sectors, 2) high operational costs, and 3) lack of qualified talent equipped with relevant knowledge of the company's business model or EdTech platforms. From the demand side, the challenges faced include 1) the resistance of prospective students to EdTech platforms (in general, public education/training institutions are preferred over private institutions), 2) lack of desire to pay and lack of ability to pay for platform services, 3) digital illiteracy, and 4) the digital infrastructure gap.

In Vietnam, EdTech platforms have not been specifically regulated by the regulatory framework. Therefore, the existing policies focus more on public schools and a few EdTech platforms. In addition, the bureaucratic process for registering EdTech platforms in Vietnam has requirements that complicate the platform initiators. For example, in 2017, to establish a language or computing centre, according to prevailing regulations, the centre must "provide adequate facilities, equipment, teaching materials and financing sources to ensure the quality of training aligns with the centre's development plan and scale of operations". However, this condition is irrelevant in the context of the EdTech platforms as it employs a distance learning business model, and trainers and learners are responsible for the learning facilities and equipment needed. In Nigeria, some of the challenges faced by EdTech platforms are, among others, the lack of adequate digital infrastructure, the lack of relevant education syllabi that match the needs of the workforce, and an education system that still emphasises exams and certifications.

4.2.2 Digital Academy

In Indonesia, the Digital Leadership Academy (DLA) programme is an excellent training programme for accelerating digital transformation in Indonesia. It is a manifestation of the triple helix collaboration model (the government, businesses, and academics). This programme is assigned to leaders in the public and private sectors. It is conducted through online and on-site learning in three campuses: Harvard Kennedy School, National University of Singapore, and Tsinghua University. The onsite learning opportunities are awarded to the participants with the best scores. Various digital skills are taught in this programme, such as artificial intelligence, machine learning, cloud computing, cyber

¹³² (Tracxn, 2023a)

¹³³ (Lang, 2023)

¹³⁴ (Flexisaf, 2021)

¹³⁵ (World Bank, 2020)

security, digital entrepreneurship, digital communication, and others. In 2021, the DLA was organised for 300 leaders from the public and private sectors.

In Vietnam, similar initiatives are conducted by the private sector. The Vietnam Digital Academy is one of the platforms that aims to provide training to learners and professionals to develop their abilities in the digital field, especially regarding digital marketing. Meanwhile, in Nigeria, the digital academy offered is more targeted at Micro, Small, and Medium Enterprises (MSMEs). The SME Digital Academy¹³⁶ is an online learning platform for MSMEs. It was initiated by the Small and Medium Enterprise Development Agency in Nigeria (SMEDAN) in collaboration with Sapphital Learning Ltd. The participants will receive a certificate and support from SMEDAN after completing the programme. Moreover, the Lagos Digital Academy provides training for professionals and entrepreneurs. Türkiye has the Digital Skills Academy (DSA), which assists in building digital capabilities and developing administrative capabilities. The DSA aims to provide quality programmes to improve the students' digital skills in various types of technology and provide a labour market related to digitalisation.

In addition to the digital academy, the Indonesian government also launched the Digital Talent Scholarship (DTS), which proves the government's commitment to providing scholarships for incentive training. This programme aims to improve the workforce's ability and competitive spirit in ICT, ranging from basic skills to intermediate skills. The DTS Program also aims to reduce the digital skills gap so that the supply of digital talent does not only grow in big cities and western Indonesia. Similarly, the Tech Scholarship Training in Nigeria is a programme that facilitates Nigerians to develop their careers in the field of technology through partially funded training scholarships. This training programme includes material for all levels, ranging from beginners to advanced students.

4.3 Employment aspects

Indonesia requires vocational school and university graduates – particularly STEM majors in the ICT field or those with digital skills – in their future workforce.¹³⁷ The standard used to measure worker competence is the Indonesian National Competency Standard/INWCS (*Standar Kompetensi Kerja Nasional Indonesia/SKKNI*). The INWCS is regulated and monitored by the Ministry of Manpower (*Kemnaker*). The government uses the INWCS as a foundation to map the jobs required by different sectors in Indonesia. In the communication, telecommunications, and information sectors, only three INWCS can be used as a reference for professionals and industries (including professional certification bodies). Unfortunately, the three INWCS are still targeting the unskilled and semi-skilled workforce. It has not targeted the workforce with more advanced skills.¹³⁸

In Nigeria, the Nigerian Skills Qualification Framework (NSQF) (previously called the National Vocational Qualification Framework (NVQF)) is the reference used to classify the skills, knowledge, and competencies required by the population. This framework also serves as a reference for the available training programmes.¹³⁹ There are currently 64 National Skills Qualifications (NSQs), or skill qualifications offered by Nigeria that its citizens can obtain. However, out of these 64 NSQs, only three qualifications are related to technology development, and only ten qualifications are specific to the development of digitalisation. Additionally, Nigeria also has the National Occupational Standards (NOS). The NOS describes the performance or competence standards that an individual must meet to be competent in the labour market. It also includes the required specifications and knowledge that must be met.

¹³⁶ <https://smedigitalacademy.com/>

¹³⁷ (Gayatri, 2022)

¹³⁸ Idem.

¹³⁹ (NBTE Secretariat, 2023)

Meanwhile, in Vietnam, the Vietnamese Qualifications Framework aims to classify the minimum academic capacity and level in vocational and undergraduate education.¹⁴⁰ Currently, all organisations in Vietnam that require official certification related to digital capabilities (digital skills) must follow the reference from 'The Information Technology Skills Standard' that was established by the Ministry of Information and Communication (MIC) in 2014.¹⁴¹ The Vietnamese MIC created the following model of ICT competency standards:

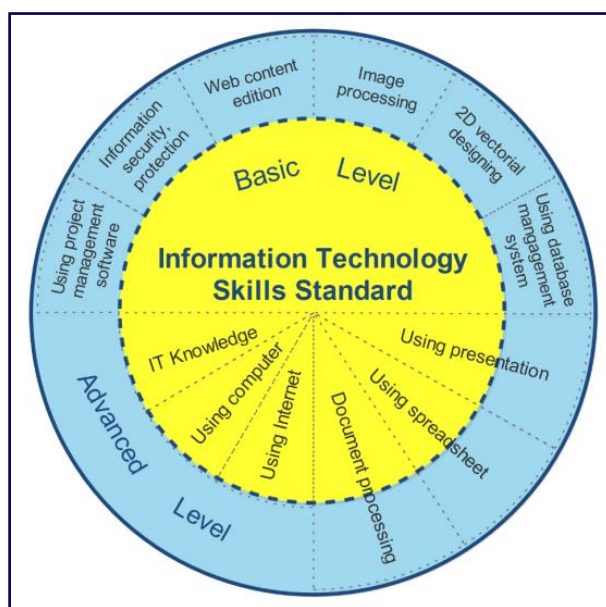


Figure 8 Model of ICT Competency Standards in Vietnam

Source: (Tan & Nguyen, 2020)

In Türkiye, the Turkish Qualifications Framework (TQF) is used as the basis for educational and training institutions to determine the competencies needed by the population. The TQF aligns with the European Qualifications Framework (EQF). In Türkiye, some of the key competencies that all individuals must achieve to achieve life-long learning are as follows:

1. Communication in the mother tongue
2. Communication in foreign languages
3. Mathematical competence and key competencies in science/technology
4. Digital competence
5. Learning to learn
6. Social and civic competence
7. Sense of initiative and entrepreneurship
8. Cultural awareness and expression

4.4 Cultural aspects

Digital culture is human behaviour in using digital technology. Studying and analysing digital culture will help understand people's behaviour when interacting, behaving, thinking, and communicating in cyberspace. On the one hand, the use of digital technology can increase productivity and reduce social inequality through better access to public services, such as improved access to health services. In addition, digital technology can have an impact on improving one's well-being and potential through broadening human insight and cognition. Conversely, digital technology – especially regarding internet

¹⁴⁰ Based on the Prime Minister's Decision No. 1982 / QĐ-TTg on the Approval for the Vietnamese Qualifications Framework.

¹⁴¹ (Tan & Nguyen, 2020)

use behaviour – can have negative impacts on mental health, such as depression and anxiety disorders. Generally, in Indonesia, responsible digital technology usage still needs to be improved. The country's high ICT capability has not been accompanied with innovation, creativity, and wisdom in its usage.¹⁴²

This challenge of building a good digital culture is not only experienced by Indonesia but also by Nigeria, Türkiye, and Vietnam. The following are some digital culture challenges that need to be addressed:

1) Internet ethics (netiquette) that still needs to be improved

Netiquette or internet ethics refers to common practices in internet usage. Netiquette has become an essential element in interacting in the digital world.¹⁴³ Digital ethics has also become one of the pillars of digital literacy. Based on a study conducted by Microsoft in 2020, through the Digital Civility Index (DCI) or Digital Civility Index survey, Indonesia is ranked 29th out of 32 countries and has the worst score in the Asia Pacific region, with a score of 76.¹⁴⁴

Table 15 The rankings and scores of Indonesia, Nigeria, Türkiye, and Vietnam in the Digital Civility Index (DCI)

The Digital Civility Index (DCI)	Indonesia	Nigeria	Türkiye	Vietnam
Ranking (out of 32 countries)	29	N/A	17	24
Score (scale of 0 - 100)	76	N/A	68	72

Source: (Mazrieva, 2021)

The prevalence of hoax news, hate speech, pornography, defamation, and even online fraud is still a challenge in Indonesia. In 2022, the National Cyber and Crypto Agency (*Badan Siber dan Sandi Negara*) recorded more than 700 million cybercrimes. The low netiquette of Indonesian citizens also indicates that many netizens do not yet have digital resilience. Digital resilience is the ability of individuals to absorb information, limit themselves, and share information in the digital world.¹⁴⁵

Nevertheless, the same challenges are also faced by Nigeria, Türkiye, and Vietnam. For example, 7.5% of cybercrimes worldwide are conducted by Nigerian citizens.¹⁴⁶ Although Türkiye's DCI ranking is still far above Indonesia, surveys show that there are still citizens who claim to have been victims of online hate speech because of different political views (39%), religion (32%), and appearance (29%).¹⁴⁷ Meanwhile, in Vietnam, there are more than 5,400 cases of cybercrimes, especially during the COVID-19 pandemic, which is rife with the spread of hoaxes and online fraud cases.¹⁴⁸ Moreover, in Vietnam, there are also concerns about the potential for new risks in human rights violations due to digitalisation, especially regarding the protection of personal data and data privacy issues. Therefore, the Vietnamese Ministry of Information and Communication is currently working on developing a code of conduct for social network users to create a healthy virtual environment.

¹⁴² Based on research by SEAMEO in (Linda, 2021).

¹⁴³ (Dhiya, 2022)

¹⁴⁴ The DCI scale is arranged on a scale of 0-100 where a low score indicates higher politeness/civility, and vice versa.

¹⁴⁵ (Pangestika, 2023)

¹⁴⁶ (ThisDayLive, 2022)

¹⁴⁷ (Daily Sabah, 2020)

¹⁴⁸ Based on data from *the Authority of Information Security (AIS)*, a work unit that is under *the Ministry of Information and Communications (MIC)* Vietnam.

2) Community perspectives on digitalisation

Digital technology is rapidly changing how people communicate, work, learn, and shop.¹⁴⁹ One of the effects of digitalisation is self-service technologies, where users can access and explore the internet on their own without any space and time limitations. The development of information and communication technology drives digital transformation, resulting in changes to the industrial order.¹⁵⁰ The emergence of the digital economy concept¹⁵¹ and digital workers have also shown that digitalisation can occur across different aspects of life, albeit with varying degrees of acceptance. For example, in the industrial sector, workers in upper/middle-level management will show different levels of acceptance of Industry 4.0 compared to workers at a lower level. Moreover, the size of the industry affects the acceptance of Industry 4.0. Large industries are more receptive to and encourage digitalisation in their companies than leaders of small and medium-sized industrial companies. Opinions that often arise include digitalisation in the industry (Industry 4.0) is perceived to require high costs (for small/medium industry leaders) or is considered to threaten job opportunities (for lower-level workers).¹⁵²

In agriculture, the readiness of Indonesian farmers to adopt digital technology is also still a challenge. In general, the average age of Indonesian farmers is 52 years, and most have only completed primary or secondary education. Thus, their limited capacity to implement digital technologies for agriculture - such as smart farming technology (SFT) - makes the adoption of new technologies challenging. Although farmers have shown a tendency to agree that digital technologies such as SFT will benefit their business sustainability, readiness to adopt such technologies is a challenge.¹⁵³ The challenges of digital technology adoption for agriculture are also experienced in Nigeria and Türkiye. In Nigeria, small-scale farmers do not have many opportunities to improve their technical skills (including the effective use of digital technology for agriculture), thus affecting their adoption rate of digital technology.¹⁵⁴ In Türkiye, the level of productivity of farmers in using digital technology, lack of transparency in supply chains, and lack of efficient public support are still challenges in promoting digitalisation in the agricultural sector.

3) The digital literacy gap

A person's level of digital literacy also affects their behaviour and digital resilience. Based on the digital literacy survey conducted by the Katadata Insight Center (KIC) with the Ministry of Communication and Informatics (*Kemkominfo*), the percentage of respondents with a high digital literacy index for each generation was 59.7% in Generation Z, 54% in Generation Y, 39% in Generation X, and 28% in baby boomers. The survey findings support Deloitte's research, which states that younger generations are highly exposed to and are connected to digital technology use. These findings also align with the duration of internet use. Generation Z and Y tend to access the internet longer (more than 6 hours) than Generation X and baby boomers (1-2 hours per day). Moreover, the digital literacy gap occurs not only between generations, but also between urban and rural locations. Based on the 2021 Indonesia Digital Literacy Status survey, residents in urban areas have a higher literacy index of 52.5%, or 2.7% higher than residents in rural areas.

To improve digital literacy, the government – through the Ministry of Communication and Informatics (*Kemkominfo*) - is working with various parties, such as the community, the private sector, and digital

¹⁴⁹ (Egard & Hansson, 2023)

¹⁵⁰ (Fukuyama, 2018)

¹⁵¹ All economic activities that arise and are made possible by the presence of digital technologies, such as the internet or artificial intelligence.

¹⁵² (Hamsani, 2023)

¹⁵³ (Agussabti, 2022)

¹⁵⁴ (Uzoma, 2023)

literacy activists, to organise *SIBERKREASI*, a National Digital Literacy Movement. This programme aims to empower and improve the digital literacy skills of the Indonesian people.¹⁵⁵

4) Digitalisation and work culture

During the COVID-19 pandemic, President Joko Widodo appealed to the public to reduce unnecessary outdoor activities and implement a Work-From-Anywhere system. This statement was made in response to Circular Letter No. 19/2020 concerning the adjustment of the Work System of Civil Servants to prevent the spread of COVID-19 in the Environment of Government Institutions, which imposed a work- from-home mode or domicile for civil servants. The pandemic accelerated changes in work culture with the support of digitalisation. However, this shift in working mode demanded various adjustments. Some of the issues that have arisen include uneven digital skills resulting in sub-optimal work mode transitions and the merging of boundaries of work matters with personal matters, which may result in negative outcomes. The Altimeter survey also mentioned several challenges in the integration of digital technology with work culture, such as the lack of literacy and digital capabilities of leaders and employees, reduced work efficiency, and limited resources.

¹⁵⁵ (SIBERKREASI, n.d.)



DIGITAL SAFEGUARDS

5. DIGITAL SAFEGUARDS

This section will discuss policies related to the digital safeguards efforts undertaken by the government of Indonesia to date. The three aspects discussed in this section are privacy policies, social protection, and antitrust laws. These three aspects will only be explained from a macro perspective and will not focus on any specific sectors.

5.1 Privacy policy

The passing of the Personal Data Protection Law (PDP Law) was a turning point for data sovereignty in Indonesia. After a long process, the PDP Bill was finally officially passed as Law No. 27/2022. Previously, the laws governing personal data protection were divided into 32 different regulations and were spread across various sectors. The PDP Law provides clarity on the main framework used for setting privacy policies, including - broadly speaking - the distinction and classification of personal data, the rights of data subjects, the responsibilities of data controllers and processors, and the establishment of new institutions to monitor the implementation of this law.

Personal data is the main object of the privacy policy. According to the PDP Law, personal data is defined as “information concerning an individual’s life, and can be identified, either directly or by a combination of other information, through electronic and non-electronic systems.” Different personal data types are classified by their nature. The following chart illustrates the different types of personal data.

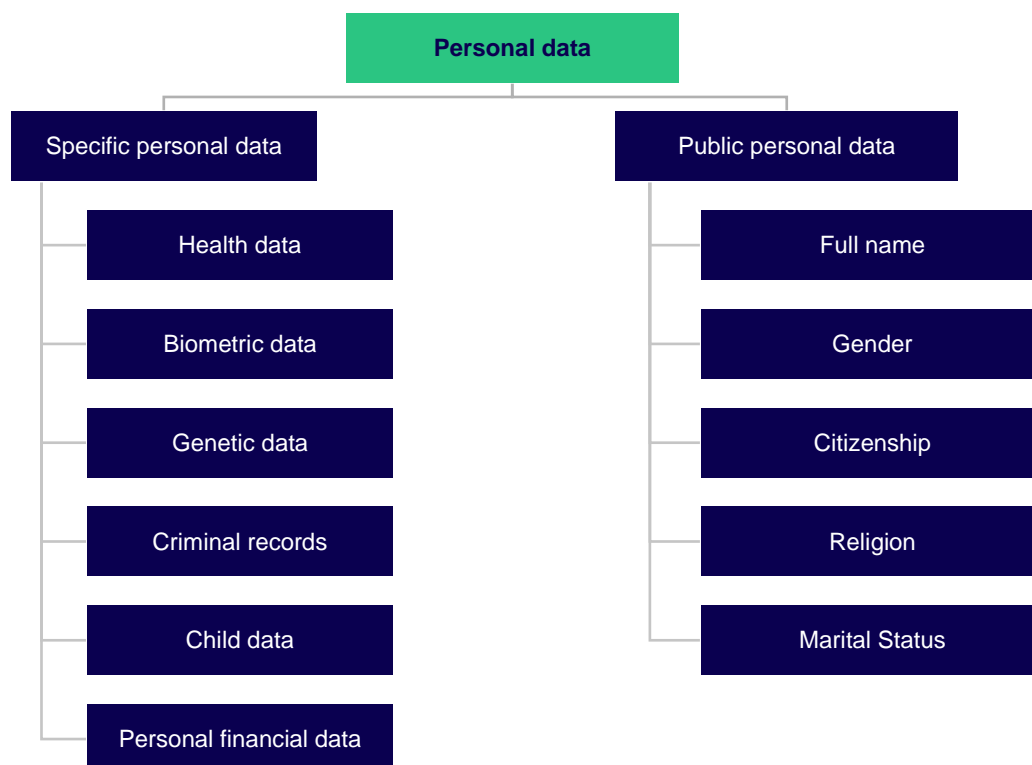


Figure 9 Classification of personal data by type

Source: Author, analysed from Law No. 27/2022 on PDP.

Meanwhile, in the data spectrum, there is public data or open data, and conversely, private data. Open data is defined as data that can be freely accessed by all levels of society. It may contain aggregated statistical data or geospatial data and does not contain personal information. Access to open data has been on the agenda of several countries, including Indonesia, to increase the transparency and accountability of government agencies.

The four countries analysed (Indonesia, Nigeria, Türkiye, and Vietnam) each have their own personal data regulations. Türkiye and Nigeria have been regulating the protection of their citizens' personal data for several years. Based on the right to privacy as a fundamental right of society, the rules of these two countries have discussed the processing of personal data, procedures, and relevant parties in processing personal data. Meanwhile, the personal data protection regulations in Indonesia and Vietnam have only been ratified less than a year ago. Therefore, its implementation is not measurable yet. The table below exhibits a comparison between data-related policies in Indonesia, Nigeria, Türkiye, and Vietnam.

Table 16 Comparison of data governance regulations in Indonesia, Nigeria, Türkiye, and Vietnam

Aspect	Indonesia	Nigeria	Türkiye	Vietnam
Personal data protection	Law No. 27/2022 on the Protection of Personal Data	The Nigeria Data Protection Act 2023 (previously the Nigeria Data Protection Regulation 2019)	Personal Data Protection Law No. 6698	Personal Data Protection Decree
Integration/ interoperability of public data	One Data Policy	Open Data Policy	OpenData Project	data.gov.vn
Cross-border data flow	Allowed if the recipient country meets certain requirements	Allowed if the recipient country meets the requirements disclosed by the Nigerian Data Protection Commission	Set forth in Article 9 Personal Data Protection Law No. 6698	There are data localisation rules that restrict the management of personal data outside the country

Source: Author, compiled from various sources.

Compared with the other studied countries, Indonesia has strong enablers or supporting frameworks. However, in terms of security, the strength of personal and non-personal data security rules in Indonesia is still insufficient. Similarly, Vietnam has a strong supporting framework and weak data security rules. Conversely, the data security framework in Türkiye is strong, but the supporting frameworks are weak. In Nigeria, both aspects are equal. The following table illustrates the comparison of supporting frameworks and data security frameworks among the four countries. ¹⁵⁶

¹⁵⁶ The assessment of this framework is derived from a report issued by the World Bank in 2021 entitled “Mapping Data Governance Legal Frameworks Around the World.” *Safeguard* is defined as the legal framework and norms protecting the rights of individuals and entities involved in data transaction processes. *Enablers* are norms and regulations that facilitate the use and reuse of data. The dimensions measured are as follows: (1) electronic transactions and *e-commerce*; (2) *enablers* for personal data; (3) *enablers* for public data; (4) *safeguards* for personal data; (5) *safeguards* for non-personal data; (6) cybersecurity and cybercrime; and (7) cross-border data transfers. In this report, there are four groupings: (a) 76-100 = very good; (b) 51-75 = good; (c) 26-50 = sufficient; and (d) 0-25 = unsatisfactory.

Table 17 Comparison of enabler frameworks and safeguards among the four countries

	Supporting pillars	Safeguarding pillars
Indonesia	good	weak
Nigeria	good	good
Türkiye	adequate	good
Vietnam	good	weak

Source: Compiled from (Chen R. , 2021)

As more information becomes accessible and the digital world expands, data becomes a valuable commodity. It is even equated with “new fuel” because of its usefulness in driving the economy. Data can be shared, transferred, and moved locally or across borders, supporting economic growth. In the business context, personal data is an aspect that is often restricted in the data exchange process.¹⁵⁷

In Indonesia, chapter VII of the PDP Law specifically regulates the transfer of personal data. Data controllers may transfer the personal data they control to other data controllers located in Indonesia as long as it follows existing law. Data transfers outside Indonesia are also permitted, provided the destination country has equivalent or higher personal data protection laws. However, although there are already articles that discuss the transfer of personal data and data classification, the mechanism of how to process data is still not stated. Moreover, no regulation has focused on the protection of sensitive data by classifying data based on risk.

Privacy policies are also important in the electronic transaction process, especially because the security of consumer data must be guaranteed. Due to the EIT Law¹⁵⁸ which focuses on the use of information technology for national economic development, points regarding the implementation of electronic systems and transactions have been formed into government regulations. The first example is Government Regulation No. 82/2012 concerning the Implementation of Electronic Systems and Transactions. This regulation was revised again in 2019 to Government Regulation No. 71/2019. This regulation gives legal clarity to electronic-based business actors and ensures the security of user data. Electronic system operators, such as e-commerce platforms, collect large amounts of personal data and are responsible for protecting such data. In other words, this regulation fills the shortcomings of the EIT Law, especially regarding practices that do not fit the current context because it was created when the e-commerce sector was not as advanced as it is now.

As a relatively new country to the massive adoption of digital technology — especially when compared to developed countries — Indonesia still needs to fix some aspects of its privacy policies. Various actors, ranging from government, private, and individuals, have their roles in supporting the country's privacy policies. The distribution of each actor's role is as follows:

¹⁵⁷ (Casalini & González, 2019)

¹⁵⁸ Law No. 11/2008 later on modified by Law No. 19/2016. The Indonesian government is currently in the process of revising the EIT Law. Several points have been proposed to be changed in the EIT Bill, namely regarding indecency, insults, defamation, extortion, threats, hoaxes, and disinformation.

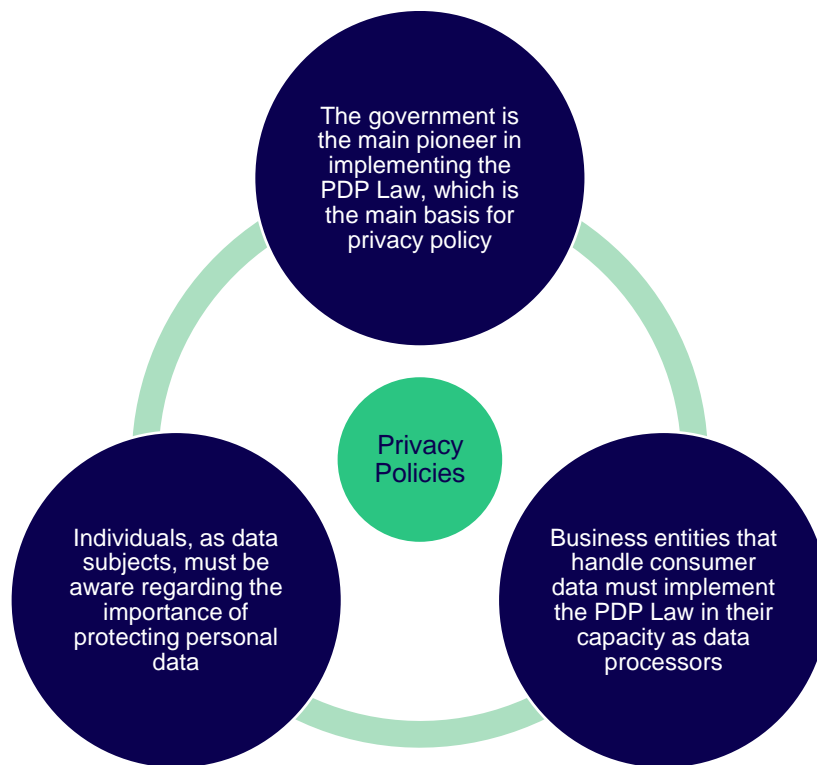


Figure 10 The role of government actors, business entities, and individuals in privacy policies

Source: Author, compiled from various sources.

Starting from the government side, although the PDP Law is still in its grace period, the implementation of each article needs to be strengthened. An example is regarding the personal data protection agency that will be established. The agency must have full authority to supervise all data processors, which includes the ministry's data processors. Moreover, many articles in this law are multi-interpretive due to the absence of other supporting rules. Thus, the completeness of the PDP Law should be current government's priority. In addition to clarifying on the existing articles, the government must immediately establish an independent personal data protection supervisory agency. In parallel, the government should pressure the business sector to adapt to this new data protection law.

Next, business entities, especially those engaged in the digital field and handling consumer data, must adjust their privacy policies to align with the PDP Law. Thus, coordination between the government and the private sector is crucial in ensuring that private companies comply with applicable legislation. Moreover, business entities must provide certainty regarding data security to ensure that their systems are protected and that they will not buy or sell any data that could potentially harm consumers.

Meanwhile, at the individual level, the most essential thing for an individual to do is to be aware of the importance of protecting the privacy and security of personal data. Knowledge about personal data and digital rights can be improved through socialisation efforts conducted by the government or non-profit institutions focusing on digital issues. In addition to focusing on knowing how to protect personal data, the public must also be given knowledge of ethics in the digital world and how to behave in cyberspace.

Box 2. Cybersecurity and privacy policies

Behind the positive impacts of the development of the digital world and increasing public participation in cyberspace, a new problem arises regarding the security and protection of personal data. Internet access has opened new opportunities for people from all walks of life to engage in the digital economy and improve their well-being. However, at the same time, they can also be harmed by digital activities.

The business operators of digital economic systems, such as e-commerce platforms or digital start-ups, have the authority to collect data from their users. User data stored by digital platforms is generally public personal data that only includes name, gender, address, phone number, or email. However, some platforms can also store credit card data as a payment method for online transactions.

To some extent, users of the digital economy sector are required to understand the platform's privacy policy and be careful in sharing their personal data because data misuse can happen to anyone. The most vulnerable members of society whose personal data is misused are those from the agricultural, forestry, and fishing sectors. Their work does not require them to be skilled at using technological devices. Therefore, many are unfamiliar with the internet. Even if they already have a device equipped with the internet, many are still unaware of the dangers of fraud, data and identity theft, or bullying. Thus, there must be increased digital literacy for those from the agricultural sector to protect their data from being misused by irresponsible parties. This effort aligns with one of the articles in the PDP Law, which emphasises the need for socialisation and education about the importance of maintaining the security and confidentiality of personal data.

5.2 Social protection

Technology adoption and digital transition have impacted the employment landscape. On the one hand, digitalisation has offered a flexible work hour mode that many people choose. On the other hand, this disruption also increases job loss risks of various positions and job cuts. Broadly speaking, there are three types of impacts. First are the direct impacts felt by internal employees in the company. Second, are the indirect impacts that affect the value chain process of an industry. Third are the induced impacts from what is occurring to external parties and their value chain. The table below illustrates the three types of impacts, along with examples.¹⁵⁹

¹⁵⁹ (Pawennei, Filaili, Novianda, & Farhan, 2021)

Table 18 Impact of digitalisation on employment

Actors	Direct impacts	Indirect impacts	Induced impacts
The government	<ul style="list-style-type: none"> Increased urgency for the government to develop digital infrastructure. The need to restructure the current labour policy. 	<ul style="list-style-type: none"> Increased collaborations between governments, business entities, and training institutions, especially in creating digital curricula. The rise in the number of foreign workers. The government must prepare for any consequences that may arise. 	<ul style="list-style-type: none"> Changes in the contribution structure of certain sectors to gross domestic income. Global encouragement to achieve net zero, which is generally supported by digitalisation. The emergence of the national brain drain phenomenon (where a country has a large number of qualified workers, but they choose to work abroad, thereby reducing the country's workforce).
Business entities	<ul style="list-style-type: none"> Increased productivity. Changes in contract systems. Changes in the organisation of work. Removal of certain jobs. 	<ul style="list-style-type: none"> Changes in the relationship between business entities with vendors and contractors (it can increase or decrease). The emergence of skills training institutions and vocational schools. 	<ul style="list-style-type: none"> The infrastructure development process can result in MSMEs to grow in the surrounding area. Reduced face-to-face meetings in conducting business activities.
Individuals	<ul style="list-style-type: none"> Workers are required to have certain abilities. Changes to job functions. Reduced working hours. Work options that are more flexible in terms of time and place. 	Contractor and vendor workers' workloads may be affected.	Increased work opportunities when MSMEs start to emerge.

Source: Author, compiled from (Pawennei I. , Filaili, Novianda, & Farhan, 2021).

The table above describes the various impacts of digitalisation on employment on three levels: countries, business entities, and individuals. For direct impacts, with the shift in norms in the digital industrial world, the government is required to begin transitioning industrial policies to be more friendly to digital transformation and building adequate digital infrastructure. Meanwhile, productivity, work systems, and work organisation changes will directly affect business entities or industries. Additionally, changes in skill requirements, work functions, and working hours will affect individuals.

For indirect impacts, the most highlighted aspects are the components of the value chain. Countries will be most affected in terms of the increase in multi-sector collaboration. In addition, the expansion of the industrial market will also cause a rise in foreign workers in the country, which means there needs to be efforts to deal with the positive and negative impacts of this. For businesses, the relationship

between the industry and contractors can change — it could either increase or decrease in intensity. These changes then influence the duties and functions of workers disclosed in contracts. There will also likely be business entities engaged in vocational training to meet workers' capacity-building needs.

Induced impacts are described as everything caused by the snowball effect of digital transformation that is outside the value chain. In the context of countries, the induced impact of digital transformation is the altered structure of contributors to gross domestic income (GDP), where the technology sector has become stronger. Technology and digitalisation also drive the achievement of the net zero process currently on the global agenda. However, a negative induced impact is the national brain drain phenomenon, where qualified domestic talent chooses to work abroad, reducing the country's number of qualified human resources. Next, for business entities, digital developments supported by infrastructure development will give rise to MSMEs around the project site, providing new job opportunities. Digitalisation will also result in the reduced intensity of face-to-face meetings for business entities.

Meanwhile, one clear example of the direct impact of digitalisation can be seen in the industrial and manufacturing sectors. The use of automated machines and robots has resulted in job losses. The trend of recent years has also proven that the banking and service sectors can be potentially replaced by machinery and artificial intelligence. This trend is seen in the reduced number of toll officers due to the use of e-tolls, the reduced number of bank branches as its funds are allocated to form digital banks,¹⁶⁰ and the loss of travel agents due to the rise of accessible travel platforms. Based on the report issued by the World Economic Forum in 2023, the types of work with the most significant decline are shown below:

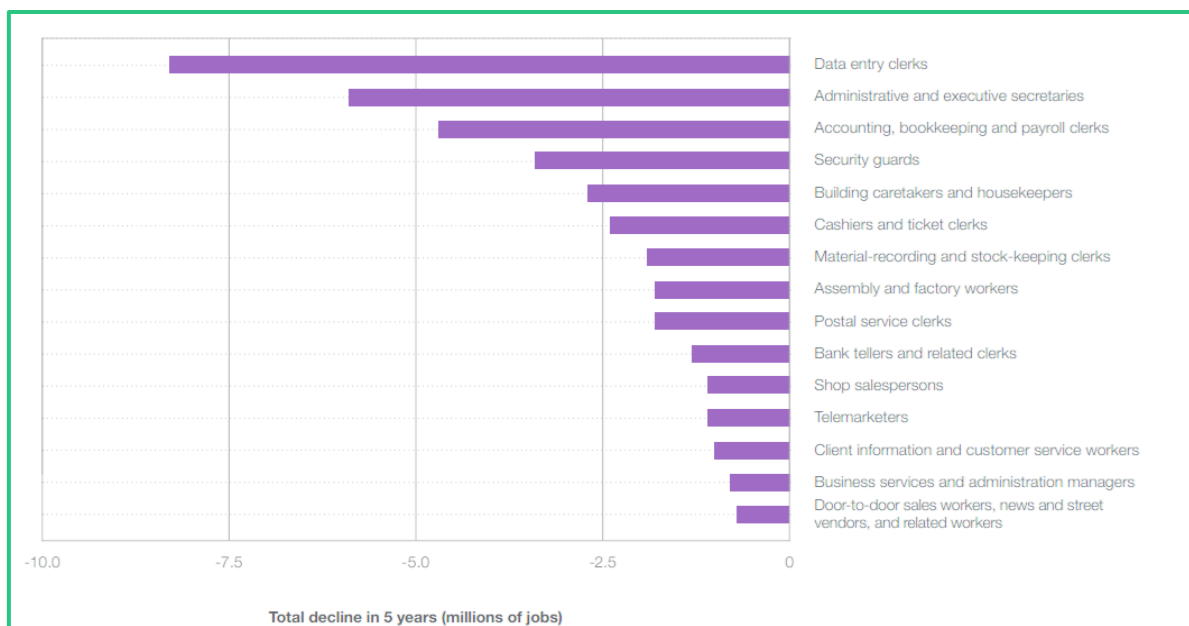


Figure 11 Fastest-declining roles over the past five years (in millions)

Source: (World Economic Forum, 2023)

¹⁶⁰ (The Straits Times, 2017)

Based on a Kompas article dated June 28, 2023, the information and communication, financial and insurance services, and corporate services sectors are the most helped by technology in Indonesia. However, these three sectors are not the largest contributors to Indonesia's GDP because the three largest contributors to GDP are the (1) manufacturing industry, (2) wholesale and retail trade and (3) agriculture, forestry, and fisheries sectors. Technologies such as artificial intelligence have had an impact on time efficiency. However, this advantage can be a double-edged sword because it will impact freelancers who are paid by the hour. Moreover, as one of the top three contributors to the country's GDP, the agricultural sector is the least exposed to technology, and most of its workers do not use the Internet.

The COVID-19 pandemic also had a significant impact on employment issues. According to data from the Ministry of Manpower (*Kementerian Ketenagakerjaan*), as of August 30, 2020, 2,175,928 workers were affected by the pandemic, including workers who were laid off, experienced job cuts, informal workers who lost their jobs, and business owners who went bankrupt. In response, the Indonesian government has enacted a Job Loss Guarantee (*Jaminan Kehilangan Pekerjaan*) programme as a safety net for those who experienced job cuts/layoffs due to the pandemic. This programme is then realised through Government Regulation No. 37/2021. This regulation is also a manifestation of Articles 82 and 185B of Law No. 11/2020 on Job Creation. The benefits provided by this programme are listed below:

- 1) cash benefits worth 45% of the worker's previous wage for the first three months and 25% of their previous wage for the following three months;
- 2) counselling to job market information and for making career plans, participants will also get self-assessments;
- 3) job training in the form of reskilling and upskilling so that participants can improve their skills and enter the job market;
- 4) information about the job market, including matching participants' competencies with appropriate job openings.

In addition to programmes specifically aimed at victims of job cuts, the government also has a Pre-Employment Card (*Kartu Prakerja*) programme for workers to increase their skills/capacity. This programme aims to improve the competence and ability of entrepreneurs as business actors, job seekers, workers who have experienced layoffs, and workers who want to develop themselves. However, the benefits of this programme are limited because prospective participants must follow a registration process and a basic ability test to qualify for the programme. After qualifying, participants will receive a Rp3,500,000 voucher that can be used to partake in the provided training programmes. Pre-Employment Card participants are also entitled to an incentive of IDR 600,000 after completing their training.

Similar to Indonesia, Nigeria implements social protection programmes to improve citizens' quality of life and work. In 2017, the Nigerian government issued policy measures that cover (1) the provision of insurance and non-cash assistance for job seekers, (2) incentives for disability and unemployment, (4) improving the quality of life through training, land provision, assistance for small-scale farmers, support for young people and women to work, and (5) access to financial services for MSMEs.¹⁶¹ The Nigerian government also provided a series of training programmes, especially for digital skills, to improve the quality of life of the younger generation.

¹⁶¹ (Friedrich Ebert Stiftung, 2018)

Meanwhile, the social protection system in Vietnam is divided into four pillars based on its policy objectives. The first pillar aims to help citizens get involved in the job market and obtain a decent job. The second pillar aims to minimise the risk of illness, work accidents, and ageing to prevent people from losing income due to the above risks. The third pillar aims to provide routine assistance and aid during emergencies. Finally, the fourth pillar aims to ensure that all people have access to basic needs such as education, accommodation, health, clean water, and information.¹⁶² Vietnam also specifically implements a special policy called the Unemployment Insurance Policy to support workers who experience layoffs. This insurance has been valid since 2009 and has a variety of benefits, including benefits for 3-12 months, free vocational training for six months, free job consultations, and health insurance during unemployment.¹⁶³

Box 3. A Description of the *Jaminan Kehilangan Pekerjaan* (JKP) Program

Workers who experience a termination of employment must meet certain conditions to benefit from the JKP program or Job Loss Guarantee Programme, including being enrolled in the Social Security Administrator for Employment (*BPJS Ketenagakerjaan*) program and having paid contributions for the last six months before being terminated. This security net is given to workers who experience layoffs due to Industry 4.0 expansion factors or other causes. Workers who resigned or whose contracts have expired cannot participate in the JKP program. Thus, this assistance is more directed to formal workers with a clear working status.

Should a permanent worker experience a termination of employment, they are entitled to JKP benefits, given that they paid their Social Security Administrator for Employment (*BPJS Ketenagakerjaan*) contributions on time in the last six months. The scheme is as follows:

P previously worked at Company X in Jakarta as a full-time employee, earning Rp15,000,000 monthly. During P's unemployment period, he will be provided with skills training and guided to find a new job suitable for his capacity. In the first three consecutive months, P received Rp6,750,000. Then, three months later, the incentive was reduced to Rp3,750,000.

Although the incentives provided during the first three months exceeded Jakarta's minimum wage of Rp4,901,798 (re: as of December 2022), this amount may not be enough to meet his daily needs. This is especially true if P is the head of his family and the main breadwinner, so all household expenses are his responsibility. Assuming that P has two children, his expenses are used to fulfil the basic needs of four people, including school fees and other expenses such as housing or vehicle payment instalments. Therefore, the cash incentive given is not enough to meet the needs of a family living in Jakarta.

Even though, in principle, the JKP program has a precise target, some issues still need to be addressed. According to the Ministry of Manpower's (*Kementerian Ketenagakerjaan*) evaluation, the program's biggest obstacle is the limited selection and availability of training programs in all regions. Another problem is when the company does not pay their employees' Social Security Administrator for Employment (*BPJS Ketenagakerjaan*) contributions. Therefore, the program running for the last 1-2 years must be further improved and upgraded.

¹⁶² (Vinh, 2016)

¹⁶³ (Trung, 2011)

Meanwhile, since 2010, Türkiye has implemented a digitally integrated system called the Integrated Social Assistance System (ISAS). Several institutions and programmes are listed in the system, one of them being the Turkish Employment Agency or ISKUR. ISKUR is a governing body created to provide jobs and help workers. The benefits provided by the programme include pocket money for the unemployed and short-term workers, compensation for those affected by layoffs, job counselling, vocational training, and assistance for job placement.¹⁶⁴

The following table depicts the social protection programmes offered by the governments of Indonesia, Nigeria, Türkiye, and Vietnam, especially for the employment sector.

Table 19 Comparison of social protection programmes in Indonesia, Nigeria, Türkiye, and Vietnam

	Indonesia	Nigeria	Türkiye	Vietnam
Training	1. Pre-Employment Card Program 2. Job Loss Guarantee	1. The Digital Job Creation Program 2. The Digital Youth Nigeria Programme 3. Digital Skills Nigeria 4. N-Power Tech	The Turkish Employment Agency (ISKUR)	Unemployment Insurance Policy
Incentives		N-Power Tech		

Source: Author, compiled from various sources.

Furthermore, the Indonesian government must expand the range of social safety nets to adapt to evolving employment trends over these past few years. The government must also consider other trends in the working world. One of the targets for social safety nets is platform workers, who often do not receive a decent minimum wage. Another rising trend is the tendency of millennials and younger generations who work freelance jobs, such as being a web developer, graphic designer, digital marketer, or digital analyst who work remotely for foreign companies. In addition, the government needs to pay attention to the issue of inclusivity for people with disabilities and women, who are vulnerable to discrimination in the working world. In this context of inclusiveness, the government can increase the types of training and assistance tailored to the needs of marginal groups. Likewise, the scope of areas that provide training also needs to be expanded.

5.3 Antitrust policy

Antitrust laws allow businesses to compete in a fair and healthy competition environment. In Indonesia, the main regulation on this matter is in Law No. 5/1999 on the Prohibition of Monopolistic Practices and Unfair Business Competition. These laws prevent restrictive agreements and abusive behaviours, including acquisitions and mergers that result in monopolies or unfair business competition. Moreover, this rule emphasises the principle of democracy in promoting economic growth. Therefore, every citizen has the opportunity to participate in healthy, effective, and efficient economic activities without unfair competition.

In principle, these laws provide room for economic development. However, the prevailing regulation could not accommodate the rapid expansion of the digital economy and the birth of new digital-based companies. The digital business market adds complexity because its business model is platform-based, multifaceted, and has an extensive network. In other words, technological disruption has driven investment and innovation while simultaneously disrupting the viability of a healthy economy.¹⁶⁵

Digital platforms are more likely to engage in business rejections, predatory pricing, pricing package offers, and rebates. Thus, consumers will more often compare these prices with other market

¹⁶⁴ (World Bank, 2018)

¹⁶⁵ (Sabirin & Herfian, 2021)

competitors, and digital platforms have an advantage in their ability to strategise with the data they have.¹⁶⁶ An example of unhealthy competition would be the competition between digital platforms and conventional service providers whose market share has been drastically reduced due to unhealthy pricing strategies—as evidenced by how digital platforms can set much lower prices.

When there is injustice in the market, business owners who are negatively affected will likely protest. Thus, when online transportation platforms started mushrooming in around 2016, the response from conventional transportation businesses such as city transportation, taxis, or *ojek pangkalan* (offline/conventional motorcycle taxis) was to reject the presence of digital-based transportation.¹⁶⁷ The demands raised were not only about unfair price competition and reduced passengers but also about the obligation of platforms to pay taxes like other transportation companies.¹⁶⁸

The above case study indicates that the government is responsible for regulating digital development so that it does not set aside conventional companies. One method to do so is to create regulations that can maintain stability and fairness in the market but still support the digital transformation process by helping conventional companies digitalise their processes and adapt to technological changes. As mentioned earlier, Indonesia still relies on Law No. 5/1999 to regulate business competition. The regulation, which is over two decades old, has not been updated to match the latest market dynamics and trends. The updates were only limited to additions and changes to several points listed in the Job Creation Law, which are then derived in Government Regulation No. 44/2021 on the Implementation of the Prohibition of Monopolistic Practices and Unfair Competition. Nevertheless, this regulation has not addressed digital aspects.

Compared to other countries, competition regulations in Indonesia still do not accommodate the digital economy. Meanwhile, the Federal Competition and Consumer Protection Commission (FCCPC), the institution that oversees market competition in Nigeria, has issued an official statement with several other African countries on collaborations to adapt anti-competition regulations to the digital market.¹⁶⁹ In 2021, the FCCPC is also allegedly forming guidelines about the definition of the digital market, including the role of each party in the digital age.¹⁷⁰

Türkiye does not have a specific competition regulation for the digital realm, but the Turkish government has submitted a draft amendment to the Turkish Competition Act. This amendment aims to regulate digital platforms and their operations in Türkiye and is broadly inspired by the Digital Market Acts issued by the European Union. The draft is awaiting feedback from companies that will be affected. However, there is no certainty regarding when this regulation will take effect.¹⁷¹ Nevertheless, this preparation still shows progress and recognition from the Turkish government about the importance of regulating the business competition aspects of digital platforms.

Similar to Indonesia, Vietnam is also still trying to find a balance between digital development and the challenges of the digital world. Vietnam also does not appear to have new business competition rules for the digital economy era.¹⁷² In response to multinational digital platforms, Vietnam has created its own digital platforms. For example, Zalo, Gazo, and Lotus are three social media platforms originating from Vietnam. In addition, there is also Be, a ride-hailing platform owned by private companies supported by the government to compete with Grab and Gojek in Vietnam. Thus, Vietnam's current approaches tend to aim at achieving independence.¹⁷³

¹⁶⁶ Idem.

¹⁶⁷ The platform-based *ride-hailing* business model had already existed before 2016, but its increased usage in that year has sparked rejection from conventional transportation providers through large-scale demonstrations.

¹⁶⁸ (Sodikin, 2016)

¹⁶⁹ (Africa Heads of Competition Dialogue, 2022)

¹⁷⁰ (Irukera, 2021)

¹⁷¹ (Mostyn, Todd, & Kalayci, 2022)

¹⁷² To date, no reference to this in English has been found.

¹⁷³ (Dat, 2022)

The digital economy and the development of digital platforms bring about new challenges, not only for Indonesia but also for other countries worldwide. Ideally, antitrust regulations should continue to encourage technological development without damaging the conventional market. One of the efforts that can be made to support conventional companies is to encourage their digital transformation and support them in following existing market trends. Thus, competition between companies will become healthier. In addition, the entry of foreign companies into the country should also not be excessively limited. They should be given entry opportunities if their presence does not harm domestic companies.

Box 4. Digital ethics

Digital technology has the potential to have both positive and negative impacts. Therefore, internet users need to understand how to control and identify technological developments so that it does not control human life but rather the opposite. This is where digital ethics are needed.

Digital ethics is about how digital innovation can be shaped to be more open, tolerant, and fair. Digital ethics is also useful in evaluating issues regarding (1) data, including its creation, filtering, processing, dissemination, sharing, and use; (2) algorithms, including AI, machine learning, and robots; and (3) programming, coding, and hacking (Öhman & Watson, 2019).

At the individual level, digital ethics is about how a person rationally and consciously acts in the digital realm in their everyday lives. Examples of actions that require digital ethics include avoiding spreading false news and reducing bullying behaviour towards people online.

Additionally, companies that use data must also understand digital ethics and ensure that no data theft can lead to misuse and harm to society.

The background of the entire page is a vibrant red. In the center, a hand is shown holding a glowing red sphere. The hand and sphere are overlaid with a complex digital pattern of white and red lines, circles, and squares, suggesting a high-tech or data-driven environment. The overall aesthetic is modern and futuristic.

RECOMMENDATION FOR STRENGTHENING DIGITAL TRANSFORMATION IN INDONESIA

6. RECOMMENDATION FOR STRENGTHENING DIGITAL TRANSFORMATION INITIATIVES IN INDONESIA

This study identified several recommendations to enhance or improve the digital transformation efforts in Indonesia. These recommendations are centred around developing regulatory frameworks, strengthening institutional settings, improving human capital, and strengthening digital safeguards. The proposed improvements will be divided into three parts: regulatory frameworks, institutional frameworks, and funding frameworks, to make it easier for policymakers to integrate these recommendations.

6.1 Recommendations for strengthening regulatory framework

6.1.1 Encourage a healthy and conducive business and investment climate

Digitalisation's disruptive nature on conventional businesses can create an ecosystem of unfair business competition. An example of this disruption would be the business conflicts that emerged when ride-hailing applications were first introduced to the public. At the time, there was tension between the online transportation business and conventional transportation. Another example would be the emergence of e-commerce platforms, which have disrupted the retail industry. The most recent phenomenon is with social commerce, which instantly disrupted e-commerce platforms and the retail industry.

Therefore, the adoption of continuously evolving digital technologies will eliminate business entities that are unable to adapt. Meanwhile, policies and regulations have not been able to keep up with the pace of technological development. If these policies and regulations are not updated and well-maintained, it may result in an unfavourable business climate.

Furthermore, the uncertainties regarding the DLC policy also create a problem for business competition. On the one hand, the government needs to ensure that domestic industries remain protected amid free trade. On the other hand, the involvement of foreign actors can often spark the creation of innovations. Indonesia's status as a user of digital technology can be improved through exchanging knowledge and technology with international actors. However, this exchange must simultaneously ensure economic sovereignty in the country.

Next, efforts to adopt digital technology require adequate investment support. To date, financial issues are still one of the main obstacles to the digital transformation agenda. Some examples include how some medium-sized industry players are reluctant to adopt digital technology because of cost issues, how 85-90% of start-ups that underwent government guidance failed due to funding issues, and how the cost component is too large for farmers to immediately take advantage of digital technology in the agricultural sector.

Unfortunately, these financial needs have not been supported by a solid policy framework, as the incentive mechanism from the current government has not accommodated many components of the cost of digital technology adoption. In addition, it is challenging to obtain investments due to complex investment schemes.

Therefore, the following efforts can be conducted to foster a healthy business and investment climate in the era of digitalisation:

1. Conduct a review of the regulatory framework and institutional business competition to always be adaptive to digital technology developments. This includes the regulatory frameworks relating to electronic documents, such as cyber notaries.
2. Balance the DLC policy with opportunities for technology transfer and exchange and foreign investments.
3. Reduce the complexity of the investment climate so that it is more conducive, such as by simplifying bureaucracy and regulations.

The following are the government actors that can potentially be involved in this improvement effort:

- The Ministry of National Development Planning/National Development Planning Agency (*Kementerian PPN/Bappenas*),
- The Ministry of Finance (*Kementerian Keuangan*),
- The Secretariat of State (*Sekretariat Negara*),
- The Ministry of Communication and Informatics (*Kementerian Komunikasi dan Informatika*),
- The Ministry of Industry (*Kementerian Perindustrian*),
- The Ministry of Cooperatives and MSMEs (*Kementerian Koperasi dan UMKM*),
- The Ministry of Trade (*Kementerian Perdagangan*),
- The Ministry of SOEs (*Kementerian BUMN*), and
- Other technical ministries.

6.1.2 Optimising the potential of digital technology for social, economic, and bureaucratic transformation

The cross-border nature of digitalisation and its potential benefits require its users to have a mature digital culture. Having a mature digital culture will mitigate the destructive impacts that may arise from digital technology use and allow users to optimise its usage for achieving development goals.

Digitalisation's disruptive nature in various aspects, including employment, needs to be managed not to marginalise vulnerable groups who do not have equal opportunities in utilising digital technology. Additionally, digitalisation brings new types of jobs based on digital skills and increases job automation, which can potentially replace human roles. Therefore, a well-established social safety net is needed to protect the groups affected.

Digitalisation is also closely related to data processing, with one of its sources being personal data. Its massive influence and ability to disrupt people's privacy need to be managed in a more accountable manner to protect the public's personal data. Although there is already the PDP law, the regulation has not grouped data based on security risks regarding sensitive data. In addition, several articles may have multiple interpretations because there are no supporting/derivative rules.

Therefore, the following are several efforts to optimise digital technology use for driving social, economic, and bureaucratic transformation:

1. Ensure there is a social security system that can be a safety net for communities affected by the adoption of digital technology, including a funding framework for social protection.
2. Assess and encourage social assistance that is more productive and not only consumptive.
3. Prepare supporting/derivative rules to PDP law.
4. Improve and expand the community's digital capacity-building programme.

The following are the government actors that can potentially be involved in this improvement effort:

- The Ministry of National Development Planning/National Development Planning Agency (*Kementerian PPN/Bappenas*),
- The Ministry of Manpower (*Kementerian Ketenagakerjaan*),

- The Ministry of Research, Technology, and Higher Education (*Kementerian Pendidikan, Kebudayaan, Riset, dan Teknologi*),
- The Ministry of Communication and Informatics (*Kementerian Komunikasi dan Informatika*),
- The Ministry of Administrative and Bureaucratic Reform (*Kementerian PAN-RB*), and
- The Ministry of Social Affairs (*Kementerian Sosial*).

6.2 Recommendations for strengthening institutional framework

6.2.1 Aligning digital transformation efforts

A common problem faced in digital transformation efforts in Indonesia is their sporadic implementation, which results in reduced effectiveness. Meanwhile, as digitalisation occurs across borders, sectors, and dimensions, it requires entities to collaborate in a coordinated motion. In addition, the rapid development of digital technologies has not been accompanied by the drafting of regulations and the formation of an institutional framework.

Therefore, the following are several efforts that could be conducted to align digital transformation across ministries/institutions/regional work units:

1. Align all digital transformation programmes in ministries/institutions/regional work units, including aligning digital transformation efforts with priorities in other sectors. For example, the digital transformation efforts to address the climate crisis also need to be aligned with the funding framework of the entire programme.
2. Review the institutional framework of digital transformation, including governance and accountability mechanisms of digital transformation policy implementation. This effort aims to analyse which government actors can organise the alignment of digital transformation. Therefore, the government does not necessarily have to create a new institution, but it can optimise the tasks and functions of existing institutions.
3. Encourage digital leadership to have digital capabilities and sensitivity to make an effective impact on decision-making.
4. Improve the capacity of government officials regularly regarding the development of digital technology.

The following are the government actors that can potentially be involved in this improvement effort:

- The Ministry of National Development Planning/National Development Planning Agency (*Kementerian PPN/Bappenas*),
- The Ministry of Finance (*Kementerian Keuangan*),
- The Ministry of Home Affairs (*Kementerian Dalam Negeri*),
- The Ministry of Administrative and Bureaucratic Reform (*Kementerian PAN-RB*), and
- The Ministry of Communications and Informatics (*Kementerian Komunikasi dan Informatika*).

6.2.2 Developing digital leadership skills

The cross-border nature of digitalisation (across sectors, time, and locations) requires cross-sector collaboration. Unfortunately, coordination issues are still a challenge that can hinder the acceleration of digital transformation. Therefore, one of the strategic efforts that can be taken to solve these problems is to develop digital leadership skills.

The following are some recommendations for developing digital leadership skills:

1. Improve digital literacy, including digital culture.
2. Improve the capacity of policymakers, especially their sensitivity and speed in preparing policies that can adapt to the rapid pace of technological development. This effort also includes

broadening their perspective of digital transformation, as it can play a broader role across different aspects, such as social, economic, political, environmental, and cultural dimensions.

3. Coordinate and align the digital transformation programme (across institutions and sectors).
4. Increase the frequency of interactions and collaborations between digital transformation actors, such as the government, the private sector, and the public.
5. Increase the policymakers' adaptability and ability to keep up with digital technology developments.

The following are the government actors that can potentially be involved in this improvement effort:

- The Ministry of National Development Planning/National Development Planning Agency (*Kementerian PPN/Bappenas*),
- The Ministry of Finance (*Kementerian Keuangan*),
- The Ministry of Home Affairs (*Kementerian Dalam Negeri*),
- The Ministry of Administrative and Bureaucratic Reform (*Kementerian PAN-RB*), and
- The Ministry of Communications and Informatics (*Kementerian Komunikasi dan Informatika*).

6.2.3 Fostering a healthy digital culture and a climate of multi-stakeholder collaboration

The cross-border nature of digitalisation and its potential benefits require its users to have a mature digital culture. Having a mature digital culture will mitigate the destructive impacts that may arise from digital technology use and allow users to optimise its usage for achieving development goals.

The following recommendations are the proposed methods for fostering a healthy digital culture and a multi-stakeholder climate of collaboration:

1. Expand the digital literacy Improvement programme and review the prevailing curriculum. This educational aspect can be a foundation for honing digital culture through the right learning curriculum.
2. The data protection aspect can be targeted by ensuring that all institutions - both public and private - develop a personal data protection code of conduct at all levels of public and private institutions.
3. Ensure there is an institutional framework overseeing the implementation of applicable privacy policies.
4. Expand efforts to increase the capacity of human resources and conventional business actors to adapt and take advantage of digital technology developments.
5. Foster an ecosystem of knowledge and innovation through collaborations and interactions between actors, so that entities would not only be the users but also the creators of technological innovations.

The following are the government actors that can potentially be involved in this improvement effort:

- The Ministry of National Development Planning/National Development Planning Agency (*Kementerian PPN/Bappenas*),
- The Ministry of Communications and Informatics (*Kementerian Komunikasi dan Informatika*),
- The Ministry of Research, Technology, and Higher Education (*Kementerian Pendidikan, Kebudayaan, Riset, dan Teknologi*),
- The Ministry of Industry (*Kementerian Perindustrian*), and
- Other technical ministries.

6.2.4 Increasing digital capacity

Improving digital capacities includes improving the digital capacities of human resources, the research and innovation climate, and expanding the availability and accessibility of digital infrastructure (including data governance).

The adoption of digital technology is often due to technological developments in other countries. In Indonesia, digital capacity is still a challenge that needs to be solved. The optimal adoption of digital technology requires its users to have a series of skills. In addition, digital culture is needed to wisely navigate the nature of digitalisation, which amplifies a community's positive and negative cultural aspects found in the offline world to the online world. Moreover, equity regarding digital infrastructure is an issue that must be resolved.

Digitalisation is also closely related to data processing, with one of its sources being personal data. Digitalisation's massive influence and ability to disrupt people's privacy needs to be managed in a more accountable manner so that the public's personal data can be protected. Moreover, although there is already the PDP law, the regulation has not focused on the protection of sensitive data by classifying data based on risk. Additionally, several articles may have multiple interpretations because there are no supporting/derivative rules.

Digital transformation for bureaucratic transformation can make public service activities more effective and efficient. However, public data, which is one of the important components of this agenda, is still not managed in a coordinated manner between various ministries/institutions/regional work units. Although the country's regulatory and institutional aspects are adequate, the implementation of bureaucratic transformation policies is sub-optimal.

The following are some recommendations to increase digital capacity:

1. Strengthen the research and innovation climate, especially for digital technology, through priority programmes, funding, and improving the capacity of research and innovation human resources.
2. Improve availability, expand accessibility, and provide affordable digital infrastructure.
3. Increase the policymakers' adaptability and ability to keep up with digital technology developments.
4. Improve the capacity of digital human resources through the curriculum of the education and training system that is adjusted periodically to digital technology developments. This includes educator/trainer capacity and teaching materials.
5. Ensure education and training infrastructure can accommodate digital technology developments. For example, sufficient ICT laboratories in schools.
6. Improve the capacity of society in general, especially regarding ethics, digital resilience, and critical thinking in cyberspace.
7. Improve digital literacy, especially regarding privacy and personal data protection, including digital ethics and cyberbullying.
8. Encourage digital leadership and promote the One Data principle.
9. Ensure all ministries/institutions/regional work units have standard data governance mechanisms.
10. Establish an independent personal data protection supervisory body.
11. Ensure the business sector starts adapting to new data protection regulations.

The following are the government actors that can potentially be involved in efforts to improve digital capacity:

- The Ministry of National Development Planning/National Development Planning Agency (*Kementerian PPN/Bappenas*),

- The Ministry of Finance (*Kementerian Keuangan*),
- The Ministry of Administrative and Bureaucratic Reform (*Kementerian PAN-RB*), and
- The Ministry of Research, Technology, and Higher Education (*Kementerian Pendidikan, Budaya, Riset, dan Teknologi*),
- The Ministry of Manpower (*Kementerian Ketenagakerjaan*),
- The Ministry of Communication and Informatics (*Kementerian Komunikasi dan Informatika*),
- The Ministry of Home Affairs (*Kementerian Dalam Negeri*),
- The Ministry of Villages, Development of Disadvantaged Regions, and Transmigration (*Kementerian Desa PDTT*),
- The Ministry of Industry (*Kementerian Perindustrian*),
- The Ministry of SOEs (*Kementerian BUMN*),
- The Ministry of Health (*Kementerian Kesehatan*),
- The Financial Services Authority (*Otoritas Jasa Keuangan*), and
- The National Cyber and Crypto Agency (*Badan Siber dan Sandi Nasional*)

6.2.5 Ensuring a social safety net for those affected by digitalisation.

The disruptive nature of digitalisation in various aspects, including employment, needs to be managed not to marginalise vulnerable groups who do not have equal opportunities in utilising digital technology. Digitalisation also brings new types of jobs based on digital skills and increases job automation, which can potentially replace human roles. Therefore, a well-established social safety net is needed to protect the groups affected by digitalisation.

The following are recommendations that can be conducted:

1. Ensure there is a social security system that can be a safety net for communities affected by the adoption of digital technology, including a financing framework for social protection.
2. Improve and expand the community's digital capacity-building programme.
3. Increase the capacity of the government apparatus associated with the new employment model driven by digitalisation.
4. Assess and encourage social assistance that is more productive and not only consumptive.

The following are the government actors that can potentially be involved in this improvement effort:

- The Ministry of National Development Planning/National Development Planning Agency (*Kementerian PPN/Bappenas*),
- The Ministry of Manpower (*Kementerian Ketenagakerjaan*),
- The Ministry of Research, Technology, and Higher Education (*Kementerian Pendidikan, Budaya, Riset, dan Teknologi*),
- The Ministry of Administrative and Bureaucratic Reform (*Kementerian PAN-RB*), and
- The Ministry of Social Affairs (*Kementerian Sosial*).

6.3 Recommendations for strengthening funding framework

6.3.1 Fostering an investment climate conducive to digitalisation

Digital technology adoption requires adequate investment support. To date, financial issues are still one of the main obstacles to the digital transformation agenda. Some examples include how some medium-sized industry players are reluctant to adopt digital technology because of cost issues, how 85-90% of start-ups that underwent government guidance failed due to funding issues, and how the cost component is too large for farmers to immediately take advantage of digital technology in the agricultural sector.

Therefore, the following recommendations can be conducted to improve funding frameworks:

1. Examine fiscal and non-fiscal incentives and disincentives for the adoption of digital technologies in various sectors and businesses.
2. Encourage investments for businesses to adopt digital technology.

The following are the government actors that can potentially be involved in this improvement effort:

- The Ministry of National Development Planning/National Development Planning Agency (*Kementerian PPN/Bappenas*),
- The Ministry of Finance (*Kementerian Keuangan*),
- The Ministry of Investment/Investment Coordinating Board (*Kementerian Investasi/BKPM*),
- The Ministry of Industry (*Kementerian Perindustrian*),
- The Ministry of Cooperatives and MSMEs (*Kementerian Koperasi dan UMKM*), and
- Other technical ministries.

6.3.2 Expanding funding schemes for digital capacity building

Increasing digital capacity requires a supportive funding framework, which includes funding for digital HR capacity building, improving the research and innovation climate, and building digital infrastructure.

The following recommendations can be conducted to improve funding frameworks:

1. Expand scholarship programmes for digital talents, including for college/university students in STEM fields.
2. Strengthen the research and innovation climate, especially for digital technology, through priority programmes, funding, and improving the capacity of research and innovation human resources.
3. Improve collaborative infrastructure development financing schemes.

The following are the government actors that can potentially be involved in this improvement effort:

- The Ministry of National Development Planning/National Development Planning Agency (*Kementerian PPN/Bappenas*),
- The Ministry of Finance (*Kementerian Keuangan*),
- The Ministry of Investment/Investment Coordinating Board (*Kementerian Investasi/BKPM*),
- The Ministry of Research, Technology, and Higher Education (*Kementerian Pendidikan, Kebudayaan, Riset, dan Teknologi*),
- The Ministry of Communication and Informatics (*Kementerian Komunikasi dan Informatika*),
- The Ministry of Public Works and Public Housing (*Kementerian Pekerjaan Umum dan Perumahan Rakyat*), and
- Other technical ministries.

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APPENDIX

Appendix A. Regional Regulation for Electronic-based Government Systems

I. Provincial level

No	Provinsi	Regulasi SPBE
1	Aceh	Pergub Aceh No. 61/2022
2	Sumatera Utara	Pergub Sumut No. 12/2022
3	Sumatera Selatan	Pergub Sumsel No. 63/2020
4	Sumatera Barat	Peraturan Daerah No. 20/2018
5	Bengkulu	Pergub Bengkulu No. 9/2022
6	Riau	Pergub Riau No. 11/2018
7	Jambi	Pergub Jambi No. 12/2022
8	Lampung	Pergub Lampung No. 8/2022
9	Bangka Belitung	Peraturan Daerah No. 6/2022
10	Kalimantan Barat	Pergub Kalbar No. 177/2021
11	Kalimantan Timur	Pergub Kaltim No. 4/2023
12	Kalimantan Selatan	Pergub Kalsel No. 78/2022
13	Kalimantan Utara	Pergub Kalut No. 51/2019
14	Kalimantan Tengah	Pergub Kalteng No. 24/2022
15	Banten	Pergub Banten No. 19/2021
16	DKI Jakarta	Pergub DKI No. 68/2022
17	Jawa Barat	Pergub Jabar No. 86/2018
18	Jawa Tengah	Pergub Jateng No. 40/2022
19	Jawa Timur	Pergub Jatim No. 53/2021
20	DI Yogyakarta	Pergub DIY No. 67/2022
21	Bali	Pergub Bali No. 44/2021
22	NTT	Pergub NTT No. 72/2022
23	NTB	Pergub NTB No. 55/2019
24	Sulawesi Barat	Pergub Sulbar No. 9/2018
25	Sulawesi Tengah	Pergub Sulteng No. 52/2022
26	Sulawesi Tenggara	Peraturan Daerah No. 2/2020
27	Maluku	Pergub Maluku No. 98/2021
28	Maluku Utara	Pergub Maluku Utara No. 18/2022
29	Kepulauan Riau	Tidak ditemukan
30	Gorontalo	Tidak ditemukan
31	Sulawesi Utara	Tidak ditemukan
32	Sulawesi Selatan	Tidak ditemukan
33	Papua Barat	Tidak ditemukan
34	Papua	Tidak ditemukan
35	Papua Tengah	Tidak ditemukan
36	Papua Pegunungan	Tidak ditemukan
37	Papua Selatan	Tidak ditemukan
38	Papua Barat Daya	Tidak ditemukan

II. Regency/City level

1. Aceh

No.	Nama Kabupaten/Kota	Regulasi SPBE
1	Kabupaten Aceh Barat	Perbup No. 40/2020
2	Kabupaten Aceh Barat Daya	Perbup No. 31/2023
3	Kabupaten Aceh Besar	x
4	Kabupaten Aceh Jaya	Perbup No. 149/2022
5	Kabupaten Aceh Selatan	x
6	Kabupaten Aceh Singkil	Perbup No. 41/2020
7	Kabupaten Aceh Tamiang	Perbup No. 3/2021
8	Kabupaten Aceh Tengah	Perbup No. 70/2019
9	Kabupaten Aceh Tenggara	x
10	Kabupaten Aceh Timur	Perbup No. 6/2021

No.	Nama Kabupaten/Kota	Regulasi SPBE
11	Kabupaten Aceh Utara	x
12	Kabupaten Bener Meriah	Perbup No. 11/2020
13	Kabupaten Bireuen	x
14	Kabupaten Gayo Lues	x
15	Kabupaten Nagan Raya	Perbup No. 27/2022
16	Kabupaten Pidie	x
17	Kabupaten Pidie Jaya	Perbup No. 45/2022
18	Kabupaten Simeulue	Perda No. 9/2019
19	Kota Banda Aceh	Perwali No. 28/2022 dan Perwali No 29/2022
20	Kota Langsa	Perwali No. 34/2020
21	Kota Lhoksumawe	x
22	Kota Sabang	Perwali No. 14/2023
23	Kota Sabulussalam	Perwali No. 38/2021

2. Sumatera Utara

No	Nama Kabupaten/Kota	Regulasi SPBE
1	Kabupaten Asahan	x
2	Kabupaten Batubara	x
3	Kabupaten Dairi	Perbup No. 12/2021
4	Kabupaten Deli Serdang	x
5	Kabupaten Humbang Hasundutan	x
6	Kabupaten Karo	x
7	Kabupaten Labuhanbatu	x
8	Kabupaten Labuhanbatu Selatan	x
9	Kabupaten Labuhanbatu Utara	Perbup No. 31/2021
10	Kabupaten Langkat	x
11	Kabupaten Mandailing Natal	Perbup No. 12/2021
12	Kabupaten Nias	x
13	Kabupaten Nias Barat	x
14	Kabupaten Nias Selatan	x
15	Kabupaten Nias Utara	x
16	Kabupaten Padang Lawas	x
17	Kabupaten Padang Lawas Utara	x
18	Kabupaten Pakpak Bharat	Perbup No. 25/2019
19	Kabupaten Samosir	x
20	Kabupaten Serdang Bedagai	Perbup No. 23/2021
21	Kabupaten Simalungun	x
22	Kabupaten Tapanuli Selatan	x
23	Kabupaten Tapanuli Tengah	x
24	Kabupaten Tapanuli Utara	x
25	Kabupaten Toba Samosir	x
26	Kota Binjai	x
27	Kota Gunungsitoli	x
28	Kota Medan	Perwali No. 39/2020
29	Kota Padangsidempuan	Perwali No. 27/2021
30	Kota Pematangsiangtar	Perwali No. 2/2022
31	Kota Sibolga	x
32	Kota Tanjungbalai	x
33	Kota Tebing Tinggi	x

3. Sumatera Barat

No	Nama Kabupaten/Kota	Regulasi SPBE
1	Kabupaten Agam	x
2	Kabupaten Dharmasraya	x
3	Kabupaten Kepulauan Mentawai	x
4	Kabupaten Lima Puluh Kota	x
5	Kabupaten Padang Pariaman	Perbup No. 25/2021
6	Kabupaten Pasaman	x
7	Kabupaten Pasaman Barat	Perbup No. 49/2019
8	Kabupaten Pesisir Selatan	Perbup No. 12/2022
9	Kabupaten Sijunjung	x

No	Nama Kabupaten/Kota	Regulasi SPBE
10	Kabupaten Solok	Perbup No. 36/2020
11	Kabupaten Solok Selatan	x
12	Kabupaten Tanah Datar	Perda No. 2/2022
13	Kota Bukittinggi	x
14	Kota Padang	Perwali No. 29/2022
15	Kota Padangpanjang	x
16	Kota Pariaman	x
17	Kota Payakumbuh	x
18	Kota Sawahlunto	x
19	Kota Solok	x

4. Sumatera Selatan

No	Nama Kabupaten/Kota	Regulasi SPBE
1	Kabupaten Banyuasin	x
2	Kabupaten Empat Lawang	x
3	Kabupaten Lahat	x
4	Kabupaten Muara Enim	Perbup No. 52/2022
5	Kabupaten Musi Banyuasin	Perbup No. 41/2021
6	Kabupaten Musi Rawas	x
7	Kabupaten Musi Rawas Utara	x
8	Kabupaten Ogan Ilir	Perbup No. 42/2022
9	Kabupaten Ogan Komering Ilir	x
10	Kabupaten Ogan Komering Ulu	x
11	Kabupaten Ogan Komering Ulu Selatan	x
12	Kabupaten Ogan Komering Ulu Timur	Perbup No. 2/2022
13	Kabupaten Penukal Abab Lematang Ilir	x
14	Kota Lubuklinggau	Perwali No. 43/2021
15	Kota Pagar Alam	Perwali No. 17/2022
16	Kota Palembang	x
17	Kota Prabumulih	x

5. Riau

No	Nama Kabupaten/Kota	Regulasi SPBE
1	Kabupaten Bengkalis	x
2	Kabupaten Indragiri Hilir	x
3	Kabupaten Indragiri Hulu	Perbup No. 37/2022
4	Kabupaten Kampar	x
5	Kabupaten Kepulauan Meranti	Perbup No. 58/2022
6	Kabupaten Kuantan Singingi	Perbup No. 33/2020
7	Kabupaten Pelalawan	x
8	Kabupaten Rokan Hilir	x
9	Kabupaten Rokan Hulu	Perbup No. 17/2022
10	Kabupaten Siak	x
11	Kota Dumai	x
12	Kota Pekanbaru	x

6. Kepulauan Riau

No	Nama Kabupaten/Kota	Regulasi SPBE
1	Kabupaten Bintan	x
2	Kabupaten Karimun	x
3	Kabupaten Kepulauan Anambas	x
4	Kabupaten Lingga	x
5	Kabupaten Natuna	Perbup No. 18/2021
6	Kota Batam	Perwali No. 40/2021
7	Kota Tanjung Pinang	Perwali No. 8/2022

7. Jambi

No	Nama Kabupaten/Kota	Regulasi SPBE
1	Kabupaten Batanghari	Perbup No. 31/2022
2	Kabupaten Bungo	x
3	Kabupaten Kerinci	x
4	Kabupaten Merangin	x

No	Nama Kabupaten/Kota	Regulasi SPBE
5	Kabupaten Muaro Jambi	x
6	Kabupaten Sarolangun	Perbup No. 13/2022
7	Kabupaten Tanjung Jabung Barat	x
8	Kabupaten Tanjung Jabung Timur	x
9	Kabupaten Tebo	x
10	Kota Jambi	Perwali No. 45/2019
11	Kota Sungai Penuh	x

8. Bengkulu

No	Nama Kabupaten/Kota	Regulasi SPBE
1	Kabupaten Bengkulu Selatan	Perbup No. 23/2018
2	Kabupaten Bengkulu Tengah	x
3	Kabupaten Bengkulu Utara	Perbup No. 15/2022
4	Kabupaten Kaur	x
5	Kabupaten Kepahiang	x
6	Kabupaten Lebong	x
7	Kabupaten Mukomuko	Perda No. 1/2020
8	Kabupaten Rejang Lebong	Perbup No. 6/2022
9	Kabupaten Seluma	Perbup No. 33/2019
10	Kota Bengkulu	Perwali No. 15/2022

9. Bangka Belitung

No	Nama Kabupaten/Kota	Regulasi SPBE
1	Kabupaten Bangka	x
2	Kabupaten Bangka Barat	Perda No. 9/2020
3	Kabupaten Bangka Selatan	Perbup No. 22/2021
4	Kabupaten Bangka Tengah	x
5	Kabupaten Belitung	Perbup No. 25/2020
6	Kabupaten Belitung Timur	Perbup No. 45/2022
7	Kota Pangkal Pinang	Perda No. 4/2022

10. Lampung

No	Nama Kabupaten/Kota	Regulasi SPBE
1	Kabupaten Lampung Tengah	Perbup No. 60/2019
2	Kabupaten Lampung Utara	Perbup No. 44/2022
3	Kabupaten Lampung Selatan	Perbup No.20/2022
4	Kabupaten Lampung Barat	Perbup No.32/2022
5	Kabupaten Lampung Timur	x
6	Kabupaten Mesuji	x
7	Kabupaten Pesawaran	Perbup No.54/2022
8	Kabupaten Pesisir Barat	Perbup No.24/2022
9	Kabupaten Pringsewu	x
10	Kabupaten Tulang Bawang	Perbup No.38/2019
11	Kabupaten Tulang Bawang Barat	x
12	Kabupaten Tanggamus	x
13	Kabupaten Way Kanan	x
14	Kota Bandar Lampung	x
15	Kota Metro	Perda 8/2019

11. Banten

No	Nama Kabupaten/Kota	Regulasi SPBE
1	Kabupaten Lebak	x
2	Kabupaten Pandeglang	x
3	Kabupaten Serang	Perbup No.51/2022
4	Kabupaten Tangerang	Perda No.6/2020
5	Kota Cilegon	x
6	Kota Serang	x
7	Kota Tangerang	Perwali No. 26/2019
8	Kota Tangerang Selatan	x

12. Jawa Barat

No	Nama Kabupaten/Kota	Regulasi SPBE
1	Kabupaten Bandung	Perbup No.69/2021
2	Kabupaten Bandung Barat	Perbup No.3/2023
3	Kabupaten Bekasi	Perbup No.2/2023
4	Kabupaten Bogor	Perbup No.63/2020
5	Kabupaten Ciamis	Perbup No.83/2020
6	Kabupaten Cianjur	Perbup No.48/2020
7	Kabupaten Cirebon	Perbup No.96/2022
8	Kabupaten Garut	Perbup No.119/2021
9	Kabupaten Indramayu	x
10	Kabupaten Karawang	Perda No. 16/2018 dan Perbup No. 39/2019
11	Kabupaten Kuningan	x
12	Kabupaten Majalengka	Perbup No.13/2021
13	Kabupaten Pangandaran	Perbup No.63/2019
14	Kabupaten Purwakarta	Perbup No.25/2023
15	Kabupaten Subang	x
16	Kabupaten Sukabumi	Perbup No.129/2021
17	Kabupaten Sumedang	Perbup No.47/2021
18	Kabupaten Tasikmalaya	Perbup No.69/2022
19	Kota Bandung	Perwali No.60/2021
20	Kota Banjar	Perwali No.12/2019
21	Kota Bekasi	Perwali No.7/2023
22	Kota Bogor	x
23	Kota Cimahi	x
24	Kota Cirebon	Perwali No.61/2021
25	Kota Depok	Perwali No.40/2021
26	Kota Sukabumi	Perda No.5/2020
27	Kota Tasikmalaya	Perwali No.101/2020

13. Jawa Tengah

No	Nama Kabupaten/Kota	Regulasi SPBE
1	Kabupaten Banjarnegara	Perbup No. 50/2020
2	Kabupaten Banyumas	Perbup No. 37/2023
3	Kabupaten Batang	Perbup No. 50/2019
4	Kabupaten Blora	Perbup No. 38/2022
5	Kabupaten Boyolali	Perbup No.16/2021
6	Kabupaten Brebes	Perbup No. 34/2022
7	Kabupaten Cilacap	Perbup No. 21/2022
8	Kabupaten Demak	Perbup No. 13/2020
9	Kabupaten Grobogan	Perbup No. 40/2019
10	Kabupaten Jepara	Perbup No. 62/2021
11	Kabupaten Karanganyar	Perbup No. 31/2022
12	Kabupaten Kebumen	Perbup No. 41/2021
13	Kabupaten Kendal	Perbup No. 35/2021
14	Kabupaten Klaten	x
15	Kabupaten Kudus	Perbup No. 30/2022
16	Kabupaten Magelang	Perbup No.26/2021
17	Kabupaten Pati	Perbup No. 29/2021
18	Kabupaten Pekalongan	x
19	Kabupaten Pemasang	x
20	Kabupaten Purbalingga	Perbup No. 90/2021
21	Kabupaten Purworejo	Perbup No. 23/2023
22	Kabupaten Rembang	Perbup No. 18/2021
23	Kabupaten Semarang	Perbup No. 62/2022
24	Kabupaten Sragen	Perbup No. 41/2019
25	Kabupaten Sukoharjo	Perbup No. 76/2020
26	Kabupaten Tegal	Perbup No. 45/2022
27	Kabupaten Temanggung	Perda No. 22/2020
28	Kabupaten Wonogiri	Perbup No. 35/2022
29	Kabupaten Wonosobo	Perbup No. 23/2023
30	Kota Magelang	Perwali No. 51/2019
31	Kota Pekalongan	Perda No. 4/2021
32	Kota Salatiga	Perwali No. 9/2023

No	Nama Kabupaten/Kota	Regulasi SPBE
33	Kota Semarang	Perwali No. 27/2021
34	Kota Surakarta	Perwali No. 8/2022
35	Kota Tegal	Perwali No. 2A/2022

14. Jawa Timur

No	Nama Kabupaten/Kota	Regulasi SPBE
1	Kabupaten Bangkalan	Perbup No. 24/2021
2	Kabupaten Banyuwangi	Perbup No. 67/2019
3	Kabupaten Blitar	Perbup No. 51/2019
4	Kabupaten Bojonegoro	Perbup No. 18/2022
5	Kabupaten Bondowoso	x
6	Kabupaten Gresik	Perbup No. 28/2023
7	Kabupaten Jember	x
8	Kabupaten Jombang	Perbup No. 15/2021
9	Kabupaten Kediri	Perbup No. 33/2019
10	Kabupaten Lamongan	Perbup No. 27/2021
11	Kabupaten Lumajang	x
12	Kabupaten Madiun	Perbup No. 81/2019
13	Kabupaten Magetan	Perda No. 6/2021
14	Kabupaten Malang	Perbup No. 25/2020
15	Kabupaten Mojokerto	x
16	Kabupaten Nganjuk	Perbup No. 11/2022
17	Kabupaten Ngawi	x
18	Kabupaten Pacitan	Perbup No. 167/2021
19	Kabupaten Pamekasan	Perbup No. 57/2019
20	Kabupaten Pasuruan	Perbup No. 31/2021
21	Kabupaten Ponorogo	Perbup No. 56/2019
22	Kabupaten Probolinggo	Perbup No. 32/2022
23	Kabupaten Sampang	Perbup No. 31/2021
24	Kabupaten Sidoarjo	x
25	Kabupaten Situbondo	Perbup No. 49/2022
26	Kabupaten Sumenep	Perbup No. 58/2022
27	Kabupaten Trenggalek	Perbup No. 11/2022
28	Kabupaten Tuban	x
29	Kabupaten Tulungagung	Perbup No. 59/2022
30	Kota Batu	Perwali No. 42/2021
31	Kota Blitar	Perwali No. 49/2020
32	Kota Kediri	Perwali No. 22/2022
33	Kota Madiun	Perwali No. 39/2021
34	Kota Malang	Perwali No. 8/2023
35	Kota Mojokerto	Perwali No. 7/2020
36	Kota Pasuruan	Perwali No. 51/2022
37	Kota Probolinggo	Perwali No. 54/2022
38	Kota Surabaya	Perwali No. 68/2020

15. DI Yogyakarta

No	Nama Kabupaten/Kota	Regulasi SPBE
1	Kabupaten Bantul	Perbup No. 61/2019
2	Kabupaten Gunungkidul	Perbup No. 42/2022
3	Kabupaten Kulonprogo	Perbup No. 5/2020
4	Kabupaten Sleman	Perbup No. 22/2021
5	Kota Yogyakarta	x

16. Bali

No	Nama Kabupaten/Kota	Regulasi SPBE
1	Kabupaten Badung	x
2	Kabupaten Bangli	Perda No. 1/2019
3	Kabupaten Buleleng	x
4	Kabupaten Gianyar	Perbup No. 50/2020
5	Kabupaten Jembrana	Perda No. 2/2022
6	Kabupaten Karangasem	x
7	Kabupaten Klungkung	Perbup No. 22/2022

No	Nama Kabupaten/Kota	Regulasi SPBE
8	Kabupaten Tabanan	x
9	Kota Denpasar	Perwali No. 28/2021

17. Nusa Tenggara Barat

No	Nama Kabupaten/Kota	Regulasi SPBE
1	Kabupaten Bima	x
2	Kabupaten Dompu	x
3	Kabupaten Lombok Barat	x
4	Kabupaten Lombok Tengah	x
5	Kabupaten Lombok Timur	x
6	Kabupaten Lombok Utara	x
7	Kabupaten Sumbawa	x
8	Kabupaten Sumbawa Barat	x
9	Kota Bima	Perwali No. 46/2019
10	Kota Mataram	x

18. Nusa Tenggara Timur

No	Nama Kabupaten/Kota	Regulasi SPBE
1	Kabupaten Alor	x
2	Kabupaten Belu	x
3	Kabupaten Ende	x
4	Kabupaten Flores Timur	x
5	Kabupaten Kupang	Perbup No. 59/2022
6	Kabupaten Lembata	x
7	Kabupaten Malaka	x
8	Kabupaten Manggarai	Perda No. 52/2021
9	Kabupaten Manggarai Barat	Perbup No. 57/2018
10	Kabupaten Manggarai Timur	x
11	Kabupaten Ngada	x
12	Kabupaten Nagekeo	x
13	Kabupaten Rote Ndao	x
14	Kabupaten Sabu Raijua	x
15	Kabupaten Sikka	x
16	Kabupaten Sumba Barat	x
17	Kabupaten Sumba Barat Daya	x
18	Kabupaten Sumba Tengah	x
19	Kabupaten Sumba Timur	x
20	Kabupaten Timor Tengah Selatan	Perbup No. 14/2019
21	Kabupaten Timor Tengah Utara	x
22	Kota Kupang	Perwali No. 22/2021

19. Kalimantan Barat

No	Nama Kabupaten/Kota	Regulasi SPBE
1	Kabupaten Bengkayang	Perbup No. 28/2022
2	Kabupaten Kapuas Hulu	Perbup No. 56/2020
3	Kabupaten Kayong Utara	x
4	Kabupaten Ketapang	x
5	Kabupaten Kubu Raya	Perbup No. 27/2021
6	Kabupaten Landak	x
7	Kabupaten Melawi	x
8	Kabupaten Mempawah	x
9	Kabupaten Sambas	Perbup No. 20/2022
10	Kabupaten Sanggau	x
11	Kabupaten Sekadau	x
12	Kabupaten Sintang	x
13	Kota Pontianak	Perwali No. 47/2021
14	Kota Singkawang	x

20. Kalimantan Selatan

No	Nama Kabupaten/Kota	Regulasi SPBE
1	Kabupaten Balangan	Perbup No. 31/2022
2	Kabupaten Banjar	Perbup No. 85/2019
3	Kabupaten Barito Kuala	Perda No. 2/2020
4	Kabupaten Hulu Sungai Selatan	Perbup No. 34/2021
5	Kabupaten Hulu Sungai Tengah	x
6	Kabupaten Hulu Sungai Utara	Perbup No. 19/2021
7	Kabupaten Kotabaru	x
8	Kabupaten Tabalong	Perbup No. 37/2021
9	Kabupaten Tanah Bumbu	Perbup No. 19/2021
10	Kabupaten Tanah Laut	Perbup No. 38/2021
11	Kabupaten Tapin	x
12	Kota Banjarbaru	Perwali No. 5/2018
13	Kota Banjarmasin	Perwali No. 89/2022

21. Kalimantan Tengah

No	Nama Kabupaten/Kota	Regulasi SPBE
1	Kabupaten Barito Selatan	Perbup No. 24/2022
2	Kabupaten Barito Timur	Perda No. 7/2019
3	Kabupaten Barito Utara	Perbup No. 33/2019
4	Kabupaten Gunung Mas	x
5	Kabupaten Kapuas	Perbup No. 2/2019
6	Kabupaten Katingan	Perbup No. 15/2022
7	Kabupaten Kotawaringin Barat	Perda No. 2/2020
8	Kabupaten Kotawaringin Timur	x
9	Kabupaten Lamandau	Perbup No. 37/2018
10	Kabupaten Murung Raya	x
11	Kabupaten Pulang Pisau	Perbup No. 6/2021
12	Kabupaten Sukamara	x
13	Kabupaten Seruyan	x
14	Kota Palangka Raya	Perwali No. 9/2022

22. Kalimantan Timur

No	Nama Kabupaten/Kota	Regulasi SPBE
1	Kabupaten Berau	Perbup No. 65/2021
2	Kabupaten Kutai Barat	Perbup No. 7/2019
3	Kabupaten Kutai Kartanegara	x
4	Kabupaten Kutai Timur	Perbup No. 22/2022
5	Kabupaten Mahakam Ulu	Perbup No. 49/2022
6	Kabupaten Paser	Perbup No. 20/2022
7	Kabupaten Penajam Paser Utara	x
8	Kota Balikpapan	Perwali No. 31/2020
9	Kota Bontang	x
10	Kota Samarinda	Perwali No. 9/2018

23. Kalimantan Utara

No	Nama Kabupaten/Kota	Regulasi SPBE
1	Kabupaten Bulungan	Perbup No. 2/2020
2	Kabupaten Malinau	x
3	Kabupaten Nunukan	Perbup No. 33/2020
4	Kabupaten Tana Tidung	x
5	Kota Tarakan	Perwali No. 6/2022

24. Gorontalo

No	Nama Kabupaten/Kota	Regulasi SPBE
1	Kabupaten Boalemo	x
2	Kabupaten Bone Bolango	Perbup No. 19/2023
3	Kabupaten Gorontalo	Perbup No. 52/2019
4	Kabupaten Gorontalo Utara	Perbup No. 16/2022
5	Kabupaten Pohuwato	Perbup No. 62/2020
6	Kota Gorontalo	Perwali No. 18/2022

25. Sulawesi Selatan

No	Nama Kabupaten/Kota	Regulasi SPBE
1	Kabupaten Bantaeng	x
2	Kabupaten Barru	x
3	Kabupaten Bone	x
4	Kabupaten Bulukumba	x
5	Kabupaten Enrekang	x
6	Kabupaten Gowa	x
7	Kabupaten Jeneponto	x
8	Kabupaten Kepulauan Selayar	x
9	Kabupaten Luwu	x
10	Kabupaten Luwu Timur	x
11	Kabupaten Luwu Utara	x
12	Kabupaten Maros	x
13	Kabupaten Pangkajene dan Kepulauan	x
14	Kabupaten Pinrang	x
15	Kabupaten Sidenreng Rappang	x
16	Kabupaten Sinjai	x
17	Kabupaten Soppeng	x
18	Kabupaten Takalar	x
19	Kabupaten Tana Toraja	x
20	Kabupaten Toraja Utara	x
21	Kabupaten Wajo	x
22	Kota Makassar	Perwali No. 84/2022
23	Kota Palopo	Perwali No. 26/2020
24	Kota Parepare	x

26. Sulawesi Tenggara

No	Nama Kabupaten/Kota	Regulasi SPBE
1	Kabupaten Bombana	Perbup No. 45/2021
2	Kabupaten Buton	x
3	Kabupaten Buton Selatan	x
4	Kabupaten Buton Tengah	Perbup No. 61/2022
5	Kabupaten Buton Utara	x
6	Kabupaten Kolaka	Perbup No. 49/2022
7	Kabupaten Kolaka Timur	x
8	Kabupaten Kolaka Utara	Perbup No. 28/2018
9	Kabupaten Konawe	x
10	Kabupaten Konawe Kepulauan	x
11	Kabupaten Konawe Selatan	Perbup No. 56/2022
12	Kabupaten Konawe Utara	Perbup No. 74/2022
13	Kabupaten Muna	x
14	Kabupaten Muna Barat	x
15	Kabupaten Wakatobi	x
16	Kota Bau-Bau	x
17	Kota Kendari	Perwali No. 51/2019

27. Sulawesi Tengah

No	Nama Kabupaten/Kota	Regulasi SPBE
1	Kabupaten Banggai	x
2	Kabupaten Banggai Kepulauan	x
3	Kabupaten Banggai Laut	x
4	Kabupaten Buol	x
5	Kabupaten Donggala	x
6	Kabupaten Morowali	x
7	Kabupaten Morowali Utara	x
8	Kabupaten Parigi Moutong	x
9	Kabupaten Poso	x
10	Kabupaten Sigi	x
11	Kabupaten Tojo Una-Una	x
12	Kabupaten Toli-Toli	x
13	Kota Palu	Perwali No. 14/2022

28. Sulawesi Utara

No	Nama Kabupaten/Kota	Regulasi SPBE
1	Kabupaten Bolaang Mongondow	x
2	Kabupaten Bolaang Mongondow Selatan	x
3	Kabupaten Bolaang Mongondow Timur	x
4	Kabupaten Bolaang Mongondow Utara	Perda No. 5/2023
5	Kabupaten Kepulauan Sangihe	x
6	Kabupaten Kepulauan Siau Tagulandang Biaro	x
7	Kabupaten Kepulauan Talaud	x
8	Kabupaten Minahasa	x
9	Kabupaten Minahasa Selatan	x
10	Kabupaten Minahasa Tenggara	x
11	Kabupaten Minahasa Utara	x
12	Kota Bitung	x
13	Kota Kotamobagu	x
14	Kota Manado	x
15	Kota Tomohon	x

29. Sulawesi Barat

No	Nama Kabupaten/Kota	Regulasi SPBE
1	Kabupaten Majene	Perbup No. 42/2022
2	Kabupaten Mamasa	x
3	Kabupaten Mamuju	x
4	Kabupaten Mamuju Tengah	Perbup No. 21/2023
5	Kabupaten Mamuju Utara	x
6	Kabupaten Polewali Mandar	Perbup No. 19/2022

30. Maluku

No	Nama Kabupaten/Kota	Regulasi SPBE
1	Kabupaten Buru	x
2	Kabupaten Buru Selatan	x
3	Kabupaten Kepulauan Aru	x
4	Kabupaten Maluku Barat Daya	x
5	Kabupaten Maluku Tengah	x
6	Kabupaten Maluku Tenggara	Perbup No. 37/2021
7	Kabupaten Maluku Tenggara Barat	x
8	Kabupaten Seram Bagian Barat	x
9	Kabupaten Seram Bagian Timur	x
10	Kota Ambon	Perwali No. 29/2021
11	Kota Tual	x

31. Maluku Utara

No	Nama Kabupaten/Kota	Regulasi SPBE
1	Kabupaten Halmahera Barat	x
2	Kabupaten Halmahera Tengah	x
3	Kabupaten Halmahera Utara	x
4	Kabupaten Halmahera Selatan	x
5	Kabupaten Kepulauan Sula	x
6	Kabupaten Halmahera Timur	x
7	Kabupaten Pulau Morotai	x
8	Kabupaten Pulau Taliabu	x
9	Kota Ternate	Perda No. 2/2023
10	Kota Tidore Kepulauan	x

32. Papua

No	Nama Kabupaten/Kota	Regulasi SPBE
1	Kabupaten Asmat	x
2	Kabupaten Biak Numfor	x
3	Kabupaten Boven Digoel	x
4	Kabupaten Deiyai	x
5	Kabupaten Dogiyai	x
6	Kabupaten Intan Jaya	x
7	Kabupaten Jayapura	x

No	Nama Kabupaten/Kota	Regulasi SPBE
8	Kabupaten Jayawijaya	x
9	Kabupaten Keerom	x
10	Kabupaten Kepulauan Yapen	x
11	Kabupaten Lanny Jaya	x
12	Kabupaten Mamberamo Raya	x
13	Kabupaten Mamberamo Tengah	x
14	Kabupaten Mappi	x
15	Kabupaten Merauke	x
16	Kabupaten Mimika	x
17	Kabupaten Nabire	x
18	Kabupaten Nduga	x
19	Kabupaten Paniai	x
20	Kabupaten Pegunungan Bintang	x
21	Kabupaten Puncak	x
22	Kabupaten Puncak Jaya	x
23	Kabupaten Sarmi	x
24	Kabupaten Supiori	x
25	Kabupaten Tolikara	x
26	Kabupaten Waropen	x
27	Kabupaten Yahukimo	x
28	Kabupaten Yalimo	x
29	Kota Jayapura	x

33. Papua Barat

No	Nama Kabupaten/Kota	Regulasi SPBE
1	Kabupaten Fakfak	x
2	Kabupaten Kaimana	x
3	Kabupaten Manokwari	Perbup No. 140/2021
4	Kabupaten Manokwari Selatan	x
5	Kabupaten Maybrat	x
6	Kabupaten Pegunungan Arfak	x
7	Kabupaten Raja Ampat	Perbup No. 9/2022
8	Kabupaten Sorong	Perbup No. 17/2022
9	Kabupaten Sorong Selatan	x
10	Kabupaten Tambrauw	x
11	Kabupaten Teluk Bintuni	x
12	Kabupaten Teluk Wondama	x

Appendix B. List of STEAM major related to digital skills

Education Institution	Group	Major
Pendidikan Tinggi (Universitas)	Science	<ul style="list-style-type: none"> ▪ <i>Chemistry and Chemical Engineering</i> ▪ <i>Physics</i> ▪ <i>Statistics and Data Science</i> ▪ <i>Applied Statistics and Computerized Statistics</i> ▪ <i>Mathematics (including Mathematics and Science Applications)</i> ▪ <i>Computer Science</i> ▪ <i>Computational Science</i> ▪ <i>Library and Information Science</i>
	Technology	<ul style="list-style-type: none"> ▪ <i>Information Management</i> ▪ <i>Information Systems and Technology</i> ▪ <i>Game Technology</i> ▪ <i>Information Security</i> ▪ <i>Accounting Computing Systems and Accounting Computerization</i> ▪ <i>Information Systems</i> ▪ <i>Information Technology (kecuali Information Technology Education)</i> ▪ <i>Automation Engineering</i>
	Engineering	<ul style="list-style-type: none"> ▪ <i>Informatics Engineering</i> ▪ <i>Software Engineering</i> ▪ <i>Computer Science</i> ▪ <i>Computer Engineering (Computer Network Engineering)</i> ▪ <i>Electrical Engineering (kecuali Electromedical Engineering, Shipping Electrical Engineering)</i> ▪ <i>Telecommunication Engineering (termasuk digital telecommunication networks)</i> ▪ <i>Engineering Physics</i> ▪ <i>Computer Systems</i> ▪ <i>Computer Systems Engineering</i> ▪ <i>Mechathronics Engineering</i> ▪ <i>Cartography and Remote Sensing</i> ▪ <i>Telecommunication Engineering</i> ▪ <i>Software Engineering Technology</i> ▪ <i>Communication Management (Engineering Field)</i> ▪ <i>Communication Information Management (Engineering Field)</i>
	Math	<ul style="list-style-type: none"> ▪ <i>Mathematics dan Applied Mathematics (tidak termasuk Mathematics Education)</i>
	Arts and Communication	<ul style="list-style-type: none"> ▪ <i>Graphic Design</i> ▪ <i>Journalism (termasuk Islamic Journalism)</i> ▪ <i>Communication Studies</i> ▪ <i>Broadcasting (termasuk Islamic Communication and Broadcasting)</i> ▪ <i>Media Production Management</i> ▪ <i>Film (including Film and Television Production, Film and Television Production Management)</i> ▪ <i>Media and Communication</i>

