Digital Indonesia Vision 2045



Inclusive

Equitable availability of digital access and safe digital space for all levels of society.

Empowering

The ability of the community to utilize digital technology productively and create added value from its utilization.

Sustainable

Digital transformation is based on fulfilling the Sustainable Development Goals Agenda.

Digital Indonesia Vision

2045

Ministry of Communication and Informatics
Republic of Indonesia

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Central Jakarta
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Budi Arie Setiadi

The Minister of Communications and Informatics

Introduction

Towards 100 years of Indonesia's independence, it is our common aspiration to be able to bring Indonesia out of the middle-income-trap and become one of the countries with advanced economies by 2045. Of course, the journey towards these goals is not easy, so appropriate, adaptive and visionary strategies and policy directions are needed. In recent decades, Indonesia has shown that with strong collaboration and well-orchestrated policies, we can use crises and challenges as a springboard for progress. Recognizing the great potential that Indonesia has while wisely mitigating the various challenges that exist, we are certainly optimistic that Indonesia can maintain resilience and positive economic growth into the future.

The challenges of the next twenty years will be very different from those we have faced over the past twenty years. The rapid pace of digital technology advancement will continue to bring dynamic complexity to various sectors. Recently, the world has been abuzz with the sophistication and versatility of artificial intelligence technology, from automating repetitive tasks to providing strategic recommendations in essential sectors such as healthcare and finance. Twenty years from now, artificial intelligence

will be an accepted part of everyday life and other new challenges will be born.

One of the major concerns and challenges arising from the rapid advancement of digital technology is the disruptive impact it has on Human Resources (HR). In 2045, Indonesia's demographic bonus is expected to peak with the productive age population accounting for 65% of the total population. Upskilling and reskilling are steps that we need to carry out massively, especially since the ratio of the number of Indonesian ICT workers is still very low, which is 1.09 million (0.75%) of the total 144.01 million Indonesian labor force according to the Statistics Indonesia (BPS) report in February 2022. Thus, anticipatory policies are needed to bridge Indonesia's demographic strength with the demands of digital technology development, so that Indonesians can not only adapt and be absorbed in the labor market but also be able to innovate and be empowered.

The Government of Indonesia's attention to the issue of human resources amid the swift flow of digital technology is one illustration of how the national digital transformation positions the Indonesian people as the main focus: in addition to avoiding the threat of the digital divide, people are also continuously encouraged to be able to utilize digital technology optimally. Therefore, we must be able to turn skepticism and concern into optimism and hope, considering that technological progress is a necessity. Together we must continue to prepare ourselves and the next generation of the nation to be able to reliably navigate the digital ocean that is full of opportunities as well as challenges towards the Golden Indonesia 2045.

Visi Indonesia Digital / Digital Indonesia Vision 2045 offers an alternative route that enriches existing efforts and strategies to realize a Golden Indonesia 2045. VID2045 specifically highlights various strategies for utilizing digital technology appropriately, productively, and purposefully through 3 (three) main approaches to achieve Indonesia's long-term national targets, namely: (1) ecosystem approach, (2) sectoral approach, and (3) regional approach.

I hope VID2045 can be a reference for all stakeholders in developing and implementing various policies aimed at making Indonesia's digital transformation a success. This strategic document, which was developed by involving various stakeholders, also reflects our collaborative spirit in realizing Indonesia's digital transformation that is inclusive, empowering and sustainable. Let's align our views and strengthen real collaboration in utilizing digital technology advancements to realize **an increasingly digital, more advanced Indonesia.**



Budi Arie Setiadi



Mira Tayyiba

Secretary General - The Ministry of Communications and Informatics

Foreword

The initiation of the preparation of the Digital Indonesia Vision (VID) 2045 departs from the hope to advance the national economy and the welfare of the Indonesian people through the right digital development policy direction. By engaging the collaboration of various parties, including cooperation with other countries, the private sector, academia, and society, we believe that VID2045 can be a solid foundation for achieving this goal.

We see that the digital ecosystem that drives national digital transformation is a unity consisting of various elements that need to be portrayed as a whole, synergistic and inseparable. This ecosystem is built naturally through intervention efforts in each of its supporting elements such as the foundation of digital infrastructure, and various elements such as security and data, digital Human Resources (HR), research and innovation, as well as regulations and policies. Therefore, VID2045 comprehensively seeks to outline strategies for building a digital ecosystem to support the achievement of goals in the realms of digital economy, digital government, and digital society as a whole.

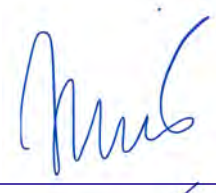
During the process of preparing VID2045, we have involved more than 50 parties consisting of relevant Ministries/Institutions, industry representatives, technology providers, ecosystem actors, associations and academics. The participation of various stakeholders in the drafting process is expected to provide aspirations as well as perspectives from various sectors on digitalization. Thus, stakeholders can determine a more synergistic and sustainable policy direction.

Furthermore, in order to maintain continuity with national and sectoral planning, VID2045 is also harmonized with the direction of development priorities in the Golden Indonesia Book 2045, the National Long-Term Development Plan (RPJPN) Draft 2025-2045, and various other national strategic documents. Therefore, the strategies developed are expected to be in accordance with the future plans of the relevant Ministries/Institutions.

VID2045 also supports the achievement of the vision of "advanced, sovereign and sustainable Indonesia" by creating a modern and responsive digital government, an innovative economy based on digital technology, and an empowered and cultured digital society. We also want to ensure that the use of digital technology in the future can provide welfare and a good quality of life to all Indonesians as well as be enjoyed by the next generation. Therefore, in its implementation, VID2045 prioritizes 3 (three) main principles, namely inclusive, empowering, and sustainable.

In line with these three principles, VID2045 outlines several strategies to accelerate digital transformation. Some of them are giga connectivity to support the application of future digital technology, increasing digital innovation, developing skilled national digital human resources with a cultured digital society, to regulations and policies that are able to create a fair playing field ecosystem. Strategies on other ecosystem elements are also well-designed to meet the digital challenges of the future.

I hope that VID2045, which has been compiled in the spirit of synergy and orchestration, can be poured and translated operationally by all stakeholders into medium and even short-term planning. This vision is not just an ambition, but a concrete action plan to achieve Digital Indonesia. With a spotlight on a responsive digital government, an innovative digital economy, and a society that harnesses digital power wisely, VID2045 encapsulates Indonesia's aspiration to become a major player in the digital age. Let us make this vision our optimistic vision in realizing Digital Indonesia for Advanced Indonesia.



Mira Tayyiba

Disclaimer

Issues

Digital-related issues that occur in Indonesia have a broad scope and the issues discussed in VID2045 accommodate some of the overall issues. For the VID2045 preparation process, it began in 2022 with the preparation of a study with international consultants, which was then compiled and refined together with more than 50 stakeholders, including Ministries and Institutions, telecommunications providers, global technology companies, associations in various fields, and academics. The preparation of the VID2045 concept is intended to support the achievement of Golden Indonesia 2045. This concept is designed through alignment with various national strategic documents, such as the RPJPN 2025-2045 draft and various digital master plans/ roadmaps that have been prepared by Ministries/Institutions.

Consideration

The Digital Indonesia Vision 2045 was developed by considering various perspectives, namely the perspective of the digital ecosystem development pillar, sectoral development, and regional development which includes policies in strengthening the digital ecosystem, the choice of sector priorities as the main driver of economic growth, and analysis to support regions in determining digital development priorities. VID2045 is a recommendation option for the preparation of national development plans.



Recomendation

In the context of national development planning, the Digital Indonesia Vision 2045 is expected to be a recommendation for designing the National Long-Term Development Plan (RPJPN) and the National Medium-Term Development Plan (RPJMN), especially in the area of national digital transformation. VID2045 will be a document that can be updated regularly (living documents) following changes in national development priorities and the dynamics of digital technology issues in the future. Furthermore, to support the implementation of VID2045, Ministries and Institutions can develop development plans or digital blueprints for more specific themes according to their sectors, such as Digital Government, Digital Economy, and Digital Society, which are expected to be aligned and have the spirit of realizing the Digital Indonesia Vision 2045.



Implementation

The implementation of the Digital Indonesia Vision 2045 in the future needs to be supported by a strong legal basis so that the implementation of national digital transformation can be carried out optimally in all sectors. In addition, an implementing institution/organization is needed that will control and manage the coordination of the national digital program. With both, the implementation of national digital transformation can be carried out synergistically and effectively, so that the steps towards Advanced Indonesia 2045 will be closer.

Executive Summary

- **Background**: As Indonesia aspires to become one of the top 5 countries with the highest gross domestic product (GDP) in the world by 2045, it is crucial to master digital technology correctly. The development of technology in the future has the opportunity to provide economic benefits for countries that can utilize it well. Therefore, many countries are preparing their respective strategies. Indonesia needs to immediately establish the direction and strategy of utilizing technology to strengthen the economy and get out of the middle-income-trap. At the same time, the application of digital technology also comes with serious challenges and threats, including in digital sovereignty, disruption to employment, technology dependency, and erosion of cultural values and Pancasila. To address this, synergized steps are needed from all stakeholders, i.e. central and local governments, industry players, and public entities.
- The drafting of the Visi Indonesia Digital/ Digital Indonesia Vision (VID) 2045 is intended to be a consensus on the future direction to enable each stakeholder entity to develop appropriate strategies in their respective sectors while simultaneously supporting the realization of common goals.
- **Current States:** In formulating future strategies, a reflection on current conditions shows that there are still various issues that need to be addressed, both in the national and regional by looking at various aspects, starting from information and communication technology (ICT) infrastructure, supporting ecosystems, to socio-cultural aspects. It is critical to limit the current conditions that need to be highlighted with consideration of the future digital direction to be targeted and focused on, that includes the current sectoral perspective of regional development priorities and will be taken into consideration in determining future priorities.

- **Megatrends:** In addition to capturing national perspectives, it is also important to understand global trends in various sectors to enable Indonesia to prioritize the direction of digital adoption and policy going forward. The technology trend is one that will dominate the future digital direction, and see how it impacts the direction of national policy. Determining the level of Indonesia 2045 policy direction provides an overview of the level of policy direction towards Digital Indonesia from pessimistic to optimistic for Indonesia in 2045 (Heavy Consumer, Technology Prosumer, and Global Innovator).

- **Vision, Mission and Strategy of Indonesia Digital 2045:** The vision and mission will be defined to sharpen the direction of the targeted digital policy, which will be derived into several layers of strategy, and its success will be measured through measurable KPIs. In addition, it also provides numerical projections and descriptions of the quantification of economic impacts with the development of Indonesia Digital 2045.

- **Call-to-Action:** Collaboration and orchestration play an important role in operationalizing the policy directions and strategies in the Digital Indonesia Vision 2045 into strategic initiatives of Ministries and Agencies. It is also necessary to establish collaboration schemes and mechanisms that involve various relevant stakeholders in the success of the strategic initiatives launched. In addition, it is necessary to propose follow-up plans and forms of organization that are considered appropriate in implementing the development agenda towards Digital Indonesia 2045.

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01 The Current State of Digital in Indonesia



In the past decade, Indonesia has seen a significant increase in the progress of digital transformation. However, the problems of uneven digital infrastructure, unstable connectivity, and slow penetration of next-generation networks are still major issues in national digital transformation. In addition, on the digital ecosystem side, the lack of digital innovation and the dominance of global tech-giants means that Indonesia is still at the technology consumer level. The situation becomes more difficult because the synchronization of infrastructure development and digital ecosystems from the central to the regions is not effective.

KOMINFO
2045 Visi Indonesia Digital



1.1 Background

The efforts of various ministerial and institutional entities in carrying out digital transformation according to their respective functions will be more effective if they lead to the same strategic direction. The Digital Indonesia Vision 2045 provides an overview of policy directions and common goals to optimize the benefits of technological development for economic, social and community development in Indonesia in the future. With the right synergy in digital transformation, it will be able to encourage the improvement of national competitiveness and bring Indonesia to become one of the advanced economies in 2045.

Various studies show that Indonesia has the potential to become a world economic power by 2045. One of the key factors is to master digital technology properly. If Indonesia is able to take advantage of digitalization in the economic sector, Indonesia is expected to increase its GDP by 22,500 trillion IDR compared to GDP growth without digital transformation[1].

The increase in productivity is also expected to increase the economy by an average of 6.0-7.0 percent p.a., allowing Indonesia to step out of the Middle Income Trap (MIT) before 2045 and become a country with a gross domestic product (GDP) value ranked 5th to 7th highest in the world, with an estimated GDP per capita income of US$ 20-23 K by 2045[2].



becoming a country with a Gross Domestic Product (GDP) value ranked 5-7th in the world

Ranking



Indonesia's potential ranking as the country with the world's highest GDP

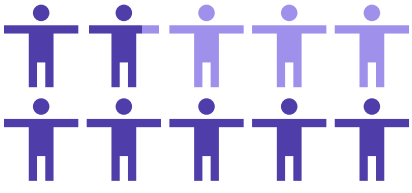
[1] Bappenas. Indonesia Digital Industry Development Master Plan 2023-2045.

[2] Bappenas. May 2023. Annex to the Draft National Long-Term Development Plan 2025-2045

In terms of human resources (HR), there is great potential to support Indonesia's economic growth. The demographic bonus potential of the productive-age population, which is predicted to reach 68% by 2030, is expected to contribute significantly to the national economy. The development of qualified and skilled national human resources according to the needs of the times is an important point in utilizing the demographic bonus to drive economic growth in the future.

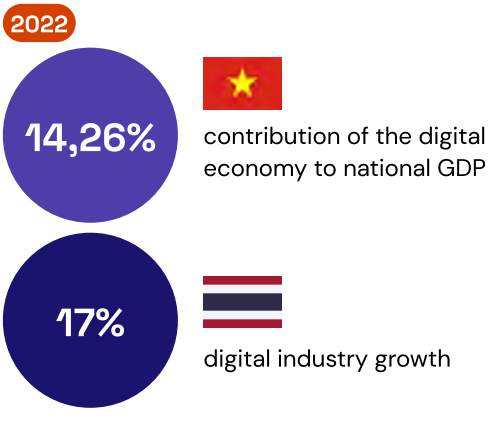
Over the past few years, positive developments have been seen in SEA countries that are progressive and advancing in the utilization digital technology.

As of 2022, Vietnam recorded the contribution of the digital economy to national GDP at 14.26%, while Thailand showed digital industry growth of 17%[3]. It shows that regional countries are also aware of the benefits of technological development and are striving to develop their mastery of digital technology, as it is a key factor for improving national competitiveness in the future.



68% productive-age

in 2030, expected to contribute significantly to the national economy



[3] Google. 2016. e-conomy sea 2022 Through the waves, towards a sea of opportunity.

There are projections of technological developments towards 2045 that show a massive surge in connectivity and data usage. By 2045, it is estimated that globally, network connectivity will have entered the 6G and 7G era, with internet traffic surging to 2000 exabytes, and home connect access to 1 Tbps[4]. The implementation of future technologies such as quantum computing, autonomous robots, and other advanced wearable devices is expected to penetrate globally and be utilized by various countries to boost their productivity growth and competitiveness. With regional countries competing to reap the economic benefits of new technologies, Indonesia also needs to prepare and quickly anticipate the implementation of future emerging technologies.

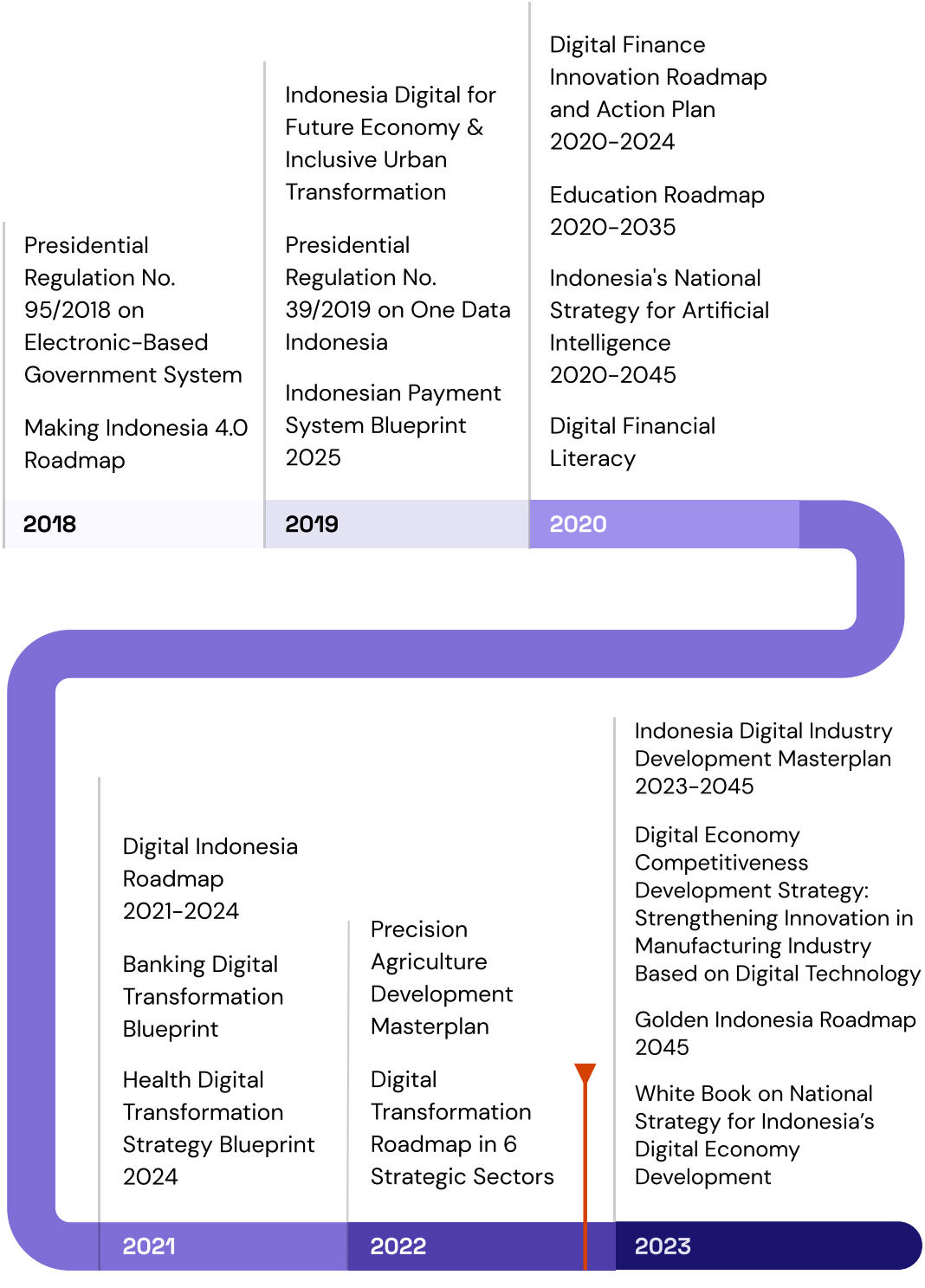
Technology and human civilization are inseparable. Digital transformation brings many potential and multiple benefits, along with potential negative impacts, challenges and risks that need to be anticipated. Technologies such as blockchain, Artificial Intelligence, Big Data Analytics, are some of the technologies that will significantly disrupt the supply chain of conventional sectors. With the rise in the use of Internet of Things devices and applications, there will also be an increase in security and privacy risks for the general public.

Broad access to information to all regions of Indonesia also brings the risk of eroding cultural values and local customs, therefore, it is important to ensure that awareness of Pancasila values, cultural values, and social norms be maintained through literacy and the development of digital ethics to all levels of society. The risks will also be increasingly difficult to control with the dominance of global players in the entire digitization journey. Consequently, data sovereignty is also an issue of the future that needs to be carefully prepared with anticipation strategies.

The Indonesian government continues to respond to the development of digital technology with various policy regulations. Each government institution develops strategic steps to deal with issues within its duties and functions. However, digital transformation is a cross-sectoral process, and requires policy consolidation between institutions to produce a comprehensive policy. Currently, there are more than 17 digital master plans and roadmaps, both existing and under development, which outline digital-related policies, goals and strategies that need to be further synchronized.

[4] Mastel. 2023.

Figure of Digital Field Masterplan/ Roadmap



These strategic documents in the digital sector have undergone various obstacles and barriers in their implementation. This is mainly a result of the lack of effective synchronization and synergy between the parties involved, both in the planning and implementation processes on the ground. The lack of synergy in policy direction between these strategic documents has hampered the potential of national digital transformation. Several roadmaps or masterplans are designed on a sectoral basis, tailored to the tasks and functions of the ministries and/ or institutions that developed them. Meanwhile, to realize Indonesia Digital, ideally a clear direction and comprehensive coordination from the government, the private sector and the public are needed.

Therefore, in order to navigate the development of digital technology, as well as overcome the issues faced, careful preparation and planning are needed, as well as the orchestration of all components of digital development on the main pillars, i.e. economy, society, government, and with infrastructure as its foundation. This is critical to determine the target direction of digital policy and the implementation of digital technology in the future.

In defining steps and strategies, it is also necessary to involve relevant parties, both from the central and local governments, the private sector, academics, experts, and non-governmental organizations. Synchronization between policies, regulations, and activities is needed to target the use of digital technology.

To address various challenges while driving the achievement of the vision, Digital Indonesia Vision 2045 is designed to provide common goals, national strategic policy direction, to be incorporated into strategies at the implementation level of all parties. The implementation of this strategy will also require the active role of all stakeholders in which the government acts as a regulator and executor, with private sector, academics, experts and non-governmental organizations play their respective roles. This strategic policy direction is developed by observing the current Indonesian context, both sectorally and regionally, as well as looking at future global trends in technology. The government can determine the strategic priorities that can be taken to anticipate the issues and challenges of technological development and gain advantages to improve competitiveness and the national economy in the future.

[5] Mastel. 2023.





More than 50 stakeholders were involved in formulating the Digital Indonesia Vision 2045 concept



1.2 Current States

1.2.1. The State of National Digital Transformation in the Infrastructure, Economy, Government and Society Sectors

A. Digital Infrastructure

Indonesia is experiencing an increase in mobile broadband penetration but fixed broadband is still relatively low. Various obstacles still challenge the development of digital infrastructure, both on the supply side and on the demand growth side. Uneven, low-speed and unstable internet connectivity are some of the main problems that need to be addressed immediately. In fact, in the face of future technological developments, Indonesia must be able to provide dual gigabit connectivity (fiber and cellular). In terms of the digital ecosystem, local content and technology adoption are still relatively low. In addition, environmental sustainability in the development of digital infrastructure should also be a focus that needs to be considered.

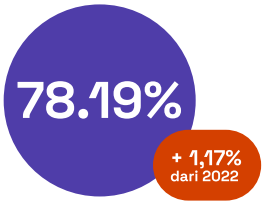
Digital infrastructure is leveraged to support the development of general and specialized telecommunications, for instance in the context of resilience, security and disaster. In recent years, rapid advancements in digital technology have changed the landscape of many sectors in business, government and social interaction. However, the success of a country depends not only on conventional aspects, but also on the ability to actively utilize digital technology.

Digital infrastructure includes quality connectivity as well as the necessary supporting infrastructure ecosystem to ensure the availability of reliable and secure telecommunications services. This is crucial in supporting general public communications, as well as special needs such as emergencies or public safety concerns.

In early 2023, the number of internet users in Indonesia has reached 78.19%, an increase of 1.17% from the previous year. The use of mobile connections has increased by 3.6% since the COVID-19 pandemic. The number of active social media users also increased by 12.6%. The increasing trend in the number of mobile connections is also seen in several other SEA countries such as Malaysia (2.9%), Thailand (4.1%), and Philippines (4.6%).[5]

In providing higher quality internet, over the past three years, telecommunication service providers have also been actively expanding 4G coverage in more areas. By 2022, 89% of Indonesia's population will have access to at least a 4G network.[6]

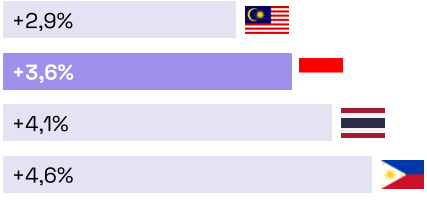
The pandemic has been a point of sharp increase in demand for broadband internet. This is in line with the increasing trend of investment in the national telecommunications sector, which is a manifestation of telecommunication providers' efforts to meet the needs of the wider community for internet data usage.



number of Indonesian internet users in early 2023



increased number of active social media users in Indonesia

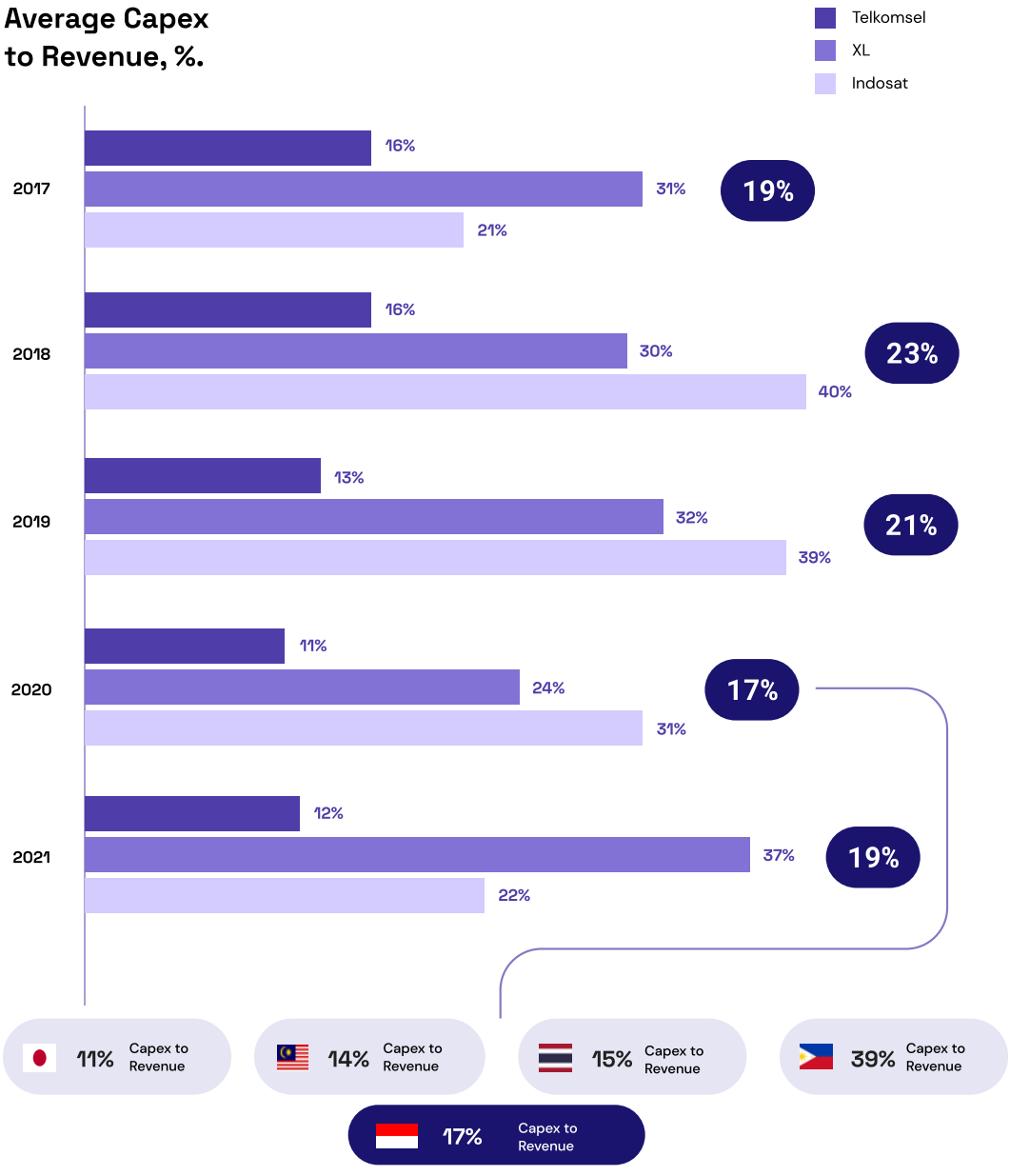


increased number of mobile connections since COVID-19 pandemic in Indonesia

[5] Kemp, Simon. 2023. Digital 2022. Meltwater.

[6] Kominfo. 2022

It is evident that in terms of the average capital expenditure (CapEx) to income ratio, Indonesia has shown a high increase in telecommunications investment compared to Malaysia (14%) and Thailand (15%). A high capex ratio suggests that companies and the economy as a whole are investing in growth and development. Nevertheless, it is important to note that a low capex ratio does not necessarily reflect poor company performance. These investment expenditures must be allocated efficiently by not making excessive investments and paying attention to the health conditions of telecommunications companies.



▲ **Figure 1.1** Capex to Revenue Ratio for Indonesia's Top Telco (%, 2017-2021)

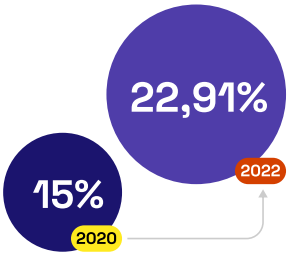
Despite its progress, there are various obstacles/challenges that Indonesia faces in digital infrastructure.

Compared to mobile broadband, fixed broadband penetration is still low, 2020 data suggests only about 15% of households are connected to fixed broadband (Kearney). Subsequently, the 2022 data shows that only 22.91% of households are covered by fixed broadband. In addition, internet speeds are still relatively low while the cost is already quite expensive. Nationally, internet speeds are also still relatively slow compared to benchmark countries, with mobile broadband speeds of 22.99 mbps and fixed broadband speeds of 26.12 mbps, along with fluctuating speed trends (download speed test as of June 2023).

Compared to other countries, Indonesia is ranked 99 out of 140 countries for mobile broadband and 122 out of 180 countries for fixed broadband. In some provinces, mobile broadband download speeds have exceeded 25 mbps, while others are still below 20 mbps. The following is the complete internet speed per province.

In terms of affordability, Indonesia's fixed broadband service costs an average of US$0.72/mbps/month. The cost is much higher than other countries, i.e. China (0.23 US/mbps/month), Singapore (0.03 US/mbps/month), and the Philippines (0.40 US/mbps/month) (Kearney).

The quality and affordability is also greatly influenced by the penetration of fiber optic networks. Currently, fiber optic penetration is still low, at 60.84% accross all sub-districts. The existing fiber optic network covers approximately 4,398 sub-districts out of a total of 7,281 sub-districts in Indonesia. The total fiber optic network construction to date is 460,000 km.[7]



households are covered by fixed broadband



mobile broadband speeds

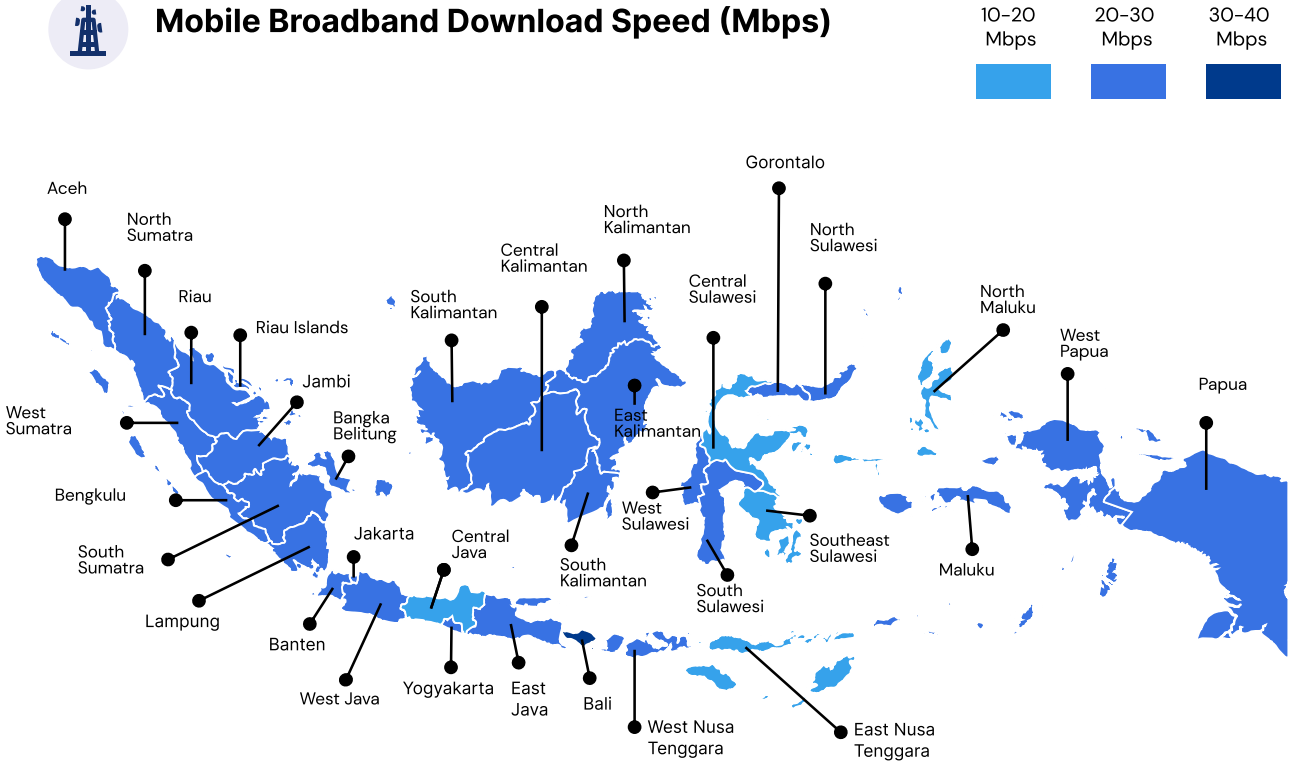


fixed broadband speeds

Data download speed test June 2023

[7] Ministry of Communication and Information. 2022. Laporan Kinerja Kominfo Tahun 2022 (Ministry of Communication and Information Performance Report 2022).

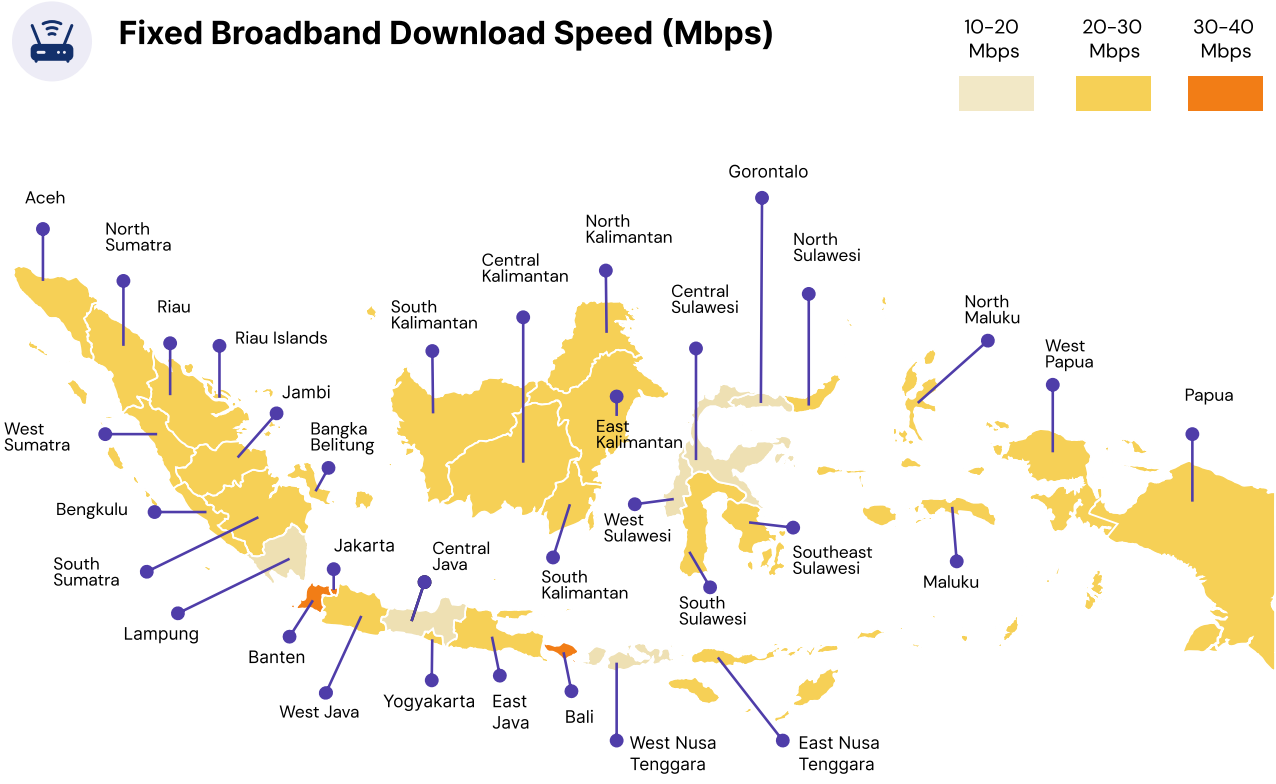
Mobile Broadband Download Speed (Mbps)



Mobile Broadband Download Speed

	Mbps
Aceh	24.83
North Sumatra	22.86
West Sumatra	20.55
Bangka Belitung	29.17
Bengkulu	21.6
Jambi	22.64
Riau	23.46
Riau Islands	25.83
South Sumatra	21.86
Lampung	20.2
Banten	23.81
Jakarta	24.57
West Java	20.71
Central Java	18.78
Yogyakarta	22.56
East Java	23.47
Bali	30.12
West Nusa Tenggara	28.33
East Nusa Tenggara	17.58
Central Kalimantan	25.2
North Kalimantan	22.9
South Kalimantan	26.7
East Kalimantan	24.47
West Kalimantan	25.81
Central Sulawesi	17.14
Gorontalo	31.21
North Sulawesi	23.77
Southeast Sulawesi	12.8
South Sulawesi	23.01
West Sulawesi	27.34
Maluku	23.07
North Maluku	16.28
Papua	24.04
West Papua	28.74

Fixed Broadband Download Speed (Mbps)



Fixed Broadband Download Speed

	Mbps
Aceh	23.57
North Sumatra	24.49
West Sumatra	20.8
Bangka Belitung	21.24
Bengkulu	20.53
Jambi	20.71
Riau	20.11
Riau Islands	23.25
South Sumatra	25.42
Lampung	17.94
Banten	30.65
Jakarta	33.94
West Java	27.73
Central Java	19.45
Yogyakarta	21
East Java	20.18
Bali	35.43
West Nusa Tenggara	18.3
East Nusa Tenggara	22.94
Central Kalimantan	21.25
North Kalimantan	24.76
South Kalimantan	26.28
East Kalimantan	23.98
West Kalimantan	23.32
Central Sulawesi	19.46
Gorontalo	19.87
North Sulawesi	23.21
Southeast Sulawesi	19.64
South Sulawesi	24.16
West Sulawesi	18.55
Maluku	23.01
North Maluku	25.73
Papua	24.66
West Papua	22.94

In an effort to improve the equal access to quality and affordable internet, the telecommunications industry also plays an important role. Maintaining the health of the telecommunications industry is therefore important, such as through the value of User Rights Fees (BHP) to telco revenues. Over the last 10 years, however, the trend of BHP Radio Frequency Spectrum for Radio Frequency Band Licenses (BHP IPFR) has shown an increasing rate with stagnant and declining telco revenues, resulting in an increasing trend of the percentage of BHP IFR to telco revenues exceeding 10% excluding other licensing fees, which could threaten the telco's sustainability.[8]

In overall, network connectivity-related issues are related to electricity and basic infrastructure limitations, network deployment barriers, availability of radio frequency spectrum, and the health of the telecommunications industry, and various issues on the domestic demand or content. Several issues and problems are faced, namely:

A limited availability of electricity or energy supply to meet the demand for infrastructure network penetration in several regions of Indonesia. Many regions are experiencing shortages of electricity. Issues are particularly acute in the outer islands and remote areas. This inequality in electricity distribution inevitably affects the provision of distribution internet networks.

The unoptimized allocation of radio frequency spectrum creates obstacles in fulfilling national frequency needs. The rapid growth of ICT technologies and services will increase the demand for spectrum for various purposes, such as broadcasting, satellite, security, disaster, as well as the implementation of new technologies.

[8] Evaluation of BHP Radio Frequency Spectrum Tariff Policy. 2020 ; ATSI. 2023

Indonesia's complex geography also makes it difficult to build and deploy networks in Indonesia. Thousands of islands and mountainous topography with minimal basic infrastructure, are very difficult to access by terrestrial infrastructure and require a combination of technologies that enable quality network penetration. This is exacerbated by disaster-prone conditions.

The development of the telecommunications industry is not healthy, observed from financial indicators, indicating that telecommunications companies have difficulties in generating cash flow due to high costs, difficulties in generating profits, poor returns on investment, and inefficient use of capital, while regulatory costs increase every year.

Deploying networks throughout Indonesia also faces regulatory barriers, including complicated licensing processes, long and inefficient bureaucracy, regulatory uncertainty, and non-uniformity of local government policies, as well as high costs depending on the region.

The number of alternative routes for international internet exchange, especially in eastern regions such as Papua, is still low. This poses a higher risk of internet outages in the Jayapura and Merauke areas due to the absence of alternative undersea routes.

Anticipating the highly dynamic development of technology in the future will require faster, higher-quality, low-latency networks, i.e. gigabit networks. Gigabit networks are capable of accelerating the adoption of emerging future technologies. This is driven by the gigabit network's large capacity and good performance, including latency of less than 1 second, data access speeds reaching up to 100 Mbps - 1Gbps, and the ability to support large-scale connectivity, where more than 10,000 connections can be accommodated per square meter.

In order to prepare towards a gigabit network, it is necessary to ensure that the existing network is capable and ready to be developed towards the next-generation network. Currently, as we enter the 5G era, penetration of 5G networks in some parts of Indonesia is already present, but still relatively low.

As of today, there are 48 cities with 5G capability, and 5G network coverage until 2022 is 0.10% measured by area, or 2.49% by residential area[9]. Some of the challenges in deploying 5G include the uneven distribution of fiber optic networks, relatively small spectrum capacity, unidentified use cases and killer applications, as well as substantial investment.

In addition, expanding network penetration more evenly requires efforts to increase growth on the demand side. In this case, the ecosystem components supporting infrastructure, namely the growth of data centers (storage), ICT devices and the availability of local content. At present, the growth of domestic data centers is still low, the distribution of ICT devices is still fairly limited and cannot be universally accessed throughout Indonesia, while local content is also still relatively minimal.



with 5G capability

with 5G network coverage until 2022 is 0.10% measured by area, or 2.49% by residential area

[9] Ministry of Communication and Information. 2022. Data processed by Pusat Monitoring Telekomunikasi/ Telecommunication Monitoring Center.

[10] Singapore Institute International Affairs Report "Charting ASEAN's Digital Future: Emerging Policy Challenge".

[11] Singapore Institute International Affairs Report "Charting ASEAN's Digital Future: Emerging Policy Challenge".

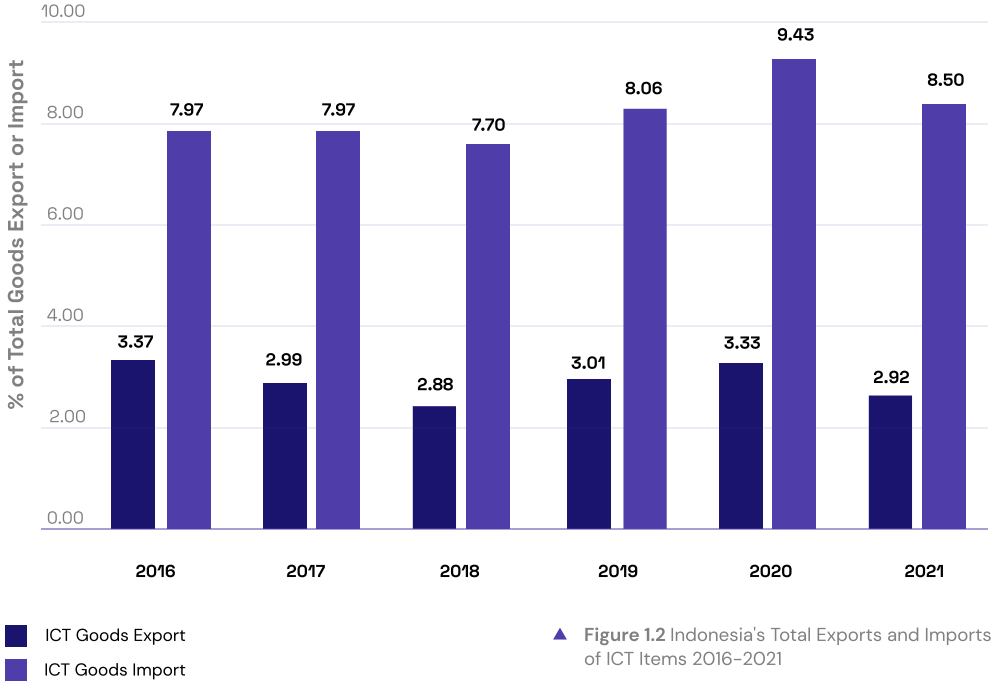
The higher penetration of broadband networks will result in increased data usage and internet traffic, leading to increased demand for data centers and servers in Indonesia as well as cloud services. It will be the same at the ASEAN regional level, where annual data growth is around 23% and from 2020 to 2025 it is estimated that there will be 175 zettabytes of data in use[10]. Considering the growth of data centers in Indonesia, the ratio of data centers to population is still very low at 0.73% (Megawatts per Population), significantly lower than developed countries such as Japan at 23.72% and Australia at 47.83% (source: Kearney). Indonesia is currently ranked 56 out of 76 countries by 2022 in the Global Cloud Ecosystem Index ranking, which represents the availability of cloud services across infrastructure, ecosystem deployment, security, and talent.

On the other hand, with the increase in data centers, there will be a significant impact on energy consumption and a negative impact on environmental sustainability. Globally, digitization contributes about 3-4% to greenhouse gas emissions, and will increase to 14% by 2040. As a result, energy issues and efforts to reduce the carbon footprint are important to consider in the future[11].

The supporting ecosystem, ICT devices such as smartphones, tablets, and computers, also play an important role in increasing broadband internet penetration. However, there are multi-dimensional issues ranging from low adoption of devices due to the price to high level of imports.

The supporting ecosystem, ICT devices such as smartphones, tablets, and computers, also play an important role in increasing broadband internet penetration. However, there are multi-dimensional issues ranging from low adoption of devices due to the price to high level of imports. Compared to other countries, access to computer devices is still very low, only 20% of households have access to computers while the Philippines has 24%, South Korea 72%, and Singapore has reached 89% (Kearney). The issue of high price of devices can limit access, especially in areas with low income levels. In addition, in terms of providing ICT devices, Indonesia still often relies on imported items. Based on data from 2016 to 2020, the current account deficit in the ICT sector continues to increase, the percentage of exports and imports can be seen in Figure 1.2.[12]

This situation negatively impacts the level of innovation in ICT companies, which has decreased due to the limitations of domestic ICT products. ICT devices such as routers, modems, and Wifi antennas also play a crucial role in maintaining internet network quality. In addition, Indonesia continues to face challenges in adopting high-tech devices. This is evident from the low adoption of Internet of Things (IoT) technology devices, which is reflected in the low ranking of smart cities. For instance, Jakarta is ranked 91, Makassar is ranked 99, out of a total of 118 countries (Kearney). These challenges include the requirement for devices that keep up with the technology penetration of the existing infrastructure in the area. ICT devices are also important to fulfill the compliance aspects of established regulations and standards.



▲ **Figure 1.2** Indonesia's Total Exports and Imports of ICT Items 2016–2021

[12] CEIC. 2023

With the rapid development of technology, however, it often bypasses existing regulations, resulting in a lack of acceleration, and hesitation from the ICT device providers. ICT device developers require an understanding and certainty of the regulations which govern privacy, security, and consumer protection. Moreover, the domination of foreign players in the ICT device sub-sector is an obstacle to the development of local industries. In terms of device procurement, 95% of component procurement is still imported and Indonesia only play as an assembler[13] ,mainly due to low production capability and high production costs. Innovation, which is the key to a more advanced ICT device ecosystem, is also relatively low, resulting in a higher dependence on new foreign technologies.

Apart from ICT devices, local content also plays an important role in the digital ecosystem. Local content is a medium to increase the role of domestic actors in the development of the national digital ecosystem. Yet, the growth of local content is still relatively low and recent data shows that the majority of websites most accessed by users in Indonesia are international websites such as Google, YouTube, Facebook, etc. About 30% of the most popular websites accessed by the public are local and only about 16% of the most downloaded apps are local (Kearney).

One of the main challenges in developing local content is that the growth of local content is still relatively slow, this obstacle is further reinforced by the public perception that local content is still less attractive than global content capable of attracting many people. This problem is also related to the low level of digital literacy and limited access to supporting technology both due to technology availability and cost constraints, which in turn limits the ability of digital content creators to produce and distribute quality and interesting local content. Regulatory and investment support for local content development is still unclear and minimal.

There are also challenges in meeting the demand for specialized telecommunications, such as resilience and disaster management. Despite developments in communication networks, such as LTE technology, the utilization of this technology for disaster management is still limited and tends to be conventional. In addition, technological developments also bring new challenges such as cybercrime. Unfortunately, there has not been sufficient effort in utilizing technology, such as data centers or the implementation of artificial intelligence (AI), to address and prevent existing cybercrime threats. These are issues that need to be addressed urgently as public resiliency, security and safety are of paramount importance.

[13] Bappenas. Rencana Induk Pengembangan Industri Digital Indonesia 2023 – 2045/ Indonesia Digital Industry Development Master Plan 2023-2045.

B. Digital Economy

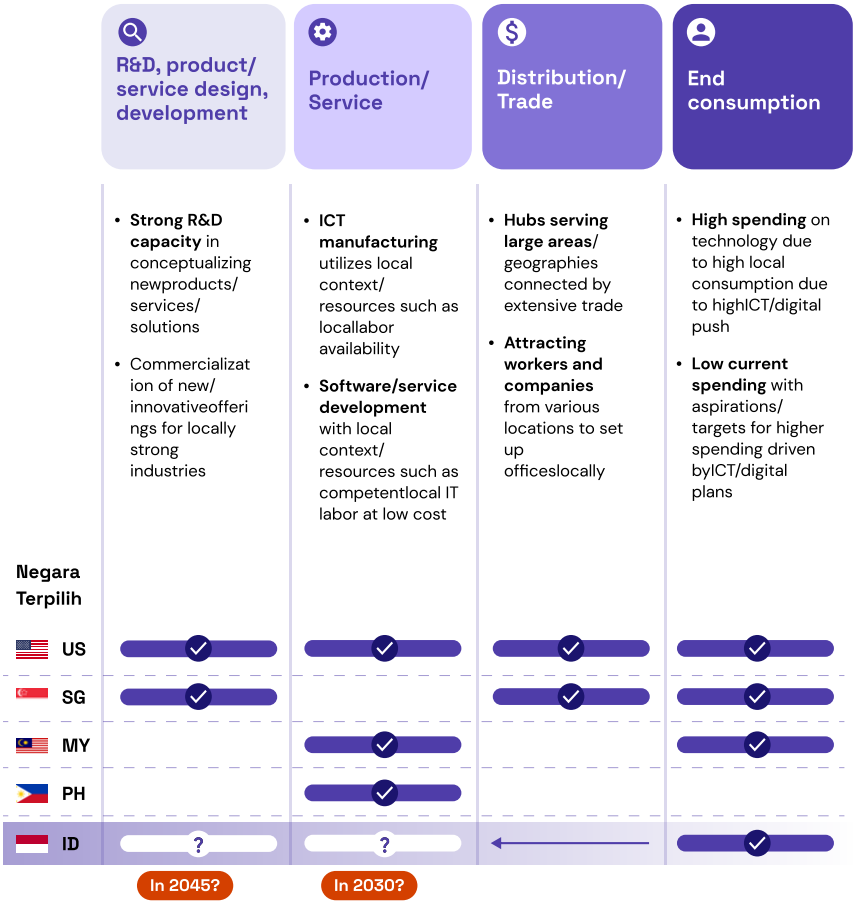
Amidst the rapid growth of the national digital economy, Indonesia is still a global technology consumer. The national digital market, both in platforms and applications, content and ICT devices is still dominated by foreign providers. Relatively low research and innovation is a complex issue that needs to be addressed from various angles. The startup ecosystem is also experiencing slow growth and is still located in certain urban centers. All of these issues also affect the low level of digital technology adoption in various key economic sectors, such as MSMEs. Meanwhile, to achieve brilliant digital economic growth, it will require a safe digital space, protected data and privacy, and a digital ecosystem that upholds a fair level of playing field.

Indonesia has been seeing good economic growth over the past decade, as seen in the increasing trend of national GDP from 8,241 IDR in 2012 to 19,588 T in 2022[14]. A look at the structure of the economy shows a shift in the proportion of economic sector contributions to national GDP, from the primary sector to the service sector.

While traditional sectors such as agriculture and fisheries are experiencing a downward trend, the services sector continues to experience increased growth. This is a good indication, as it shows the evolutionary process that is common in countries undergoing transformation to a more developed state.

The development of the service sector will be a driver for the acceleration of national digital transformation. Nonetheless, the trend still has the potential to increase significantly if Indonesia's major economic issues can be addressed. The issues include stagnant productivity, a high-cost economic structure, and a less competitive economic portfolio.

This issue is a realization of various economic problems that need to be resolved simultaneously, such as bureaucratic complexity, lack of innovation, disparities in regional economic growth, and various issues related to uncertain regulations and policies.



Sumber: Kearney Analysis

▲ **Figure 1.3** Potential Dominant Position in the Digital Product/Service Value Chain

Looking at the growth of the value of the digital economy, Indonesia continues to experience growth, and in 2021, the value of Indonesia's digital economy is estimated to contribute around 1,490 T IDR, in which the contribution of the digital industry reaches 6.12% of GDP[15]. On further analysis, in the digital value chain, Indonesia is still a consumer country globally.

To understand the issues and problems in the digital economy, it is necessary to have a broad view, and from upstream to downstream.

These problems can be translated at the level of digital technology development, to the adoption of digital technology into various strategic sectors. Some of the main issues include the lack of research and innovation in the digital sphere, digital business development is still dominated by modeling replication of global startups and minimal implementation of future technologies, support for Intellectual Property Rights (HAKI), and barriers to the adoption of digital technology in strategic sectors.

[15] Bappenas, measured based on GDP at current prices

A. Research and Innovation Development

At present, Indonesia is still classified as a technology consumer, given that it still has limitations in terms of hi-tech hubs. As a result, existing local startups tend to replicate global business models. The current situation is that players import technology from abroad to be used in their business. This activity requires a huge cost compared to producing technology domestically. But it requires resource support to enable the production of own technology.

One component of the national startup ecosystem is to encourage R&D activities in order to achieve the effectiveness and efficiency of technology that will be used by digital economy players. The output of science and technology (S&T) can be obtained from universities and non-governmental and governmental research institutions. Startup companies have the idea to adopt existing technologies to be developed further[16]. This is not the case for micro, small and medium enterprises (MSMEs) where access to science and technology and knowledge mastery is minimal.

The government needs to bring together science and technology actors with digital economy players to create the technology the players want. Additionally, R&D activities also need to be fostered to make the adoption of foreign technologies and the process of imitation and invention of new technologies affordable, thereby creating technologies that are cheap and can be widely used. The government needs to ensure and convince the private sector to invest in the R&D sector, providing rewards or profits after the R&D activity is completed. The business scheme of the R&D sector needs to be evaluated to make it a profitable business scheme for the private sector.

The expectation is that R&D activities are not only accessed by large-scale startup companies, but can also be accessed by early stage startup companies and MSME players. This will create an ecosystem that encourages the cycle of science and technology from upstream to downstream, and encourages competition between digital businesses.

[16] Bachtiar, Palmira Permata., et al. 2022. City-Level Tech Startups Ecosystems and Talent Development in Indonesia. Asian Development Bank: Manila. https://www.adb.org/sites/default/files/publication/843456/adb- brief-228-startup-ecosystems-indonesia.pdf

The notion of R&D as the primary profit creator is counterproductive, as it should be more of an innovation creator that focuses on problem solving and long-term value creation. At this stage, the role of institutions with authority over the innovation research ecosystem is important to provide future direction. Furthermore, access to qualified human resources is essential, allowing R&D teams to have the expertise and capacity to create significant innovations. Operational support such as office facilities and permits should also be in place to ensure that the R&D team can focus on creativity and experimentation.

Until now, the availability of adequate funding to support high-risk experiments and leading-edge innovations has been limited. And yet, innovation often requires significant investment and has a high degree of uncertainty. Therefore, telcos need to ensure that there is a source of funds that can be used to support these experiments without exposing the R&D team to excessive financial pressure.

The protection of intellectual property rights must also be considered in the context of R&D. The innovations produced need to be safeguarded and protected to prevent it from being easily copied or misused by other parties. To create an environment that supports productive R&D, telcos need to integrate all these elements well.

B. National Startup Ecosystem

Startup growth in Indonesia is experiencing a progressive trend and is one of the top in the Asia region. As of 2022, the number of startups in Indonesia reached 2,341 startups-second highest in Asia after India[17]. Furthermore, Jakarta is ranked 12th out of 100 cities in the world in the Top 100 Emerging Ecosystems. Jakarta's ecosystem value reached US$71 billion, surpassing the global average of US$34.6 billion. The assessment is based on a number of factors, such as investment in startups, company acquisitions (value of exits), valuation of existing startup companies, and growth and innovation in relevant industries and business sectors.

The development of Indonesia's national digital ecosystem is fairly competitive, capable of producing several new unicorns in the past five years, even expanding services to the regional level. This reflects that Indonesia's startup potential is large and has the opportunity to be scaled up, but also illustrates the attractiveness and growth potential of the Startup ecosystem in Indonesia.



number of startups in Indonesia

No. 2

country with the highest number of startups in Asia

No. 12

cities in the world in Top 100 Emerging Ecosystems.

Jakarta's ecosystem value

US$71 billion



US$34.6 billion global average

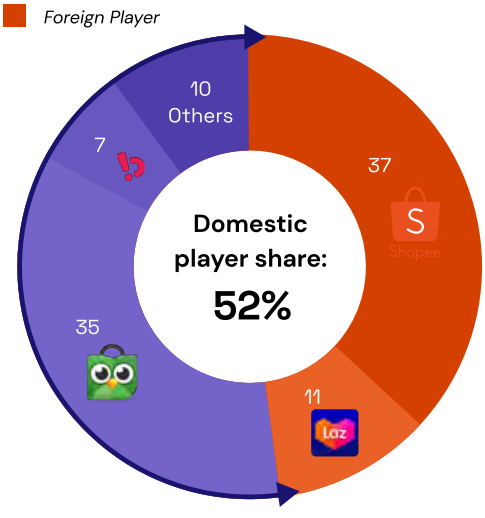
[17] Bachtiar, Palmira Permata., et al. 2023. Indonesia's Technology Startups: Voices from the Ecosystem. Asian Development Bank: Manila. https://www.adb.org/sites/default/files/publication/888071/indonesia-tech-startups- voices-ecosystem.pdf

Valuation of tech companies
(USD billion, July 2022)

Companies	Market cap (USD B)
Amazon	1,150
Meta	458
Alibaba	330
Sea	41
Goto	**24**
Bukalapak	**2**
Traveloka	**1**
Xendit	**1**

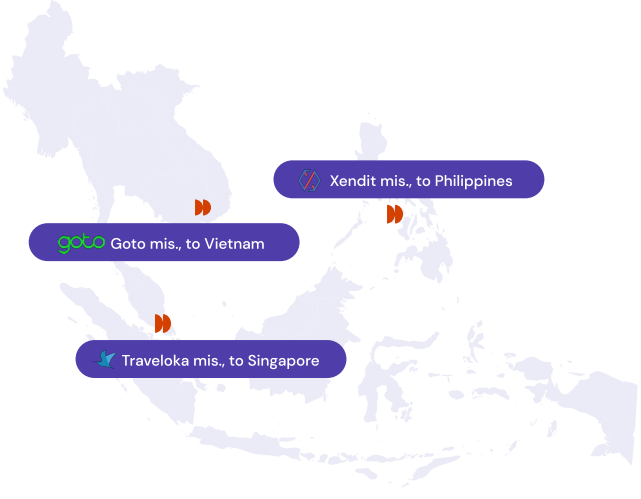
Indonesian players are small in scale compared to global & regional tech giants

Market share of e-Commerce players
(% dari GMV, 2020)



Indonesian players can compete in Indonesia

Regional expansion
(some examples of domestic startups and their forays into regional markets)



Indonesia players can compete regionally

▲ **Figure 1.4** Overview of Indonesia's Technology Ecosystem

The rapid growth of the startup ecosystem in Indonesia is also supported by the presence of 120 startup incubators and accelerators, and 200 financial institutions that support startup finance[18]. In terms of funding, total early stage funding, including seed funding and series A, also exceeds the global average. Total early stage funding in Indonesia reached US$1.7 billion, while the global average is US$970 million. That said, the funding values at the series B and series C stages are still relatively small. This indicates that startups in Indonesia are still having difficulty in reaching the next stage of the funding cycle.

Several strategic issues and problems exist in the development of the national startup ecosystem, including startup models lacking innovation and more replication of global players, slow formation of new ecosystems, talents scarcity (lack of human resources with adequate capacity), financing problems, and minimal access to knowledge.

Issues and problems arising from the dominance of global tech giants, affecting the movement of national startup model trends. National startups need to increase research and innovation to prevent continuous replication of global tech giants' business models. The phenomenon can be explained by several factors, including risk mitigation by implementing established business models, greater opportunities for funding, faster operations with best practices, and the huge global market potential, such as in e-commerce and ride-hailing startups. Considering Indonesia's vast geography and diverse regional characters, there is a huge potential for new markets if national startups can unlock and create various business models and technology solutions tailored to address regional problems.

Another issue is how the mature startup ecosystem is only centered on a few big cities, such as Jakarta, Bandung, and Jogja. To foster new urban startup ecosystem centers, a city must have all aspects of the ecosystem that support it, from digital infrastructure, availability of talent, availability of local ecosystem players (such as incubators and accelerators), as well as good cooperation and collaboration between the government, private sector and the community.

On talent scarcity, 52% of digital companies (startups) at the national MSME level have difficulty finding local talents with digital expertise, especially to fulfill the requirement for talents with advanced technical capacity[19]. As for financing and investment, several issues have become obstacles,

[18] *Ibid*
[19] East Ventures. 2022. *Digital Competitiveness Index: Towards Indonesia's Digital Golden Era.*

including long and complex licensing challenges that discourage investors to expand their investment portfolios, regulatory inconsistency and uncertainty, high taxes, and lack of incentives to increase investment.

What is also important but still lacking in Indonesia is a platform for easy access to the information needed. Currently, the lack of knowledge and expertise exchange platforms makes it difficult for new startups looking to develop business models to obtain strategic information. Startups need access to strategic information that can be obtained from economic priority sectors, central and local government priorities and plans, as well as public data from other stakeholders. The presence of tools that enable the exchange of knowledge and expertise will provide good business instrument for the growth and development of startups in Indonesia.

C. Intellectual property rights

Intellectual property rights (HAKI) are an important factor in developing the national digital economy, especially for R&D activities in the digital sector. The government must ensure that the output of research activities can be secured and protected. HAKI can be granted in the form of Trademark protection for products produced and Patent protection for technological inventions created (either patents or simple patents). In addition, the return on investment (RoI) of the research activity needs to be calculated. It is important for the government to determine a profitable business model in the R&D sector.

D. Digital Adoption of Prioritized Sector

Digital adoption in priority sectors is a strategic step in facing the growing digital era. Priority sectors such as manufacturing, agriculture, logistics and finance play an important role in economic growth of a country. Manufacturing is one of the sectors that contributes the most to Indonesia's GDP. In 2021, manufacturing accounted for 20% of Indonesia's GDP[20]. Unfortunately, the sector's growth has slowed in recent years due to stagnant productivity and limited innovation.

The productivity-to-cost ratio in the manufacturing sector has only been in the range of 90-100 from 2005 to 2019 (Kearney). If we look deeper, Indonesia's manufacturing labor costs are still less competitive than other countries at 278 USD/month while Thailand is 256 USD/month and Vietnam is 181 USD/month (Kearney). This indicates that despite relatively high production costs, productivity has not increased significantly in recent years.

In the trade and retail sector, Indonesia has various potential and productive economic sectors. However, one sector that has a significant contribution to national GDP is the MSME sector. This sector is a national priority and the center of the government's attention. Almost all businesses in Indonesia (99%) are categorized as MSMEs with employment of 89% of the national workforce and contribution to GDP in 2021 of 61.1%. And yet the MSME sector has lower productivity and limited digital adoption at only 25%, and contributes only 14% to exports (Kearney).

[20] Central Bureau of Statistics, Kearney

E. Funding and Investment

In supporting the growth of the digital economy, the role of funding and investment is one of the key things. That being said, there are a number of challenges facing Indonesia today. First, the current level of investment has not yet reached an adequate level. Government spending in the ICT sector is relatively small compared to other countries as a percentage of GDP expenditure.

In addition, investment in research and development by the company is still limited. Similarly, over the past few years, there has been a declining trend in the share of Foreign Direct Investment (FDI), while investment from Venture Capital in Indonesia has continued to grow by 18% from 2018 to 2021[21].

[21] World Intellectual Property Rights Organization (WIPO), Dealroom, News articles, Kearney

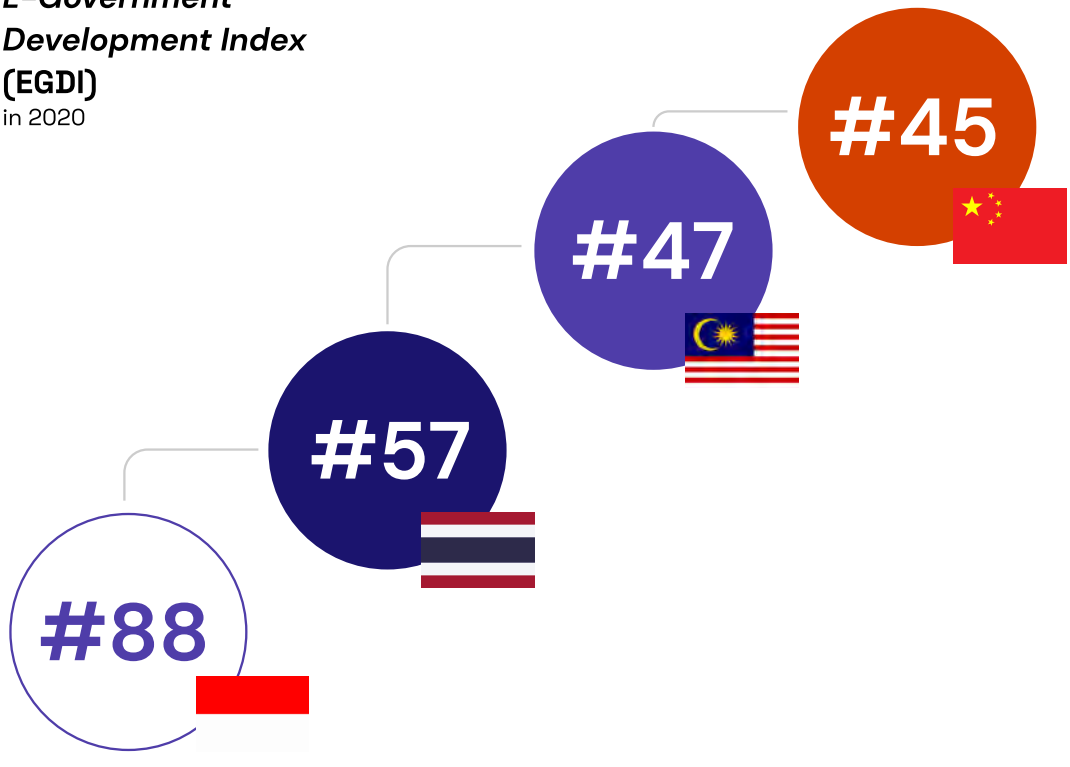
C. Digital Government

Although measures such as the implementation of the Electronic-Based Government System (SPBE) have been taken to improve the efficiency and accessibility of public services, a number of problems are still faced in the process of government digitization. The problem of integration and interoperability of thousands of scattered government applications and systems, with the dynamics of different agency needs. Limited technology infrastructure and technology capabilities in government and cybersecurity challenges are still major concerns. In addition, increasing the transparency of public data and taking data leakage seriously are aspects that need further attention.

In recent years, the rapid rise of digital technology has changed the landscape in many sectors, including government. These progressions have provided new opportunities to improve the quality of public services and transparency in governance. Compared to other countries, Indonesia is still lagging behind in the provision of quality public services. In 2020, Indonesia ranked 73rd in the Government Effectiveness Index (Kearney).

The government continues to improve and strive to increase the effective use of digital technology in providing services to the public. By initiating the implementation of the Electronic-Based Government System (SPBE) as a conceptual foundation in managing digital governance in Indonesia. Still, the effectiveness in designing and implementing e-government policies is low and lags behind other benchmark countries.

***E-Government Development Index* (EGDI)**
in 2020



According to a survey conducted by the International Communication Union (ITU) related to the E-Government Development Index (EGDI) in 2020, Indonesia is still ranked 88th out of 193 countries. while Malaysia has been ranked 47th, Thailand is ranked 57th, and China is ranked 45th (Kearney).

This is inseparable from the full implementation of SPBE still facing obstacles and challenges. These obstacles include:

A. Limitations of Technology Infrastructure

Reliable infrastructure for e-government services (government data centers) has not yet reached all regions, especially rural areas, coupled with different levels of sophistication that can make it difficult to develop and use consistent and comprehensive e-government services, as well as limited capabilities and expertise in managing digital infrastructure related to the capabilities of available human resources.

B. Large number of government applications

The government has 24 thousand applications that are used across various state agencies and institutions both at the central level and at the regional level. The problem is further compounded by unreliable data integrity – there are 2,700 data servers scattered across government agencies due to the absence of a national data center. Other than that, one of the challenges faced is the lack of interoperability between various systems and applications used by the government due to the absence of standardization. Poorly integrated systems can hinder the exchange of data and information between different institutions. This can also lead to data duplication and less efficient government administration processes.

C.Transparency and accountability

Since the data provided to the public is scattered and its origination is unclear, the transparency and accountability aspects of the data are of less concern. The government needs to guarantee public access to data, as well as the validity of the data presented. The government needs to acknowledge that the data provided is not only a source of public information, but as 'data is the new oil'. The availability of data can bring more value added that is used across various sectors of the economy.

D. Cybersecurity

Indonesia still lags behind regional countries in national cybersecurity, ranking 85 out of 175 countries (Kearney). Cybersecurity violations still occur frequently, but the legal basis related to cybersecurity has not yet

been formulated as it still requires comprehensive formulation and strong agreement, the problem of silos in government institutions in solving cybersecurity problems is also a challenge, this is what makes it difficult for further development related to protecting the security and privacy of public and government data. The government needs to accelerate the discussion and ratification of formal cybersecurity regulations.

E. Data protection and privacy

Indonesia currently has a Personal Data Protection Law (PDP Act) that gives the government the authority to oversee the management of personal data by electronic system providers (PSEs) by the government, private sector, and international organizations in Indonesia[22]. Following the enactment of the PDP Act, however, data leaks are still common. In the 2022 Q3 survey, Indonesia became the third country with the most data leakage cases after Russia and France with more than 13 million cases[23], with the most attacks carried out on government websites followed by NGOs, then Think Tanks[24]. It is recognized that the government is currently in the transition phase of implementing the PDP Act, however, this issue could have been projected in the drafting stage of the PDP Act. Data leaks that occur necessarily create distrust from the public towards government officials because the security of their personal data is often threatened. Therefore, precautionary measures are needed from the government to prevent recurring data leaks.

[22] BPK, 2022. Regulatory Database: Act No. 27 Year 2022 Personal Data Protection.

[23] Surfshark, 2022. Data breaches rise globally in Q3 of 2022.

[24]Microsoft, 2021. Microsoft Digital Defense Report.

D. Digital Society

The increasing population growth in Indonesia, especially in the productive age group, reflects the growing demographic dynamics. A demographic bonus that is utilized wisely and optimally will be able to contribute to increased economic growth and the nation's competitiveness. However, there are several challenges that need to be faced, including national human resources lacking capacity in the ICT/digital field in accordance with industry developments, limited access to qualified digital education and training, formal education is difficult to keep up with changes in the digital era, and low understanding of digital literacy in various sectors and regions of Indonesia.

Indonesia will experience a demographic bonus in 2045, where this condition refers to the proportion of the productive age population will increase significantly, which will create opportunities for Indonesia in utilizing digital technology to drive national economic growth.

Based on the Indonesian population projection report released by BPS, **in 2045 the projected population with the age group of 15-64 years will reach 214.2 million out of a total population of 329.1 million. This means that by 2045, the productive-age population accounts for 65% of Indonesia's total population**[25].

[25] BPS. Indonesia Population Projections 2020-2050 Based on the 2020 Population Census.

The government must leverage this moment to increase productivity and economic growth, and design policies to align with changes in labor market demands that are influenced by dynamic technological developments. **Through the implementation of digital transformation, it will potentially create around 9-12 million new jobs.**

On the other hand, the digitalization process has also triggered a decline in job demand. Around 60% of the working-age population in Indonesia working in six (6) main sectors - agriculture, forestry, fisheries, trade, retail, manufacturing, accommodation and culinary services, construction, and education - are potentially threatened by automation (Kearney, 2022).

Routine and mundane tasks can be replaced by machines and automation, leading to a decrease in demand for workers in these sectors. Addressing digital transformation in the workplace therefore requires careful planning. In the longer term, the government must also develop policies to deal with the ageing population.

Regarding the digital sector, Indonesia shows a strong internet subscriber base as well as the large value of Indonesia's internet economy, reaching US$ 174 billion, which accounts for 40% of Southeast Asia's total internet economy. In addition, Indonesia exhibits more active internet user characteristics than the global average, for example, 9 hours are spent daily using the internet in Indonesia compared to 7 hours globally.

Beyond the number of people and the number of internet users, Indonesia faces a major challenge, i.e. the availability of ICT/digital professionals. Given the existing potential and high demand, the number of ICT sector workers compared to total workers is still below average at around 0.5%, far behind Malaysia which reaches 7.7%, Singapore 5.1%, China 3.0%, and India 1% (Kearney). This is in part due to the challenges faced, and the following are the main issues:

A. The role of formal education

Formal education is one of the leading pillars in improving the quality of digital society. Digital technology can be understood and mastered if formal education also makes the digital sector as learning and the use of digital technology can also facilitate teaching in schools.

Prior to addressing formal and digital education, it is necessary to consider the state of education in Indonesia. One way to evaluate curriculum across countries is through the PISA (Program for International Student Assessment) model. PISA measures reading, math, and science literacy. Since its participation, Indonesia's PISA scores at first glance appear less promising as reflected by fluctuating scores in the last 7 years for each ability (2000, 2003, 2006, 2009, 2012, 2015, 2015, and 2018)[26].

Reflecting on the PISA index, the existing curriculum must first address (non-digital) literacy challenges before starting to design a curriculum that incorporates the digital sector. Not only that, the curriculum also needs to include STEM (Science, Technology, Engineering, and Mathematics) education.

Data from 2020 shows that only 20.16 percent of college graduates in STEM fields in Indonesia[27]. Skills such as creative thinking, the use of AI & big data, and analytical thinking must also be developed to face the challenges of the future workplace. Therefore, the role of teachers is very important in educating students in the digital era. Teachers should be given competency training related to teaching in the digital era according to their respective areas, training in the use of digital technology to support learning, as well as a good interaction pattern for online or offline learning modes.

Lastly, the presence of digital technology increases competency among individuals in the labor market. Unfortunately, students' awareness of digital technology (both in terms of knowledge and usage) is limited to graduates of major public or private universities located in Java and Bali, as well as some in major cities outside Java and Bali.

Hence, special attention is needed to narrow the gap in awareness of digital technology outside Java and Bali to prevent steep inequality and provide opportunities for all students to compete in the national labor market.

[26] Center for Educational Assessment, Ministry of Education Research and Development. 2019. Education in Indonesia, Learning from the PISA 2018 Program for International Student Assessment Results. Jakarta.

[27] Publications of the Directorate General of Higher Education, Higher Education Statistics 2020

B. Digital proficiency

Internet penetration in Indonesia in 2023 will reach 215 million people, or almost 80% of Indonesia's population[28]. Internet users in Indonesia are also more active than the global average at 9 hours per day compared to the global average of 7 hours per day.

But the use of the internet is only limited for leisure time such as searching for information, using social media, watching, and others[30]. The use of the internet for non-productive purposes is also not accompanied by good netiquette on social media. If not accompanied by proper use, it can lead to a shift in Pancasila-based values. According to the Digital Civility Index report, Indonesia ranks 29th out of 32 countries in a survey of civility on social media31. In addition, from 2018 to September 17, 2023, the Ministry has tackled 3,761,730 negative contents. Of these, 969,308 contents were related to online gambling, 8,954 contents were related to illegal fintech, and 1,211,571 contents were related to pornography. On top of that, it was noted that tackling the insertion of gambling pages on Government Sites had reached 9,607 findings[32]. Additionally, fraud in the form of disinformation (hoaxes) is also increasingly prevalent among the public, with 11,759 fake contents recorded between 2018 and June 2023[33].

Technological disruption can also pose other social challenges such as the marginalization of local languages and cultures, changes in religious practices and local traditional values that have been closely preserved for centuries by local communities.

The presence of digital technology can also contribute to an increase in social inequality, both geographically and demographically. The impact of this social inequality often results in the emergence of various social problems today. The rapid development of technology and infrastructure has not been balanced with the ability to change people's attitudes, mindsets and lifestyles.

[28] Indonesian Internet Service Providers Association. 2023. APJII Survey on Internet Users in Indonesia Reached 215 Million People

[29] Kemp, Simon. 2023. Digital 2023: Indonesia. Meltwater. https://datareportal.com/reports/digital-2023- indonesia

[30] *Ibid*

[31] Ekklesia, Dia Gloria. 2022. Digital Civility Index and National Character in Development Discourse. KRITIS Vol 31 No 1. https://ejournal.uksw.edu/kritis/article/view/5094

[32] Ministry of Communication and Information. 2023. As of September 17, Ministry of Communication and Information has handled 3.7 million negative contents.

[33] Katadata Insight Center; Kominfo AIS Team

[34]OJK. 2023. Press Release: MSME Financing Through Online Loans Continues to Grow, Public Lending Still Under Control.

One of the social impacts is the increase in the number of unpaid loans through peer to peer (P2P) lending services or online lending (pinjol). Data from OJK (Financial Services Authority) shows an increase in online loans of 28.11% to a total of 51.46 trillion IDR34. This brings potential dangers and problems, such as people's dependence on online loans due to the ease of applying for loans, even though the interest rates are much higher compared to conventional banks.

In terms of regions, the development of digital infrastructure and implementation of digital technology in Indonesia is still concentrated in Java and Bali, leaving gaps in non-Java and Bali regions. Demographically, inequalities by gender, age and social class also exist. There is a gender Inequality in digital transformation in many countries[35]. In terms of female gender representation in STEM fields alone, there are only 35% of women studying in these fields worldwide[36].

Meanwhile, according to the World Bank Report, younger people are 10 times more likely to have access to the internet than older people[37]. Even further, those with higher education backgrounds have 5 times more internet access than people with secondary or lower education backgrounds38. This is compounded by the fact that low-income families have 3 times less access to the internet than children born into affluent families39.

In the end, the active participation of local communities is needed to determine the direction of Indonesia's digitalization, at least in their respective regions. The role of citizens is important in order to determine their needs for digital technology, as well as how to reap the benefits (not only in material aspects, but also social). Beyond that, the expectation is that with the active role of citizens, the values and local customs that have been preserved will not be eroded by the use of digital technology.

[35] Ranitta, Angela. 2022. Minister of Communications: Gender Inequality in Digital Transformation. KBR.id: Jakarta. https://kbr.id/nasional/07-2022/menkominfo ada_ketimpangan_gender_dalam_transformasi_digital/108957.html

[36] *Ibid.*

[37] The World Bank. 2021. Beyond Unicorns: Harnessing Digital Technologies for Inclusion in Indonesia. Jakarta.

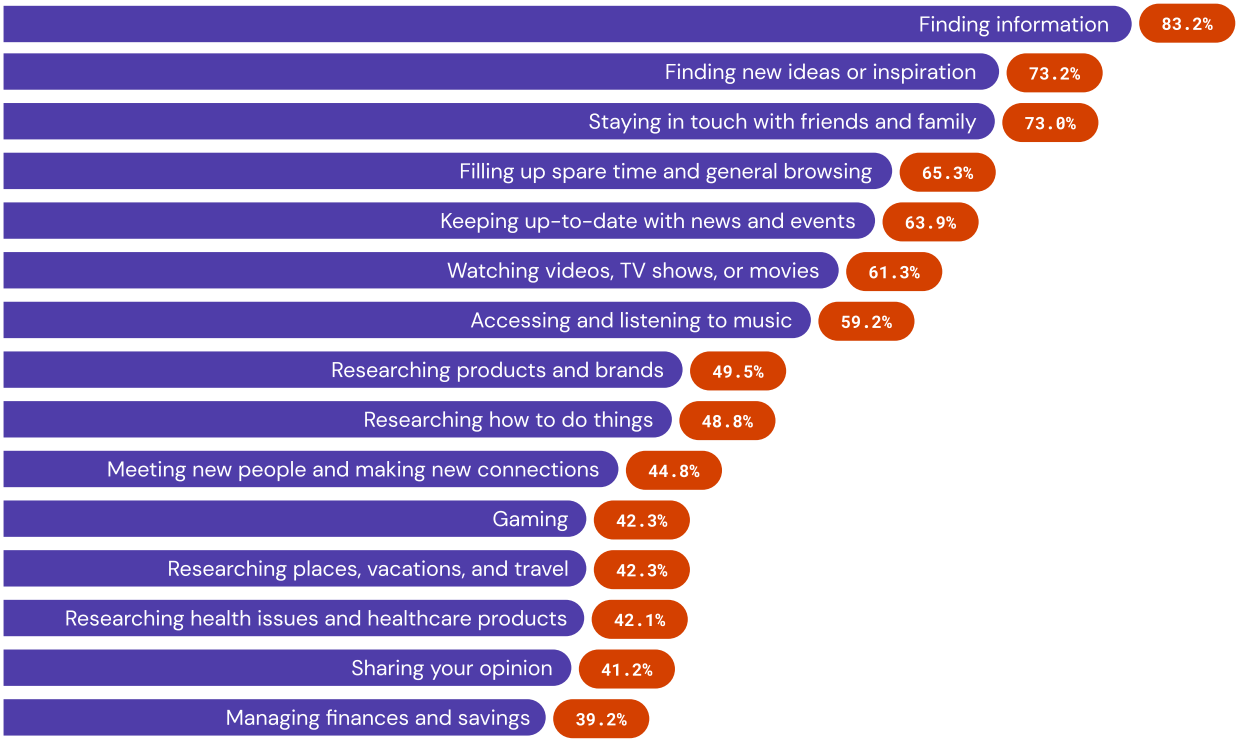
[38] Setiawan, Imam., et al. 2022. How to bridge the gap in Indonesia's inequality in internet access. The World Bank: Jakarta. https://blogs.worldbank.org/eastasiapacific/how-bridge-gap-indonesias-inequality-internet- access

[39] *Ibid.*

Main Reasons For Using The Internet

Primary reasons why internet users aged 16 to 64 use the internet

Jan 2023



Source: Digital 2023: Indonesia[29]

▲ **Figure 1.5** Main Reasons for Using the Internet

1.2.2. The Current State in the Regional Aspect

The Central Bureau of Statistics (BPS) has issued the Information, Technology and Communication Development Index (IP-ICT) which refers to the components developed by the International Telecommunication Union (ITU)[40]. There are three main indicators that make up the IP-ICT:

Sub-index	Indonesia ICT Development Index		Growth (%)
	2020	2021	
ICT access and infrastructure	5,67	5,76	1,59
ICT Usage	5,34	5,66	5,99
ICT Expertise	5,92	5,97	0,84
ICT Development Index	5,59	5,76	3,04

▲ **Table 1.2** ICT Development Index

The table above explains that there is a growth in the ICT Development Index from 2020 to 2021 of 3.04%. The smallest growth is in ICT Expertise at 0.84% and the highest is in ICT usage at 5.99%. Nonetheless, the ICT Expertise index has a high proportion scale (5.97) compared to the ICT Usage index (5.66) and ICT Access and Infrastructure index (5.76). With the ICT Expertise sub-index having a low acceleration rate, while the ICT Usage Index is increasingly massive, this indicates that the use of ICT in Indonesia is not followed by qualified expertise or diversified expertise.

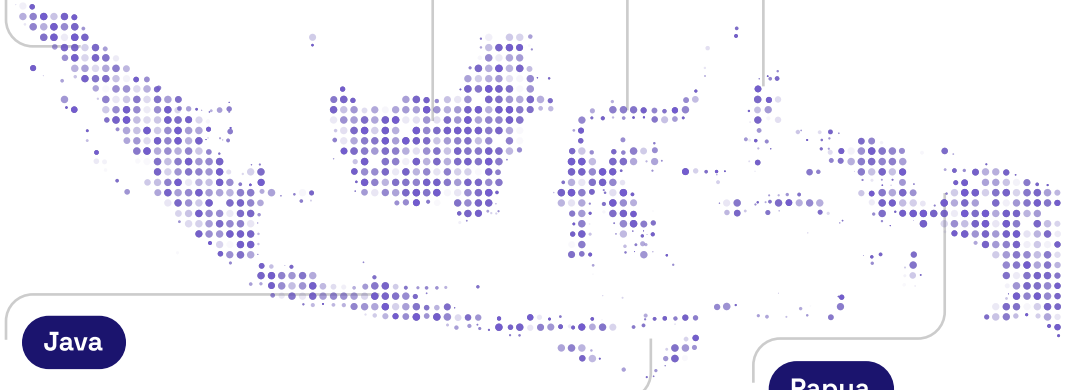
The ICT Usage Index has the highest growth due to the fact that during the Covid-19 pandemic, internet penetration grew rapidly from 53.73% in 2020 to 62.10% in 2021[41]. ICT development index values are categorized into high (7.51 - 10.00), medium (5.01-7.50), and low (0.00 - 2.50). Reflecting on this index value, the national ICT development index is still at a medium level.

Furthermore, digitization in the future is expected to increasingly catch up with developments in non-metropolitan areas not just tier 1 cities.

[40] Central Bureau of Statistics. 2022. Information and Communication Technology Development Index 2021.

[41] *Ibid*

That said, each region has its own advantages and potential. In this context, it is important to assess the more detailed conditions relating to the development of digital technologies on Indonesia's main islands and how this relates to the development of these regions in general.



Kalimantan

Still faced with challenges in improving competitiveness and the quality of human resources.

Sulawesi

The development of digital infrastructure is uneven, and it is still limited for telecommunications use.

Sumatra

The coverage of the cellular network is not yet matched by its utilization to support productive activities.

Maluku

The development of digital infrastructure is still quite low.

Java

The use of digital infrastructure has not been fully utilized to support development and productive sector activities.

Bali - Nusa Tenggara

Digital infrastructure development is still uneven.

Papua

The development of digital infrastructure is still low and uneven.

Sumatra

Cellular network coverage in the Sumatra Island region has not been followed by its utilization to support productive activities and is still limited to telecommunications use. The development of telecommunications infrastructure on the island of Sumatra has almost reached all areas. 4G mobile network coverage has reached 74.62 percent in Sumatra[42], with an average internet speed of 17.2 Mbps. Despite this, it is still below the national average speed[43]. To increase the speed, utilizing fiber optic is crucial. As of today, the availability of fiber optic has only reached around 61.81 percent for all sub-districts[44].

Fast internet is necessary for the implementation of IoT (Internet of Things) in the agricultural sector, which helps the efficiency and productivity of this key sector on the island. Currently, the 5G network available on the island of Sumatra is limited to 10 cities/districts, including Medan, Pekanbaru, Palembang, Batam, Banda Aceh, Belitung and Bandar Lampung[45].

Supporting infrastructure for the adoption of advanced technology is important, especially at a number of points in special economic zones in the Sumatra region such as Aceh, North Sumatra, Riau Islands, and Bangka Belitung.

Overall, ICT development on the island is quite good as it has an average Information and Communication Technology Development Index (IP-ICT) score of 5.82, above the Indonesian average[46]. To improve the optimal utilization of ICT, it is also necessary to focus on the condition of digital talents in the Sumatra region. Based on the Indonesian Digital Society Index (IMDI) results, Sumatra Island has an average IMDI score of 37.57 (below the national average). South Sumatra has the lowest score with 32.74 and Riau Islands has the highest score with 43.35[47]. This indicates that the digital society in the Sumatra region still needs more attention due to uneven value disparities, even though the region is clustered on one archipelago with adjoining regions.

[42] Ministry of Communication and Information Data 2022

[43] Ookla. 2023. Speed Test, Internet Speeds in Indonesia.

[44] Ministry of Communication and Information Data 2021

[45] Telkomsel, XL, and Indosat. Processed data.

[46] Central Bureau of Statistics. 2022. Information and Communication Technology Development Index 2021.

[47] Ministry of Communication and Information. 2023. IMDI Publication Book 2022.

Jawa

The utilization of ICT infrastructure in the Java Island region has not been fully utilized to support development and productive sector activities. The development of telecommunications and communications infrastructure in Java Island has been evenly distributed and reached all areas of the region. 4G cellular network coverage has reached approximately 97.83 percent in Java[48], with fiber optic availability also reaching 98.28 percent for all sub-districts[49]. Although 4G and fiber optic coverage has been evenly distributed, internet speeds in Java are still not optimal and uneven, with Jakarta having an average mobile broadband internet speed of 19.63 Mbps, compared to Central Java which is still at 14.43 Mbps[50]. The development of ICT infrastructure and fast internet will boost sectors other than telecommunications such as payment systems, health, education, as well as special economic zones located in West Java and East Java. At present, the available 5G network in Java Island has reached 24 city/district nodes located in strategic economic areas, including Greater Jakarta, Bandung, Semarang, Surabaya, Jogjakarta, and Solo[51]. This is the foundation for encouraging digital utilization for productive activities such as supporting digitalization in new industrial and business areas and developing further digital infrastructure. In ICT development, one of which can be reflected in the ICT Development Index, the island of Java is the highest in Indonesia with an Information and Communication Technology Development Index (IP-ICT) score of 6.45. It is important, at the same time, to equalize ICT implementation as Central Java and East Java regions are still lagging behind in ICT implementation with index scores of 5.56 and 5.55 in the utilization pillar[52]. This is partly due to the fact that the majority of the population work as farmers, who are still heavily involved in traditional activities and face limitations in technology adoption.

To improve the optimal utilization of ICT, it is also necessary to focus on the condition of digital talents in Java region. Based on the results of the Indonesian Digital Society Index (IMDI), the Java Island region has the highest and most evenly distributed IMDI score of 44.10. East Java is the region with the lowest IMDI score of 39.42 and DKI Jakarta has the highest score of 47.98[53]. The condition of the digital society in the Java region is quite good compared to other regions, but there are still differences in specific conditions, which require different strategies in each province, for example, the infrastructure and digital ecosystem in Banten and Yogyakarta provinces are still low. In general, Java Island needs a strategy to improve digital skills at the intermediate and advanced levels.

[48] Ministry of Communication and Information Data 2022.

[49] Ministry of Communication and Information Data 2021.

[50] Ookla. 2023. Speed Test, Internet Speeds in Indonesia.

[51] Telkomsel, XL, and Indosat. Processed data.

[52] Central Bureau of Statistics. 2022. Information and Communication Technology Development Index 2021.

[53] Ministry of Communication and Information. 2023. IMDI Publication Book 2022

Bali - Nusa Tenggara

The development of telecommunications and communications infrastructure in the Bali Island and Nusa Tenggara Islands is still uneven and dominated by development in the Bali Island region. Overall, 4G mobile network coverage has only reached around 78.52 percent of the Bali-Nusa Tenggara region[54], with fiber optic availability only reaching 50.10 percent[55]. There is also a high disparity in terms of coverage, with Bali reaching 95.86 percent while NTB is still at 64.16 percent and NTT at 75.57 percent. The average mobile broadband internet speed in Bali and Nusa Tenggara is quite unequal with Bali having an average speed of 25.34 Mbps and Nusa Tenggara around 15 Mbps[56]. Bali Province is known as one of the favorite areas to work and vacation (digital nomad), thus to encourage the tourism sector in Bali which is also included in the special economic zones located at several locations and also in the Nusa Tenggara region, 5G networks are currently available in 7 cities / districts including Denpasar City, Badung, Ubud, Central Lombok, West Lombok and Sumbawa[57]. ICT development is also still centered on the island of Bali. This is reflected by the score of the Information and Communication Technology Development Index (IP-ICT) on Bali island at 6.49 and is superior overall compared to the Nusa Tenggara province (NTB at 5.39 and NTT at 5)[58]. Special attention needs to be given to the implementation of ICT use in the province.

In addition, to improve the optimal utilization of ICT, it is also necessary to address the condition of digital talents in the Bali-Nusa Tenggara region. Based on the results of the Indonesian Digital Society Index (IMDI), Bali region has an IMDI score of 47.96, West Nusa Tenggara (NTB) of 40.41, and East Nusa Tenggara (NTT) of 32.55[59]. This shows that there is a considerable disparity in the capabilities of the digital community in the Bali-Nusa Tenggara Region.

[54] Data Kominfo 2022.

[55] Data Kominfo 2021.

[56] Ookla. 2023. Speed Test, Internet Speeds in Indonesia.

[57] Telkomsel, XL, dan Indosat. Processed.

[58] Badan Pusat Statistik. 2022. Information and Communication Technology Development Index 2021.

[59] Ministry of Communication and Information. 2023. IMDI Publication Book. 2022.

Kalimantan

The Kalimantan region is still faced with the challenge of improving competitiveness and the quality of human resources marked by the high gap in the Human Development Index (HDI) between provinces and between districts / cities. Meanwhile, in an effort to increase competitiveness, it is necessary to improve the quality of the digital society. Based on the results of the Indonesian Digital Society Index (IMDI), East Kalimantan Province, which will be the location of the new capital city, has the highest IMDI score of 45.06, while Central Kalimantan Province has the lowest IMDI score of 35.38. With a unified geographical formation in a large island, the disparity of IMDI scores does not have a large difference between one another as it is in the range above 35[60]. This requires a special strategy to improve the skills of the digital society, growth in the quality and quantity of research, development of innovation, and sustainable technological mastery.

In terms of ICT infrastructure, 4G coverage across Kalimantan Island has only reached 44.24 percent[61], with an average mobile broadband internet speed of 17.3 Mbps[62]. To increase the speed, utilizing fiber optic is crucial. As of today, the availability of fiber optic has only reached around 61.23 percent for all sub-districts[63]. ICT development on the island is fairly good as it has an average Information and Communication Technology Development Index (IP-ICT) score of 5.90[64]. But there is still a significant concentration in the East Kalimantan region. The 5G network is only available in four locations, namely Tarakan City, Banjarmasin, and two cities adjacent to the National Capital (IKN), Samarinda and Balikpapan, overall[65]. The development of advanced technology infrastructure in the Kalimantan region needs to be encouraged, including in special economic zones located in the East Kalimantan region.

[60] Ministry of Communication and Information. 2023. IMDI Publication Book 2022

[61] Ministry of Communication and Information Data 2022

[62] Ookla. 2023. Speed Test, Internet Speeds in Indonesia.

[63] Ministry of Communication and Information Data 2021.

[64] Central Bureau of Statistics. 2022. Information and Communication Technology Development Index 2021.

[65] Telkomsel, XL, and Indosat. Processed data.

Sulawesi

Telecommunications and communications infrastructure development has not been evenly distributed and is still used for limited telecommunications use. 4G cellular network coverage currently only reaches around 52.45 percent of the total area of Sulawesi[66]. On Sulawesi Island, the average mobile broadband internet speed is 15.78 Mbps[67]. The internet speed is still below the national average. To increase the speed, utilizing fiber optic is crucial. As of today, the availability of fiber optic has only reached around 62.76 percent for all sub-districts[68]. Sulawesi Island requires improved digital infrastructure to support the growth of the economic sector, especially the processing industry which is the main focus as well as support for special economic zones located in the North Sulawesi and Central Sulawesi regions. Currently, 5G networks are only available in Makassar City and Morowali, both metropolitan cities and industrial centers on the island[69]. ICT development on the island of Sulawesi as a whole shows that it is still slower than other major islands. Sulawesi currently has an average Information and Communication Technology Development Index (ICT) score of 5.65, which is below National's figure. ICT access and infrastructure development is best in North Sulawesi. Sulawesi has fairly good development of the ICT expertise pillar with a score of 6.16 and above the national average[70].

Regarding awareness of digital technology adoption, the Indonesian Digital Society Index (IMDI) score for Sulawesi has an average score of 34.49, with West Sulawesi province being the lowest with an IMDI score of 29.87 and Gorontalo province the highest with a score of 38.66[71]. This indicates that the digital society in the Sulawesi Island region still needs more attention in each pillar, especially for West Sulawesi Province due to the disparity in IMDI scores which is quite high compared to other provinces in the Sulawesi region.

[66] Ministry of Communication and Information Data 2022

[67] Ookla. 2023. Speed Test, Internet Speeds in Indonesia.

[68] Ministry of Communication and Information Data 2021.

[69] Telkomsel, XL, and Indosat. Processed data.

[70] Central Bureau of Statistics. 2022. Information and Communication Technology Development Index 2021.

[71] Ministry of Communication and Information. 2023. IMDI Publication Book 2022

Maluku

Telecommunication and communication infrastructure development in Maluku Region is still quite low. 4G mobile network coverage has only reached around 36.78 percent of the total area of Maluku, below the national average of 65.57 percent[72]. This is due, among other things, to the geographical conditions consisting of islands and mountains as well as isolated and scattered settlements. The average internet speed in Maluku Island for mobile broadband is 12.25 Mbps, far behind other regions in Indonesia[73]. To increase the speed, utilizing fiber optic is crucial. At present, the availability of fiber optic has only reached around 13.23 percent for all sub-districts in Maluku and Papua[74]. On top of that, the region of Maluku has not yet been facilitated by the 5G network. Digital utilization in the Maluku Region is also still limited. Utilization is limited to telecommunications and has not been used to support productive sector activities, especially in special economic zones located in North Maluku.

ICT development in the Maluku region is quite unequal between the provinces of Maluku and North Maluku. Maluku's Information and Communication Technology Development Index (IP-ICT) score is 5.65 and North Maluku's is 5.03. A significant difference in ICT development can be seen in the usage pillar where Maluku province has an index score of 4.73 and North Maluku 3.92[75].

Furthermore, in terms of awareness of digital technology adoption, the Indonesian Digital Society Index (IMDI) score in the Maluku region shows scores is around 20.90 in North Maluku Province and 36.48 in Maluku Province[76]. This figure shows that the Maluku Island region ranks last in the Digital Society Index score in Indonesia. A special initiative is needed to improve the digital capabilities of the people on Maluku Island.

[72] Ministry of Communication and Information Data 2022.

[73] Ookla. 2023. Speed Test, Internet Speeds in Indonesia.

[74] Ministry of Communication and Information Data 2021.

[75] Central Bureau of Statistics. 2022. Information and Communication Technology Development Index 2021.

[76] Ministry of Communication and Information. 2023. IMDI Publication Book 2022

Papua

Telecommunications and digital infrastructure development in the Papua Region is still low and uneven. 4G cellular network coverage only reaches around 25.66 percent of the total area of Papua[77]. This is due to the extreme geographical conditions consisting of mountains, isolated and highly dispersed settlements and vulnerability to security disturbances. Internet speeds in Papua have an average of 16.34 Mbps for mobile broadband[78]. Fiber optic availability is crucial to increase internet speed, however, to date, fiber optic availability has only reached around 13.23 percent for all sub-districts in Maluku and Papua[79]. Digital infrastructure is essential for the advancement of the Papua region. Currently, 5G networks are only available in the Mimika region, the mining center of Papua[80]. Digital utilization in the Papua Region is also very limited and is only implemented in some urban areas. Utilization is still limited to telecommunications and has not yet reached utilization in the productive sector. The extreme geographical conditions of the Papua Region greatly require the availability of digital services to be able to provide adequate public services to reach inland areas, as well as support for the special economic zone sector in West Papua. The ICT Development Index score on the island of Papua is the lowest in Indonesia with a score of 4.41. Development on the access and infrastructure pillar and the utilization pillar are the lowest in Indonesia[81].

To improve the optimal utilization of ICT, it is also necessary to focus on the condition of digital talents in the Papua region. Based on the results of the Indonesian Digital Society Index (IMDI), Papua and West Papua regions have IMDI scores with a slight difference. West Papua Province has an IMDI score of 34.49 and Papua Province has an IMDI score of 33.69[82]. The low IMDI score shows that Papuans are not ready to operate and implement existing digital technology. The government needs to consider this matter as Papua island has natural and energy potential that can be further developed with the help of digital technology.

[77] Ministry of Communication and Information Data 2022.

[78] Ookla. 2023. Speed Test, Internet Speeds in Indonesia.

[79] Ministry of Communication and Information Data 2021.

[80] Telkomsel, XL, and Indosat. Processed data.

[81] Central Bureau of Statistics. 2022. Information and Communication Technology Development Index 2021.

[82] Ministry of Communication and Information. 2023. IMDI Publication Book 2022

1.2.3. Macro and Sectoral Conditions

Fiscal policy in 2023 will focus on infrastructure development to support economic transformation.[83] This transformation will be driven by digital acceleration through technology development and adoption, as well as the implementation of digitalization with the support of digital transformation. The digital transformation is expected to create healthier competition and expand market access, ultimately boosting Indonesia's economic growth, as measured by GDP.

Several leading sectors have utilized and fostered the use of technology and the implementation of digitalization in the process of their activities, however, it is necessary to acknowledge that each industrial sector has different potentials and challenges in developing and adopting digital technology. The maturity level of digital in each sector is reflected in the digital maturity level, which is broken down into 4 levels, as follows:



Nascent

The initial stage in the development of digitalization in a sector or industry where digital services are still limited, few technology players in the industry, digital strategies or plans are not yet in place or implemented.



Emerging

An emerging stage in which digitization in a sector or industry begins to develop further, characterized by some services being in place, sectoral national platforms being established, some technology players in place, and in-sector digital transformation strategies and plans in place.



Advanced

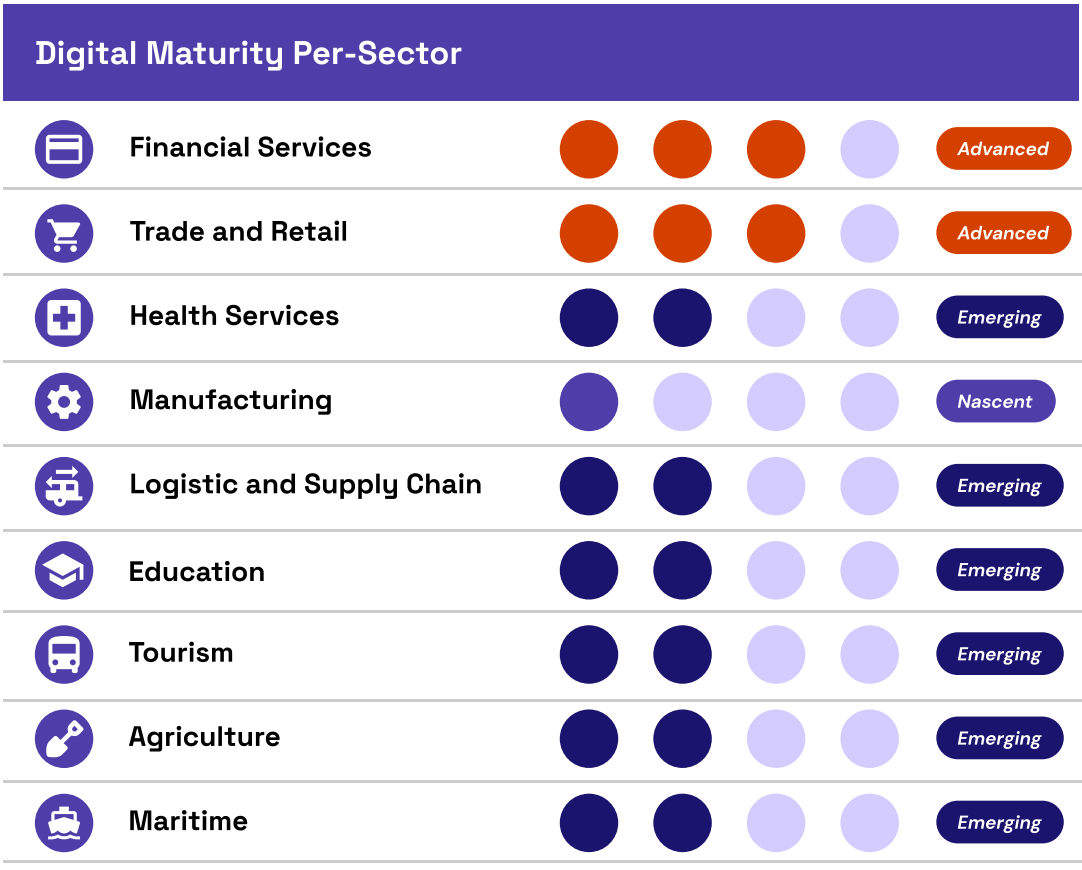
An advanced stage where digitization in a sector or industry reaches a more advanced level characterized by comprehensive digital services, sectoral national platforms have been established with high adoption, multiple technology players are in place, and sector digital transformation strategies and plans are present with dedicated units to manage the implementation.

Developed

Developed level is the stage where digitization in a sector or industry has reached a peak level characterized by digital services covering the entire region, sectoral national platforms are in place with high adoption and comprehensive features, technology ecosystems have reached a mature stage, and sector-wide digital transformation strategies and plans are in place with dedicated governance units to manage its implementation.

[83] Ministry of Finance. 2023. Macroeconomic Framework and Fiscal Policy Principles for 2023.

In terms of technology utilization in industrial sectors, Indonesia is still at an emerging level of digital maturity. The potential to maximize the utilization of digital technology in every industrial sector can drive a shift in the economic sector to reach the next level. The condition of each sector is described below:



▲ **Figure 1.6** Digital Maturity of 9 Sectors

Financial Services

The financial sector has a digital maturity level that is considered to have entered the advanced stage. This is reflected in several things that have demonstrated progress in adopting digital technology, for instance, the development of several digital master plans such as the payment system blueprint in Indonesia 2025 by BI and the banking digital transformation blueprint by OJK, suggesting that the government is in the process of supporting the digital transformation process in the national financial sector. Furthermore, different types of financial services have been developed and widely adopted by the public, mainly for payments, then other uses such as savings, loans, and investments. 52% of Indonesians have bank accounts, and bank loans have contributed to 35% of GDP. While this percentage still lags behind benchmark countries such as Korea, Singapore, China and India, it represents the fact that Indonesia is beginning to expand its financial inclusion and services.

Cashless payment transactions are also on the rise. Neurosensum Indonesia's research revealed that after the pandemic in 2020, a surge in digital wallet usage occured, reaching 44% compared to the previous year[84]. As of 2022, QRIS transaction users also have an upward trend, with 91.7 million transactions with a total of 9.66 trillion, compared to 2020, which only reached 5 million transactions with a total transaction value of 365 billion.

Although the digital maturity of the financial services sector has reached a sophisticated level, there are still several challenges faced by Indonesia such as data misuse and poor billing practices to customers that reduce the level of public trust in financial services, limited integration of E-KTP making it difficult for various financial service processes, and regional inequality in access to financial services is still concentrated only in the Java region.

[84] Bank Indonesia. 2023. Digital Wallet on the Rise, Sparking Interest During the Pandemic.

Trade and Retail

The trade and retail sector has an advanced level of digital maturity as it utilizes various digital technologies. BPS data shows that this sector has a contribution of 12.93 percent to Indonesia's GDP[85] despite the Covid-19 pandemic, thus the utilization of digital technology will further boost its potential.

Digital maturity in this sector is reflected in several things such as, several players have utilized e-commerce, although technology adoption is still limited. In 2021, the number of e-commerce businesses increased by 24.1 percent to 2,868,178[86] from 2,361,423 in the previous year. The implementation of digitalization has driven a shift in the behavior of trade and retail sector businesses in leveraging digital platforms.

In addition, digital platforms for commerce have also been developed by super apps players in Indonesia. 53% of the commerce industry's market share has been digitally served by technology players. Big data and analytics are also leveraged to drive sales growth with effective marketing strategies and tailor product offerings to market needs. Not only that, the government also provides grants for incubating technology users as well as providing support for innovation in the sector.

The government is also establishing regulations to govern and supervise trading activities, as well as create a safe environment for e-commerce players, while protecting consumers from harmful business practices.

The implementation of digital technology in this sector, however, has not yet touched the MSME segment as a whole, especially in terms of traditional trade. BCG and Blibli's research shows that in 2021 only around 20 percent of MSMEs already have digital literacy and use e-commerce platforms out of the total MSMEs[87]. The reason is that they are still experiencing obstacles that include:

1. MSMEs find it difficult to gain access to conventional funding sources like banks, venture capital, and other funding.
2. MSMEs are limited in the implementation of technology in business operations and in various aspects of their business, including supplier sourcing, bookkeeping, management, logistics, and payment systems.
3. Traditional entrepreneurs find it difficult to compete due to disruption from modern markets.
4. In terms of payment systems, most retail transactions are still dominated by cash payments.

[85] BPS. 2020. Indonesia Trade Profile 2020.

[86] BPS Publication, eCommerce Statistics 2022

[87] BCG & Blibli. 2022. Creating Inclusive Growth Through Digitalization of MSMEs in Indonesia.

Health Services

Digital maturity in health services in Indonesia is classified as an emerging level, as it is considered to have shown progress in adopting digital technology both in terms of services and technology players. This is evident from Indonesia's early steps in establishing national telemedicine platforms such as Halodoc, FitAja, Alodokter and so on. Telemedicine is helping to expand access and improve the quality of healthcare. Since the start of the pandemic, the use of digital services in the healthcare sector has increased significantly and facilitated people's activities. For example, the use of Administrative Services through Whatsapp (PANDAWA) has significantly facilitated access for the public to register for BPJS Kesehatan membership. This is reflected in the increase in the number of BPJS members, which reached 235.7 million people in January 2022. Data from IDI (Indonesian Medical Association) shows that in 2020, there were around 15,000 general practitioners and specialists registered and active in telemedicine platforms. The challenge ahead is that digitization in the health sector will not only relate to the expansion of services, but also to the quality of services provided. To achieve more equitable service quality, there are issues and challenges that must be anticipated, i.e.:

1. There is an imbalance in the quality of access services and the number of health workers. Patients in Indonesia have difficulty accessing quality healthcare outside of Java.
2. Patients outside of Java in Indonesia have difficulty accessing quality healthcare.
3. Health services at the local level have their own data structures, making it difficult to integrate data across regions and nationally.
4. Existing healthcare regulations limit innovation.

To improve the performance of health services, Indonesia can emulate and adopt digitalization trends that have been implemented globally, including the creation of artificial organs in the form of prosthetic devices, stroke diagnosis platforms, digital in-home care, and visualization of human organs using AR technology. These indicators show that the digital maturity level of the healthcare sector is developing. To increase the digital maturity level in this sector, it is necessary to improve the restrictive health regulations to enter into partnerships with foreign parties, increase ICT spending in the health sector and equalize the number of hospital beds outside Java.

Manufacturing

At this moment, Indonesia's manufacturing sector is still considered to be in the nascent stage of digital maturity. This is mainly due to the fact that the manufacturing sector is still in the early stages where digital technology is being utilized. The maturity level is represented by several points for instance, the government began to provide support as a first step in the form of the preparation of the Industry 4.0 Roadmap, to guide digital transformation in Indonesia's industrial sector[88]. Aside from that, the sector has also started to adopt the fourth industrial revolution (4IR) technology but its adoption is still at an early stage and still focused on commodity manufacturing only. It is also reflected in national empowerment programs to provide services for MSMEs as a strong initial foundation in adopting digital technology. Based on data released by ADB in 2020, only 6% of the manufacturing industry in Indonesia has implemented Industry 4.0 technologies, such as robotics, cloud, big data, AI, 3D printing, while around 64% of industry players are still in the Industry 3.0 phase or digitalization stage. Moreover, with no local companies in the manufacturing sector reaching unicorn status, the government and businesses must continue to push for the development of this sector and increase its added value.

The manufacturing sector in Indonesia is currently facing several problems, such as stagnant productivity with a productivity index from 2005 to 2019 in the range of 100 and 90, lagging behind China and India and followed by high labor costs of US$ 310 per month in 2021 (Kearney). This indicates that productivity is still low and innovation is limited, as companies are reluctant to adopt digital technology due to high labor costs, which can lead to a loss of competitiveness in the global market.

[88] Ministry of Industry. 2022. Industrial Revolution 4.0 Optimizes Indonesia's Potential in the Manufacturing Sector.

Logistics and Supply Chain

As for the logistics and supply chain sector, they are at the emerging level for their digital maturity level. This is due to several factors, while progress has been made, there are still challenges to overcome. This emerging condition is represented by several things such as, the implementation of digital technology in the port (smart port) is in place even though it is still limited. There are **five ports that already implement smart ports**, i.e. Kuala Tanjung Port, Cikarang dry port, Tanjung Priok Port, Semarang Container Terminal, and Teluk Lamong Terminal[89]. On top of that, a national logistics platform has been established in the country, the National Logistics Ecosystem, which is expected to support the supply chain management process at the national level, although it is not yet integrated with other platforms. The demand for modern warehousing as a part of the logistics industry is also on the rise.



Logistics costs to Indonesia's GDP reached 16.9% in 2019, which is still relatively high considering that the final draft of the RPJPN 2025-2045 aims to reduce logistics costs to 8% by 2045.

However, to realize this, Indonesia faces major challenges, including the suboptimal use of sea toll capacity, long logistics delivery times at the domestic level, inefficient logistics delivery business processes, the absence of digital analysis technology that helps supply chain supply and demand planning, the foundation of the digital industry in the logistics sector has not been integrated between its platforms, logistics platforms that adopt digital technology are still limited to a few ports.

Despite this, Indonesia's logistics performance ranking has improved. In 2010, Indonesia's logistics performance index ranked 75th in the world and in 2018 it increased to 46th. This improvement in logistics performance is driven by the rapid development of e-commerce in Indonesia in recent years. This development has led to an increase in goods and services delivery activities as a result of online transactions, resulting in increased demand for postal and courier services. This increase is also reflected in the contribution of the postal and courier sector to GDP, which reached 141.53 trillion IDR[90].

[89] Ritonga et. al. 2022. Readiness for Smart Port Implementation in Indonesia. Coastal and Ocean Journal.

[90] BPS, 2021

Education

The education sector in Indonesia is currently considered to be at an emerging level for digital maturity. There are only 309,441 graduates of STEM-related universities in Indonesia[91]. This number is still far from the required workforce in the field projected by the Ministry of Labor where in 2023-2025 the STEM field requires about nearly 2 million manpower[92]. In addition, technology utilization such as the availability of computer devices at elementary school level has only reached 34.1% of the total schools. The senior high school level has a better percentage at 92.4%[93]. This figure shows that technology usage is still low in elementary education but good at higher levels. The lack of improvement in education in Indonesia is caused by several problems that also pose as challenges, those are:

1. Administrative tasks are burdensome to perform as they take up a lot of time outside of teaching and learning activities.
2. Low teacher competency scores.
3. Good quality classrooms are not evenly distributed throughout Indonesia.
4. Internet access in schools is still centered on Java.

The government seeks to improve education performance by constantly increasing expenditure allocations. In 2020, the government's spending on education amounted to IDR 508 trillion, an increase of about 5% since 2015. Several schools in Indonesia are trying to use digital technology through LMS (Learning Management System) platforms that support student learning. The covid-19 pandemic in 2020 encouraged educational institutions to create distance learning methods and digital-based learning content such as interactive videos and e-learning assessments. Indonesia can start adopting global digitalization trends such as VR & AR-based virtual laboratories and online learning platforms.

[91] Publications of the Directorate General of Higher Education, Higher Education Statistics 2020.

[92] Ministry of Manpower of the Republic of Indonesia. Projections of Manpower Requirements in Companies Based on Competencies in the ICT Sector in 2022-2025.

[93] Ministry of Education and Culture. 2022. Mapping of Information Technology Capabilities in Elementary and Secondary Education in Indonesia.

Tourism

The tourism sector in Indonesia is currently considered to be at the emerging level for its overall digital maturity level. Digitalization of the tourism sector focuses on utilizing digital technology where at present the social media platform is the backbone of the media for marketing and branding as well as disseminating information related to tourism. Today, Indonesia has several startups engaged in tourism that help ease of access and services in lodging accommodation, transportation and tourism attractions. Throughout 2022 the value of online tourism bookings reached 52 trillion IDR and is projected to reach 128 trillion IDR by the end of 2023[94]. A large number of tourist destinations in Indonesia have not been visited by international tourists due to several challenges experienced by the local tourism sector, such as:

1. Dissemination of information about tourist sites is still limited, especially areas outside Java-Bali.
2. Low branding awareness by local entrepreneurs in the tourism sector.
3. Low and uneven implementation of digital transactions.

Despite facing several challenges, Indonesia remains one of the tourist destination countries that has an ever-increasing trend of international tourism revenue. Indonesia's revenue from foreign tourists in 2019 amounted to US$ 18.4 million, an increase compared to 2016 of US$ 12.6 million. The share of international tourist revenue to Indonesia's GDP also increased from 1.3% in 2016 to 1.6% in 2019. Indonesia's international tourist arrivals are concentrated in Bali and Nusa Tenggara region which reached 6.3 million visitors in 2019 or around 64% of the total international tourists. Indonesia's tourism can further develop by adopting global trends such as the optimization of travel experiences and the use of AI-based virtual travel assistants, and game-based travel to explore cities.

[94] East Ventures, Katadata Insight Center (KIC), and PwC. Tourism Online Booking Value and its Projection (2017-2027).

Agriculture

The agricultural sector in Indonesia is currently considered to be at an emerging level for digital maturity. As an agricultural country, Indonesia has a majority of its population relying on agricultural commodities as a source of daily food supply and livelihood, with around 28% of the total population working in this sector. The maturity level is at an emerging level, represented by digital adoption that is still limited to the last stage (sales) through the use of digital marketplaces (e-commerce) in reaching consumers. The adoption of digital agriculture, which reflects the application of technology using big data applications and precision technology systems in the agrarian sector[95] is still at an emerging stage.

Despite the fact that this sector is a reliable sector, there are still some fundamental problems that need to be anticipated, such as agricultural production is still concentrated in Java alone, the yield and quality of production is still low, due to 90% of MSME farmers still utilizing conventional methods, complicated supply chain flows causing market access to commodity sales to be limited, differences in land zoning by the government which causes non-optimal land use, and limited knowledge of farmers both in terms of digital, internet use and knowledge of funding.

In digital utilization, the government needs to be aware of at least some of the challenges that may be faced, as follows[96] control over data and data ownership, technology production and data development, cybersecurity/data security. By anticipating possible challenges and managing problems, the government can create an enabling environment for the adoption of digital technology among smallholders, ensure proper utilization of technology, and achieve the role of the agricultural sector in achieving food security and economic growth.

[95] Rotz, S., et al. (2019), The Politics of Digital Agricultural Technologies: A Preliminary Review. Sociologia Ruralis, 59: 203-229. https://doi.org/10.1111/soru.12233

[96] *Ibid*

Maritime

Indonesia is one of the world's fisheries and aquaculture producers and the second largest producer of marine capture fisheries after China with a total production of more than 6 million tons[97]. In terms of overall digital adoption, the marine sector in Indonesia, as reflected in the digital maturity level, is at the emerging level due to the sector's still developing stage in technology adoption. The utilization of technology to increase productivity in the marine sector has begun to be seen in several aspects. For example, the use of aquaculture technology with the implementation of smart feeders enables automatic feeding and documents fish growth more efficiently. In addition, a government platform for traceability, such as STELINA (National Fish Traceability and Logistics System) and e-logbooks, has begun to develop and provide end-to-end services in the fisheries sector, such as automated feeding.

However, the maturity conditions that have developed in this sector also still have problems as well as challenges that must still be faced, such as:

1. Infrastructure adequacy, where rural infrastructure such as roads, transportation, cold-chain storage, etc. are still low which can lead to 15% losses after harvest. In addition, internet infrastructure in rural areas is still lagging behind, with around 70% of fishermen living in rural areas near the sea.
2. Low skills, with 95% of fishers being traditional fishers and 70% of digitally literate fishers still in the early stages of digital adoption.
3. There is no government-imposed roadmap specifically for the marine sector.

[97] FAO. 2022. *The State of World Fisheries and Aquaculture.*

1.2.4. Technology Disruption

The latest technologies such as internet of things, metaverse, blockchain, artificial intelligence have been used by people to facilitate their work. To promote its application to all aspects, and control the impact of its utilization, the government needs to be present and provide regulation while protecting its people from the threats of such digital technology. Moreover, the presence of digital technology also carries the risk of disruption to the industrial landscape, labor landscape, and society in general.

Security and Personal Data Aspects[98]

In addition to facilitating human life, digital technology not only disrupts its users but can also threaten its users if not properly anticipated by policy makers.

The use of AI in the public sector can detect threats on the internet in order to take preventive measures. However, AI can also be misused, especially by cybercriminals. Cybercriminals are thwarting the algorithms used for such precautions. In addition, AI can also mimic human behavior, as well as create and alter fake images/photos[99].

Moreover, the rise of so-called Crime-as-a-service (CaaS) has manifested itself in the form of ransomware or malware[100]. Through CaaS, cybercriminals break into users' personal data by purchasing subscriptions or buying services. CaaS can also leverage AI to manipulate potential buyers through fake images/video. Money laundering (ML) will also grow rapidly due to this automation[101].

[98] Huang, Yan., et al. 2023. Security and Privacy in a Metaverse: A Comprehensive Survey. Big Data Mining and Analytics.

[99] Fortinet, 2022. Cyber Threat Predictions for 2023: An Annual Perspective by FortiGuard Labs.

[100] *Ibid*

[101] *Ibid*

Increasing Inequality between Employers and Employees

The development and adoption of technology in various sectors has led to the shift of human work to automation. Digital technology has also resulted in various types of imbalances, including[102]:

1. Uneven capital distribution and workforce distribution
2. Changes in market structure
3. Strengthening of sector-specific monopolies
4. Lack of expertise
5. Automation potentially reduces employment

Inclusivity Risk

The massive development of digital technology is not accompanied by increased access as well as options for utilizing digital technology. This is referred to as the digital paradox-a condition where the benefits of digital have not been utilized by all levels of society. Digital paradox occurs as a result of three reasons:

1. Inadequate digital infrastructure
2. Affordable internet service fees
3. Skills to utilize digital technology

These three things need to be encouraged as input for digital policy for Indonesia not to lose competition with other countries. Furthermore, the increasingly massive penetration of digital technology and its diversification are forcing the government to accelerate the development of hard infrastructure and improve soft infrastructure.

[102] *Qureshi, Zen. 2022. How Digital Transformation is driving economic change. Brookings.*

Digital ethics risks

Digital technology through algorithms can steer people's activities in the digital world and in the real world. A strategy is needed to better navigate people's activities in the digital era. This is what is known as digital ethics. Digital ethics is the ability of individuals to recognize, demonstrate, adjust, rationalize, evaluate, and develop digital ethics governance (netiquette) in daily life[104].

Digital ethics is important to be applied in real life as a form of regulating activities in the digital era. In the Digital Civility Index report issued by Microsoft in 2021, Indonesians were 'crowned' as the most disrespectful social media users in Southeast Asia and ranked 29th out of 32 countries studied[105]. Reflecting on this report, the government should make digital ethics an issue that must be addressed in developing digital policies.

Socio-cultural risks

The massive use of information technology at various levels of society also has an impact on changes in people's behavior and cultural changes[103]. Excessive use of social media may affect the pattern of community interaction in the real world, impact the way people perceive existing norms/culture/customs, and may affect the social cohesiveness of the community. Beyond that, the use of digital technology might unconsciously dictate people's behavior based on the algorithms created by the digital devices. Therefore, it requires not only digital literacy, but also the knowledge on how to utilize digital technology, as well as the strengthening of social institutions (religious institutions, schools, families) to guide people towards a more responsible use of digital technology.

[103] Adhiarso, et al., 2019. The Impact of Digital Technology to Change People's Behaviour in Using the Media. UGM Digital Press: Yogyakarta.

[104] Fajri, Dwi Latifatul. 2022. Digital Ethics is the Rules of Technology Use, Here's How It's Explained. Katadata: Jakarta. https://katadata.co.id/agung/berita/632439fa869df/etika-digital-adalah-aturan-penggunaan-teknologi- ini-penjelasannya

[105] Ekklesia, Dia Gloria. 2022. Digital Civility Index and National Character in Development Discourse. KRITIS Vol 31 No 1. Salatiga. https://ejournal.uksw.edu/kritis/article/view/5094

Digital space security

The focus of digital space security is moving away from the 'cyber security' narrative to 'digital security'. By using the term 'digital', aspects of social security and digital economic security are also a concern[106]. Applying a digital security approach means that technology, law enforcement, and national and international security have an impact on economic and social aspects. For instance, activities using digital technology can disrupt the availability, integrity, and confidentiality of data, as well as the security of software, hardware, and networks[107].

Digital sovereignty

Digital sovereignty is important for a country due to mutual distrust between countries. Digital sovereignty is achieved when a country has the ability to control data, software and hardware[108]. Typically, each country has different regulations and perspectives, which poses a challenge in regulating the governance of cross-border data flows. When a country is unable to control the use of data, especially those involving cross-border data, it can potentially pose connectivity risks and trigger fragmentation in the high-tech market, which in turn can have an impact on threats to state sovereignty[109].



Source: OECD

▲ **Figure 1.7** Digital Space Security

[106] OECD. 2023. Digital security is essential for trust in the digital age. OECD: Paris. https://www.oecd.org/digital/digital- security/#:~:text=Why%20"digital%20security"%20instead%20of,or%20national%20and%20international%20s ecurity.

[107] Ibid

[108] Larsen, Benjamin Cedric. 2022. The geopolitics of AI and the rise of digital sovereignty. Brookings: New York. https://www.brookings.edu/research/the-geopolitics-of-ai-and-the-rise-of-digital-sovereignty/

[109] Ibid

02

Shaping the Future Policy Direction of Indonesia 2045



In designing the future direction of Indonesia Digital 2045, a comprehensive analysis was conducted, comprising an analysis of the national baseline conditions, shaping the future direction based on trends and best direction scenarios, and developing a Vision Mission Strategy along with measurable targets towards 2045.

KOMINFO | 2045 Visi Indonesia Digital



Baseline analysis of national digital condition

Input

Baseline analysis of the current state (where we are), best-in-class (where other countries are), gap and root cause analysis (where is the gap and why)

Designing the Digital Indonesia Vision 2030 and 2045

Input

Based on the envisioned future scenario of money, the Digital Indonesia Vision 2030 & 2045 draft includes 'where to compete' and 'how to compete'.

Indonesia's National Digital Strategy and Roadmap

Input

The national digital strategy includes:

- Digital development focus areas
- Priority metrics for each focus area

The national roadmap includes:

- Key strategies
- Framework (including milestones and KPIs

Key resource requirements and economic impacts

Investment of resources required to implement the Strategy

Common frameworks and models for calculating economic and non-economic impacts

Digital transformation office design

Figure 2.1 Process Framework for Developing Visi Indonesia Digital 2045



In determining the direction of future policies, a series of stages of analysis were carried out starting from analyzing global megatrends, its implications for Indonesia, to identifying the level of policy scenarios that need to be targeted. The analysis is outlined below:

- **Analysis of global megatrends and its implications for Indonesia:** future technologies, digital industry ecosystem development, macroeconomics, demographics, geopolitics and regulations, environment
- **Scenario level analysis of the policy direction to be targeted:** consumer, prosumer, and digital innovator levels

2.1 Megatrends

The future development of megatrends is a factor that needs to be projected, and its implications estimated. Various megatrends will greatly affect digital development globally, especially the development of future technologies. Digital technology that breaks the barriers of space and time requires policy makers to capture the digital technology trends that are developing in other countries and where the world will develop in the next 20 years. The Megatrends chapter aims to provide information on the projected issues and challenges that arise from upcoming global trends, as well as how these trends will evolve.

2.1.1. The Impact of Megatrends in Several Sectors

There are six sectors to focus on to see the impact of megatrends. These sectors were selected from previous studies along with additional sectors[110]. The six sectors are:



[110] Kearney. 2022. Visi Indonesia Digital 2030 & 2045.

A. Technology Megatrends

The government needs to anticipate and project the rapid development of digital technology. It is important to determine which digital technologies need to be adopted and what level of adoption is required. In addition, the government needs to actively prepare human resources who are able to adapt to digital technological advances.

Furthermore, the government needs data sets in preparation of policies in order to have comprehensive information for the identification of objects and outputs of a policy. The megatrend data will help explain the urgency of adopting digital technology in all sectors, as well as provide input for the government to create targeted digital strategies and policies. It can further inform the design of strategic priorities for Visi Indonesia Digital 2045.

The following is a list of digital technology trends that will continue to grow in the coming years, as well as their impact in related fields[111]:

1. Robotics Automation Process and AI

Automation processes using AI are increasingly spreading and becoming a part of our daily lives. AI is a digital computing technology capable of solving cognitive problems related to human intelligence such as learning, problem solving, and pattern reading. In addition to AI, internet-connected technological devices named as Internet of things (IoT) is also one of the emerging automation. The internet of things (IoT) is a collective network that integrates data through the internet and technologies that facilitate data exchange between devices and the cloud. These two technologies drive robotics automation.

[111] World Economic Forum. 2021. Top 10 tech trends that will shape the coming decade, according to McKinsey. https://www.weforum.org/agenda/2021/10/technology-trends-top-10-mckinsey/

The utilization and adoption of AI and IoT is already underway in several industries. AI for creating images and videos, and AI for writing are currently available. Eventually, AI will become the base technology for creating other technology products, or AI will become the base technology for the service sector. IoT in industry is a technology that uses sensors and actuators to improve industrial production processes. IoT implementation in the industrial sector has great potential to drive the automation of production processes, produce products, and integrate various production steps that ultimately form an agile supply chain. This concept is often referred to as "smart industry" or "smart factory".

In Indonesia, the implementation of such technology has the potential to automate some of the most significant manual labor-intensive jobs, which in turn can increase productivity. But the implementation of industrial automation also poses a threat to the loss of several types of jobs in labor-intensive industrial sectors such as agriculture, which accounts for about 28% of Indonesia's workforce. In order to deal with this situation, structural changes in human resource development (HRD) are an important mitigation step as well as an effort to increase competitiveness in line with developed countries.

2. Metaverse

Metaverse is an online platform that uses augmented reality and virtual reality technology to allow users to socialize, work, play or shop virtually. The Metaverse will still be at the forefront of technological innovation and technological investment, although it will not become mainstream. Metaverse usage will be incorporated into existing technologies, meaning private companies will have to improve their technology ecosystems. In this way, the company will think about connecting the metaverse platform on a single gadget. Metaverse technology is often used in the industrial setting, especially for production. But in the near future, it is inevitable that the metaverse will have an impact on the consumer side as well.

Indonesia has yet to implement metaverse technology due to accessibility challenges and gaps in access to internet quality and smart devices. Meanwhile, the utilization of the metaverse has great potential to increase economic value in various vertical industries, such as distance learning and digital tourism. However, there are also some regulatory concerns that could pose challenges for Indonesians. One of the main concerns is the violation of privacy and potential irregularities in the utilization of the metaverse. On top of that, the yet-to-be-defined regulations may impact the traditional social media sector, with the possibility of increased regulatory concerns in that area.

3. The future of connectivity

Region	2020	2030	CAGR
Middle East & Africa	4.9	53.9	27%
Central & Eastern Europe	7.6	60.3	23%
Western Europe	11.2	102.0	25%
North America	12.1	96.6	23%
Latin America	5.8	72.8	29%
Northeast Asia	10.9	77.9	22%
Southeast Asia & Oceania	7.0	99.5	30%
Global Average	9.3	73.9	23%

▲ **Figure 2.2** Mobile Data Traffic per Smartphone

5G internet speeds and IoT will improve connectivity in the transportation, healthcare, and retail sectors. Manufacturing digitalization through the use of robots and wireless technology can control the production process. Globally, everyone will become more connected with an increase in the number of smart phones by 2030 and mobile data traffic per smart user. Worldwide, changes in mobile carrier technology (whether 4G, 5G or later 6G) will drive utilization of applications and services by individuals, industries and government agencies. This leads to increased data usage. Unfortunately, Indonesia still shows limited mobile coverage with only 38% of villages receiving a strong 4G reception and a low smartphone penetration of only 62% of the total population. In addition, internet speeds in Indonesia are still relatively low compared to other countries.

Increased demand and data traffic will also continue to impact Indonesia. The growing and pervasive digital adoption is an implication of the Hyper Connectivity that will happen in Indonesia in the future. However, the inadequacy of the current digital infrastructure will hinder alignment with the above trends, limiting the number and complexity of applications and services that can be used in Indonesia.

4. Quantum Computing Technology

Quantum computing technology is the ability to calculate based on the probability of a condition. Quantum computing has the potential to process more data in less time. Computing technology needs to be prepared by determining the economic activities that will be targeted. First-wave industries such as finance, travel, logistics, energy, are certainly different from data-driven industries, in terms of the digital transformation process towards the use of computing technology.

The implementation of quantum computing technology globally is shown by the number of developed and technologically superior countries investing in R&D on quantum computing technology. At this time Indonesia has begun to develop quantum computing technology by establishing communities related to development in the field of quantum computing.

The presence of quantum computing technology development provides benefits to vertical industries in Indonesia. In the 2030 and 2045 development years, technology adoption in Indonesia's vertical industries becomes more sophisticated. However, this implies that the overall benefits will be limited, depending on the use case in the Indonesian industry. Quantum computing also has security risks that threaten national interests

5. Blockchain Technology

Blockchain is a digital decentralized record-keeping technology or data bank that is cryptographed to prevent its use from being altered by other users. With these advantages, many governments are considering blockchain to improve the quality of public services, especially to increase the security of personal data.

Blockchain technology can be used to strengthen the country's defense against cyberattacks. Blockchain can reduce the country's expenditure on cyber protection, and it also tends to be more secure for digital transactions. Problems that can be solved through blockchain[112] include:

1. Document validation
2. Patent protection
3. Public data management
4. Contract document scanning
5. Proof of ownership right and financial transfers

Blockchain has been adopted by the Indonesian government. Since early 2022, there are seven ministries exploring the use of blockchain to record various information in a structured and secure manner[113]. The challenge presented today is that there are silo databases, i.e. there are various systems for storing data that are not well integrated.

Blockchain technology utilization by key industries in Indonesia is a positive implication of its presence for Indonesia in the future. Blockchain is beneficial to facilitate the storage and verification of people's personal data without showing other information.

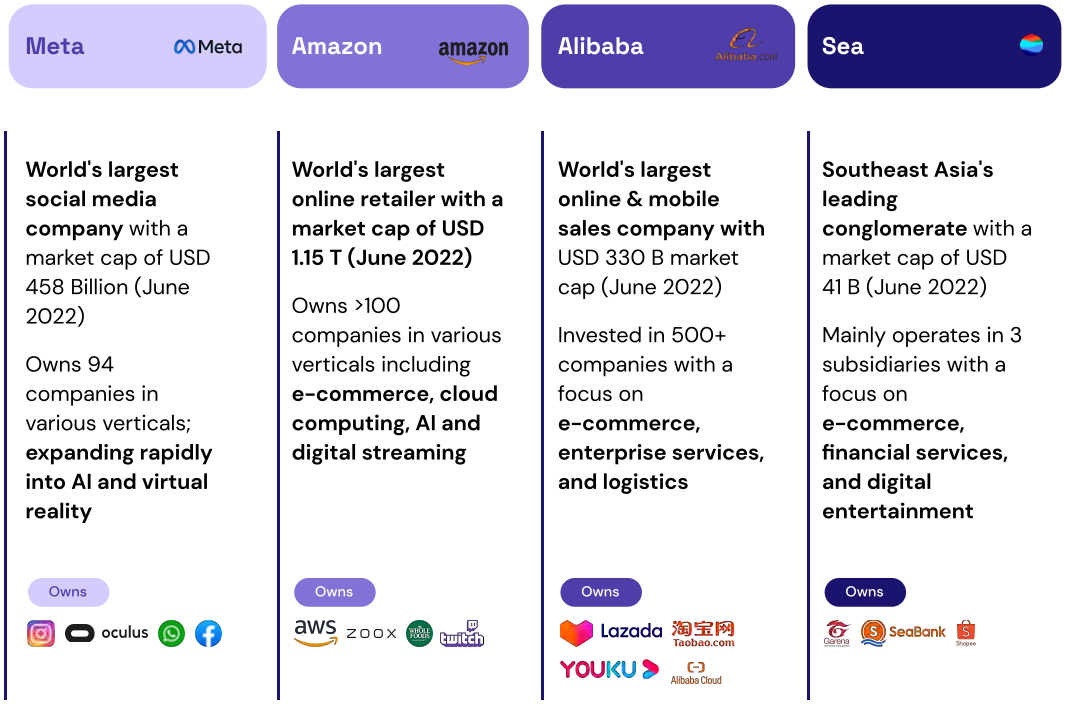
[112] McKinsey, 2020. *How governments can harness the potential of blockchain.*
[113] Pardede, Raynard Kristian Bonanio. 2023. Adoption of Block Chain Technology in Indonesia Continues to Grow. Kompas. https://www.kompas.id/baca/ekonomi/2023/03/25/adopsi-teknologi-blockchain-di-indonesia-perlu- didorong

B. Digital Industry Ecosystem Megatrends

The global dominance of 'tech giants' and the emergence of 'high-tech manufacturing clusters' will shape the digital industrial ecosystem around the world. In this regard, the dominance of tech giants (i.e. Google, Amazon, etc.) in the digital ecosystem continues to expand globally, providing strong competition for local companies, especially smaller companies. Indonesia has a strong domestic ecosystem to compete with global digital companies, one of which is in Indonesia's e-commerce market share, which shows 52% of Indonesia's e-commerce player share comes from the domestic side.

The push from global technological developments will also strengthen high-tech manufacturing clusters in the digital industrial ecosystem. Indonesia needs to focus on developing a high-tech ecosystem, especially in the field of electric vehicles. Currently, Indonesia has an electric vehicle value chain, ranging from research and development, electric vehicle battery manufacturing, to electric vehicle assembly. The development of this high-tech ecosystem is expected to reduce dependence on imports of key technologies.

The government can leverage these tech giants to accelerate technology or knowledge transfer to the local ecosystem. But there is a potential downside as these tech giants could further dominate Indonesia's tech value chain through a strong digital push, amplifying the threat to the local ecosystem, if not managed well. The impact of these developments will have implications for Indonesia in the future.



▲ **Figure 2.3** Selected Tech Giant

C. Macroeconomic Megatrends

At the very least, there are three main macroeconomic trends related to the development of digital technology:

1. Digital technology influences international trade

Technological advancements have reduced barriers to international trade, be it government to government, business to business, or people to people. Countries capable of mastering digital technology will be able to downstream raw goods in order to produce product diversification and play a greater role in the global trade chain or global value chain.

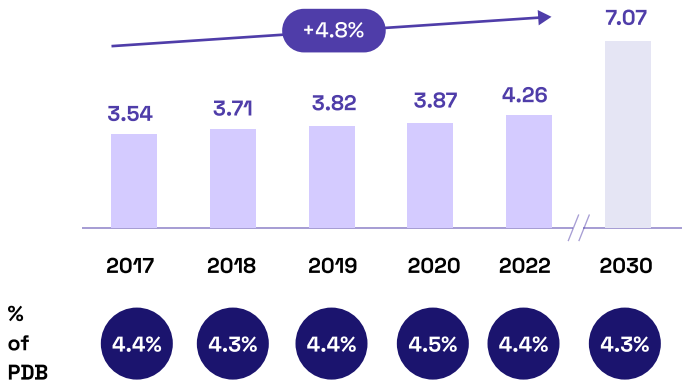
As for Indonesia, there will be more economic cooperation in the region due to technological innovation. Ease of transactions has been realized between Indonesia, Malaysia, Singapore, and Thailand due to QR technology that can increase economic transactions between neighboring countries[114]. It is possible that the ASEAN or Indo-Pacific region will be integrated through this digital technology. Indonesia will likely leverage technology to increase its role in international trade.

2. Increased global economic spending on the digital sector

Global spending on digital technology has increased from 2017 to 2021, growing at about 4.8% of GDP over that time (Kearney). This 'digital investment ramp-up' will continue along the same trajectory, with a focus on enterprise software to drive digital transformation. Apart from investment in software, the IT services segment also received investment growth of up to 6.2% from 2017 to 2021.

Following the trend, Indonesia's digital spending can also be increased to accelerate widespread digital adoption. However, Indonesia needs to attract the right investments from local and foreign sources to further advance its digital investments as it currently lags behind in ICT sector spending compared to its GDP (1.1% vs. 4.4% global average in 2021).

[114] Bank Indonesia. 2023. Cross Border QRIS: Spending Rupiah Abroad!



▲ **Figure 2.4** Global ICT Spending

3. Strengthening global production networks and global value chains

As digital technology plays an increasingly important role, international co-production networks (GPNs) and global value chains (GVCs) are becoming stronger.

The digital technology used can reduce production costs and increase global demand-allowing Indonesia to reap the economic benefits. In addition, products that require semiconductor components will gain increased demand[115]. Semiconductors are needed as components for the assembly of digital devices.

[115] The Economist Intelligence Unit 2022.

D. Demographic Megatrends

According to World Population Prospects, the global population is currently over 7 billion and is expected to increase to 9.7 billion by 2050[116]. Although the world's population continues to grow, the rate of growth is slowing down significantly. Digital technology plays an important role in influencing people's conceptions. Here are the global demographic trends to keep an eye on:

1. Increased urbanization trend

The number of urban residents is increasing resulting in an increase in the size of urban areas. Rural areas that were originally based on the agrarian sector are now experiencing land conversion into residential and commercial areas. The expansion of the world's urban areas has also been accompanied by the development and management of more compact cities with expanded public services. Global urbanization leads to higher economic benefits. This will provide benefits in the form of agglomeration of people and companies, which in turn will lead to lower production costs.

Cities in Indonesia need more resources to keep up with increasing urbanization. In 2020, the percentage of urban population in Indonesia was 57% of the total population and is projected to reach 69% of the total population by 2045.

This increasing trend implies a more developed Indonesian society, with lower costs and an improved economy due to the concentration of people in big cities. However, this increase has the potential to reduce Indonesia's digital human resources if not managed properly.

[116] United Nations Department of Economic and Social Affairs. 2022. World Population Prospects 2022: Summary of Results. United Nations: New York.



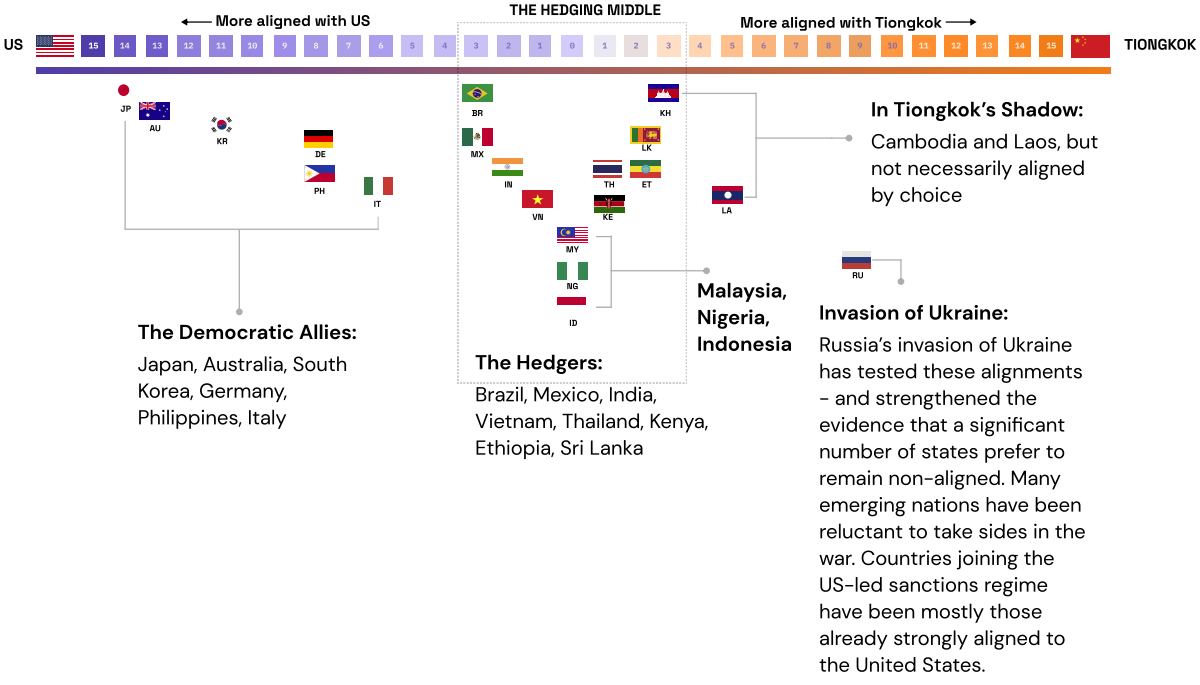
2. Asia and Africa become the world's demographic focus

The global population is increasing sharply and is concentrated in Asia and Africa. A large population and stable economic growth are enticing investors to invest in the region. According to the United Nations, in 2020 there were 23 megacities-cities with a population of more than 10 million-with more than half of the megacities located in developing countries.

Indonesia can capitalize on this momentum as one of the countries that has a qualified workforce with the transfer of knowledge from urbanization. This provides a competitive advantage on one of the factors of production for domestic companies.

E. Geopolitical and Regulatory Megatrends

Future geopolitical trends are also something that needs to be estimated and anticipated as it will affect the balance of the global constellation and affect Indonesia's position. As is the case this year, global uncertainty hit the world after the Covid-19 pandemic subsided, followed by the Russia-Ukraine conflict resulting in a spike in food and energy prices, increased inflation, increased benchmark interest rates, and increased tightening of the domestic commodity industry, impacting countries that are still in the process of recovery and experiencing stagnation in global economic growth.



▲ **Figure 2.5** Geopolitical Landscape

In future geopolitical trends, economic and military relations will become more complicated, with each country trying to balance the influence of the United States (US) and China, especially for countries in Asia, Africa and Latin America. The Rand study shows that the geopolitical landscape will still favor the US with its partner countries. This is because the US and its partners are the center of global connectivity. Meanwhile, Asian countries still contribute to the 'non-aligned' position between the US and China and take a 'middle' position, including Indonesia. For this reason, Indonesia's strategy is to maintain a balanced partnership without tending to a particular bloc, so that strategic relations in the context of economy, trade and military can be in a good position.

Another Rand study mapped out a typology of wars that could occur in 2030[118]. There are four types of warfare: counter-terror, gray-zone, asymmetric and high-intensity; and four types of geopolitical threats: military, space and nuclear, cyber and restraint. Cyber warfare will become one of the geopolitical contestations characterized by strengthening cyber surveillance and subversion, strengthening cyber sabotage[119] and being in the type of gray zone, asymmetrical, and high-intensity warfare. This means that cyberspace will become a tool to control resources and assets with non-military strategies.

[117] Mazarr, Michael J., et al. 2022. Understanding a New Era of Strategic Competition. Rand Corporation: California. https://www.rand.org/content/dam/rand/pubs/research_reports/RRA200/RRA290- 4/RAND_RRA290-4.pdf

[118] Cohen, Raphael S., et al. 2020. The Future of Warfare in 2030. Rand Corporation: California. http://routledge.com

[119] Ibid, page 25



▲ **Figure 2.6** High-Tech Manufacturing Value Chain

Russia's invasion of Ukraine has certainly damaged global supply chains. Ukraine is a 70% global supplier of fluorescent gas, while Russia is a 40% global exporter of Palladium-both of which are used for semiconductor manufacturing[120].

With Russia banned from importing semiconductors due to its invasion of Ukraine, semiconductors have become an important commodity for any country that successfully develops them. Indonesia can capitalize on this condition as a supplier of chips that enable technological devices. Manufacturing these chips requires industrial design to boost exports of chips needed for digital technology products.

Indonesia can take advantage of the global constellation. However, it is necessary to keep an eye on cybersecurity and cyber threats that may increase amidst the unstable geopolitical situation. To navigate the cyber world, Indonesia needs to be aware of global digital technology regulation trends.

In addition to taking advantage of the global constellation, Indonesia also needs to pay attention on cyber that may increase amid in the midst of an unstable geopolitical situation. To navigate the cyber world, Indonesia needs to be aware of global digital technology regulation trends.

[120] Tech UK. 2023. *Open and secure: Charting a path for UK tech in a world of resurgent strategic competition.*

F. Environmental Megatrends

The adoption of digital technology has a two-way impact on the environment, with a wealth of environmental data making transformative change towards sustainability more likely to be achieved[122]. However, digital technology, which is assumed to minimize environmental degradation, also has an impact on environmental quality. Among the negative externalities from the use of digital technology that impact the environment area[123] [124]:

1. Emissions from internet networks and data centers, and technology tool components
2. Life cycle of technology tools; rate of obsolescence
3. 70% of the world's manufacturing centers are in China, while more than 50% of data centers are in the United States
4. Electricity usage for battery
5. Components of technology tool manufacturing
6. The construction of subsea networks requires ships that require a lot of fuel

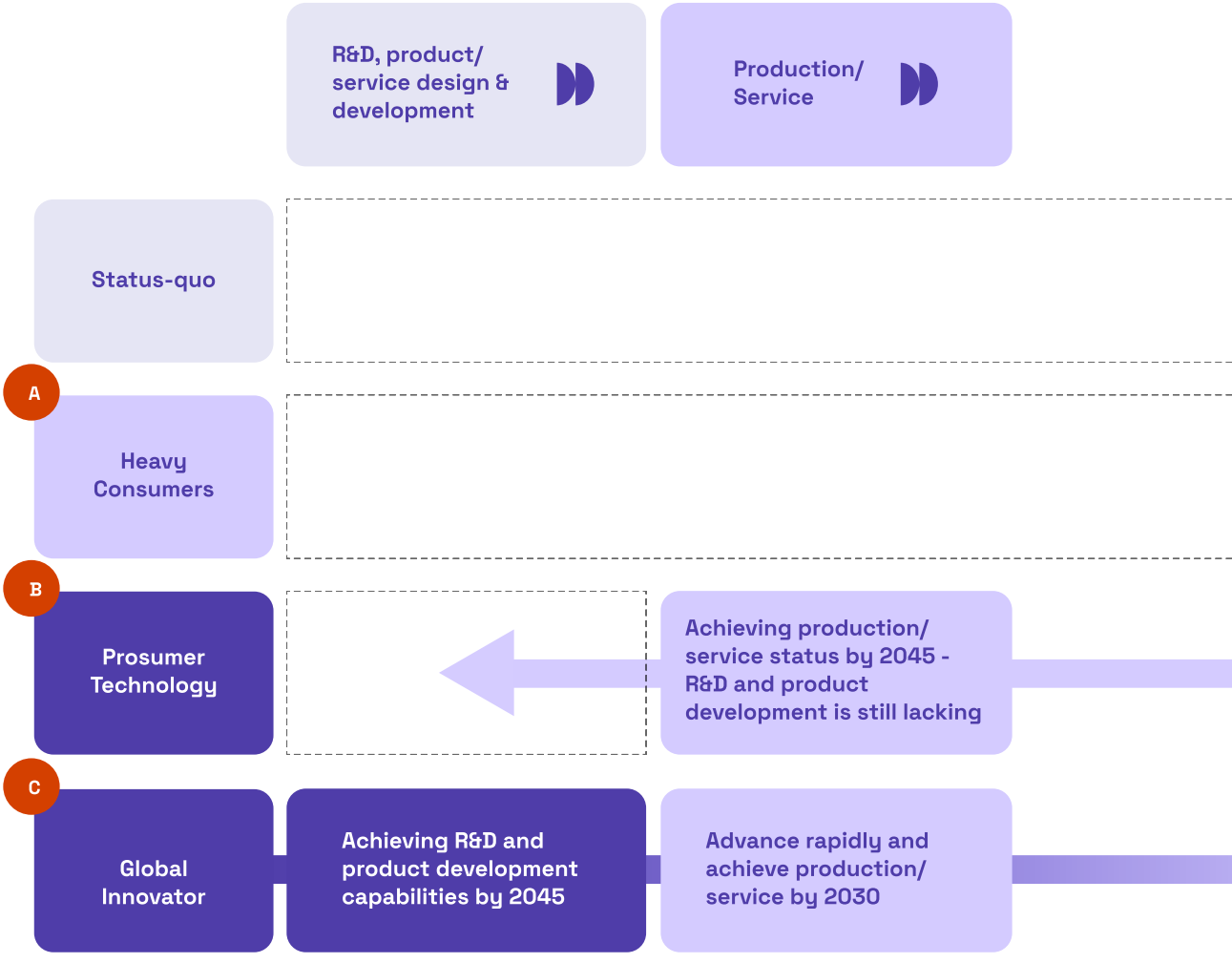
Renewable energy projects, energy storage, green technology, and investments into the sustainability sector are showing significant progress. Green technology is not only made up of environmentally friendly components, but is also geared towards minimizing environmental impacts and supporting a more sustainable environment. The government is required to support the utilization of this green technology, while preparing infrastructure and regulations that make it easier for this technology trend to be absorbed.

Indonesia has a large consumption of liquid petroleum and coal energy, larger than the average country in the world. The proportion of renewable energy use in Indonesia is also low. With the increasing use of renewable and clean energy, this threatens Indonesia's exports, which rely on coal, palm oil and natural gas. The implication for Indonesia of this renewable technology is to increase the efficiency of fuel consumption and address Indonesia's negative contribution to global climate change. Nevertheless, this has the potential to increase Indonesia's import dependency in the future.

[121] International Telecommunication Union. 2023. The Global Digital Regulatory Outlook 2023. ITU: Geneva.
[122] IBM Institute for Business Value. 2021. Digital technology and the environment.
[123] Institut Montaigne. 2023. The Environmental Impact and Potential of Digital Technology. Paris
[124] McNutt, Louis. 2023. What is the environmental impact of digital technology?



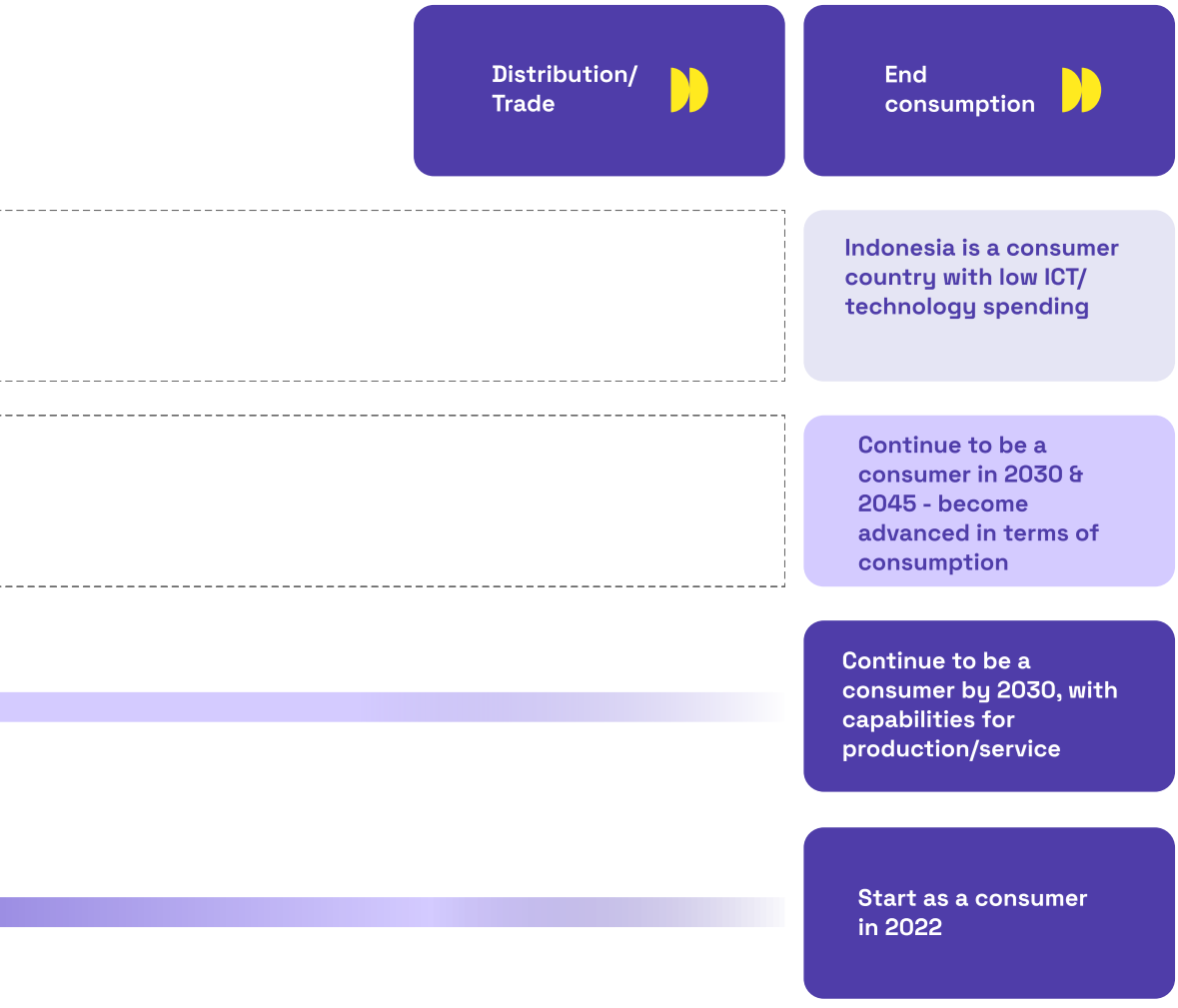
2.2 Shaping the Policy Direction of Indonesia 2045



▲ **Figure 2.7** Potential Scenarios for 2030 & 2045

We have identified the state of digital technology and its level of adoption in the national, regional, and vertical industry contexts. Based on this, it is apparent that Indonesia is still not optimally utilizing the potential of digitalization.

Furthermore, in addressing these conditions, it is imperative to consider the development of various emerging technological and non-technological megatrends. This allows us to take maximum advantage of the digital transformation that is taking place.



Subsequently, Kominfo has identified three potential scenarios for Indonesia 2045 digital landscape. Based on the analysis, Indonesia remains a technology consumer with limited spending on digital technology. However, Indonesia has great potential to achieve a strategic position as one of the major players in the global market.

1. Heavy Consumer Scenario

In this scenario, Indonesia is still a technology consumer with limited production in the digital technology sector. Dependency on imports for key technologies has limited domestic production and exports. Despite advances in technology consumption, domestic technology production capabilities are limited due to the low expenditure on Research and Development (R&D) at this stage. In terms of infrastructure, efforts to improve digital infrastructure are still low, so the available digital infrastructure is centralized in Java and big cities.

Human resource development in this scenario is limited to the major cities and to the top schools. This means that there is no equalization for skills training and digital talent. Consequently, people with low digital knowledge will be less likely to adopt digital technology. The majority of MSMEs are traditional and tech startups are still limited. In this scenario, regulation and digital security are still basic.

2. Technology Prosumer Scenario

In this scenario, Indonesia transforms into a technology prosumer with increasing capabilities in high-tech manufacturing production. This development has had a positive impact on increasing exports of technology products. In addition, while expenditure on Research and Development (R&D) is still quite low compared to other countries, it has started to grow. In this scenario, digital infrastructure upgrades occur outside major cities and expand to regions with specific economic conditions and activities. As a manufacturer, digital infrastructure is important to improve efficiency and productivity.

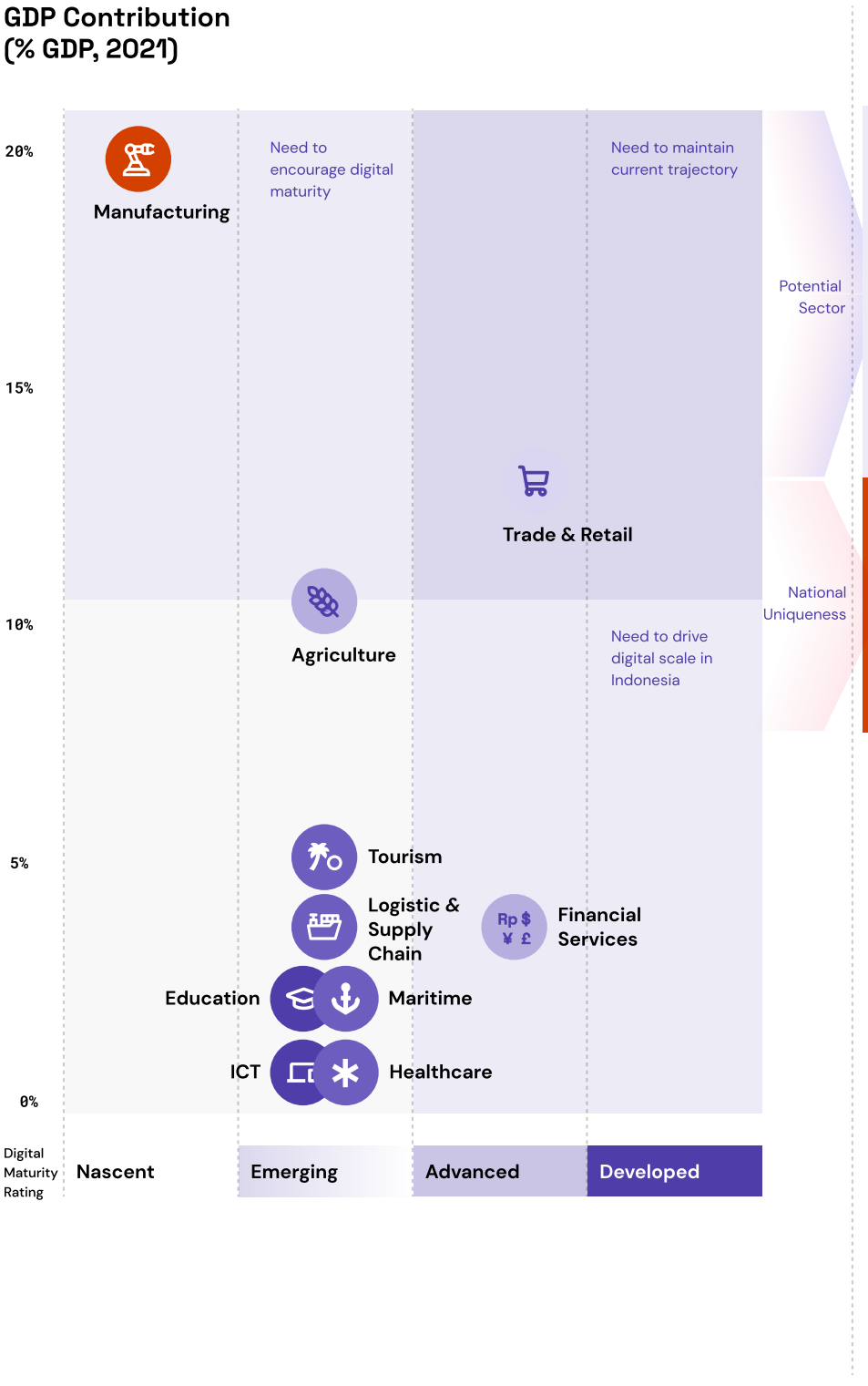
Education and Human Resource development are improving. Digital technology has become one of the national curricula to produce a more digitally literate society. In this scenario, HR development is more spread out and targets all regions of Indonesia but has not yet reached remote areas of Indonesia. A more digitally literate society results in an MSME ecosystem that adopts more technology in its business processes. Startups and companies in the technology sector are also expanding. As a prosumer, the investment climate in digital technology will be higher than at the consumer stage, because the Indonesian market is ready and able to produce digital products.

3. Global Innovator Scenario

Indonesia's goal is to be able to achieve the 'Global Innovator' scenario. In this scenario, Indonesia achieves high levels of production and service, becoming a global engine of innovation. Until 2045, efforts will continue to be made to develop research and product development, especially in vertical sectors that Indonesia currently excels in, such as financial services and trade & retail.

As a global innovator, human resources and digital infrastructure will synergize with each other as people's literacy level in digital technology is higher. All parts of Indonesia are equipped with digital infrastructure and can be directly utilized by the public. This will boost production, both in terms of independent manufacturing and MSMEs with high digital adoption rates. In this scenario, Indonesia's investment regime is already strong in consumer, high-tech and research and development.

To reach beyond the level of a heavy consumer, Indonesia must focus on several strategic areas that are prioritized in future development planning. Based on the figure below, digital maturity in most industrial sectors in Indonesia is still at the Emerging level. Utilization of digital technology will maximize the potential of each industrial sector and encourage it to move towards an advanced level. In turn, this will increase the sector's contribution to the country's total Gross Domestic Product (GDP).



▲ **Figure 2.8** Digital maturity of various national industry sectors

Current Condition	Aspired State	Potential Area Focus
• Some players (e.g. MSMEs) have started utilizing digital (e.g. e- Commerce for sales/marketing) • Mature digital ecosystem (presence of local unicorns)	Global Innovator	Digital adoption of advanced technologies across retail MSME
• National platform in place (e.g. SNAP) with gradual adoption from financial services players • Mature digital ecosystem (presence of local unicorns)	Global Innovator	Digital adoption of advanced technologies across banks
• Nascent adoption of 4IR technology by manufacturing players Absence of hi-tech hub facilities • Limited digital ecosystem (e.g. number of global players)	Technology Prosumer	Adoption of 4IR technology in electronics, automotive, textile, etc
• Emerging tech adoption across MSMEs/big players • Limited adoption on government platforms • Emerging ecosystem (e.g. limited tech players)	Technology Prosumer	Adoption of 4IR technology in palm oil products, tobacco, etc
• Emerging tech adoption in MSMEs (e.g. traceability) • Limited adoption on government platforms • Emerging ecosystem (e.g. limited tech players)	Technology Prosumer	Port operators' adoption of digital solutions in fisheries MSMEs
• Limited innovation; many follow the available technology • Limited infrastructure availability (e.g. power supply) • Strong ecosystem in software and data hosting	Technology Prosumer	Adoption of advanced technologies (e.g. AI, ML) for electronics and software development
• Limited technology use cases (e.g. social media for marketing) • No tourism innovation hub • Relatively mature ecosystem (e.g. presence of unicorns)	Technology Prosumer	City-wide smart city development
• Lagging technology adoption across logistics players • Limited adoption in the National Logistic Ecosystem • Nascent ecosystem (e.g. limited services from tech players)	Technology Prosumer	Adoption of 4IR technology across all port operators
• Limited use of advance tech by EdTech players • Limited adoption in national e-learning platforms • Emerging ecosystem (e.g. limited tech players)	Technology Prosumer	Adoption of digital learning across educational institutions
• Basic telehealth services (e.g. teleconsultation) in the city • National health platform still under development • Emerging ecosystem (e.g. tech players still subscale)	Technology Prosumer	Adoption of digital solutions for hospitals and tech players in healthcare

Potential Sector National Uniqueness

[1] Maritime GDP includes fishery products and marine
Source: Kearney analysis

The nine strategic economic sectors have different contributions to the economy. All of these sectors will require accelerated digital transformation to increase their productivity. However, in terms of prioritizing national development, there are five economic sectors that can be given support first, namely the financial services, trade and retail, manufacturing, agriculture, and marine sectors. This is because these selected sectors have the greatest potential to lift national economic growth.

Indonesia is expected to develop R&D and product/service development capabilities by 2045, especially in industry sectors that are already quite advanced in Indonesia, such as Financial Services, Trade & Retail. Several countries, such as the United Arab Emirates (UAE), managed to improve their global ranking in trade value and China improved its global ranking in financial services export value, by utilizing digital technology.

Considering Indonesia's unique tropical climate and archipelagic geography, it is important for Indonesia to enhance its R&D and product/service development capabilities in the agricultural and marine sectors. This way, Indonesia can become a global leader in these sectors by 2045. Other countries such as Ecuador managed to leapfrog the fisheries export value rankings and India maintained its position as a leading agricultural country with the use of digital technology in agriculture.

By increasing digital maturity in various industrial sectors, Indonesia has a great opportunity to optimize its economic potential and reach the top 5-7 GDP positions in the world in accordance with the ideals of Indonesia Emas 2045. Through appropriate strategic measures and utilization of Indonesia's potential and uniqueness, the country can elevate its industrial sectors from the status of heavy consumers to technology prosumers or even to Global Innovators by 2045.



03 Vision, Mission and Strategy of Indonesia Digital 2045



In anticipating the development of digital technology as well as realizing Indonesia's digital aspirations in 2045, careful preparation and planning in various sectors are needed, as well as the orchestration of all components of digital development - as stated in the framework of the Digital Indonesia Vision 2045 which is supported by 3 pillars, namely:

1. *Modern and responsive digital government,*
2. *Digital economy to create an innovative economy based on digital technology,*
3. *Empowered and cultured digital society.*



3.1 Vision and Mission of Indonesia Digital 2045

Indonesia's vision for 2045 is "Sovereign, Advanced, Just and Prosperous". Following the vision, the government has derived the five main objectives of Visi Indonesia Emas 2045 as follows:



Per capita income at par with developed countries



0% poverty and reduced inequality



Increased international leadership and influence



Increased competitiveness of the nation



Reduced greenhouse gas emission intensity leading to net zero emission

To realize the goals of achieving the Vision and Mission towards Indonesia 2045, Digital Indonesia Vision 2045 was developed, vision that will focus on policy direction on national efforts to achieve capacity and mastery of digital technology in the future. This vision aims to, 1) make Indonesia a major digital power in Southeast Asia, 2) establish a competitive Indonesia with mastery over digital technology.

This vision aims to:

1

Make Indonesia a major digital power in Southeast Asia

2

Establish a competitive Indonesia with mastery over digital technology

The vision of Indonesia Digital 2045 is:

"Achieving an Inclusive and Collaborative Digital Ecosystem Based on Innovation, to Support Advanced, Sovereign, and Sustainable Indonesia"

Achieving this vision will be done by prioritizing the following digital development principles:

1

Inclusive

Equitable availability of digital access and safe digital space for all levels of society.

2

Empowering

The ability of the community to utilize digital technology productively and create added value from its utilization.

3

Sustainable

Digital transformation is based on fulfilling the Sustainable Development Goals Agenda.

Digital Indonesia Mission 2045

Driven by Digital Indonesia Vision 2045, several mission points were identified as the goals for the future direction of Indonesia Digital. The following are the missions:

1

Accelerate national digital transformation as an integrated strategy to increase economic growth, improve the quality of public services, and strengthen national resilience and security.

2

Develop and strengthen a comprehensive and sustainable national digital ecosystem with the active participation of all stakeholders: government, business and industry, associations, academia, and the community as co-creators of the digital ecosystem.

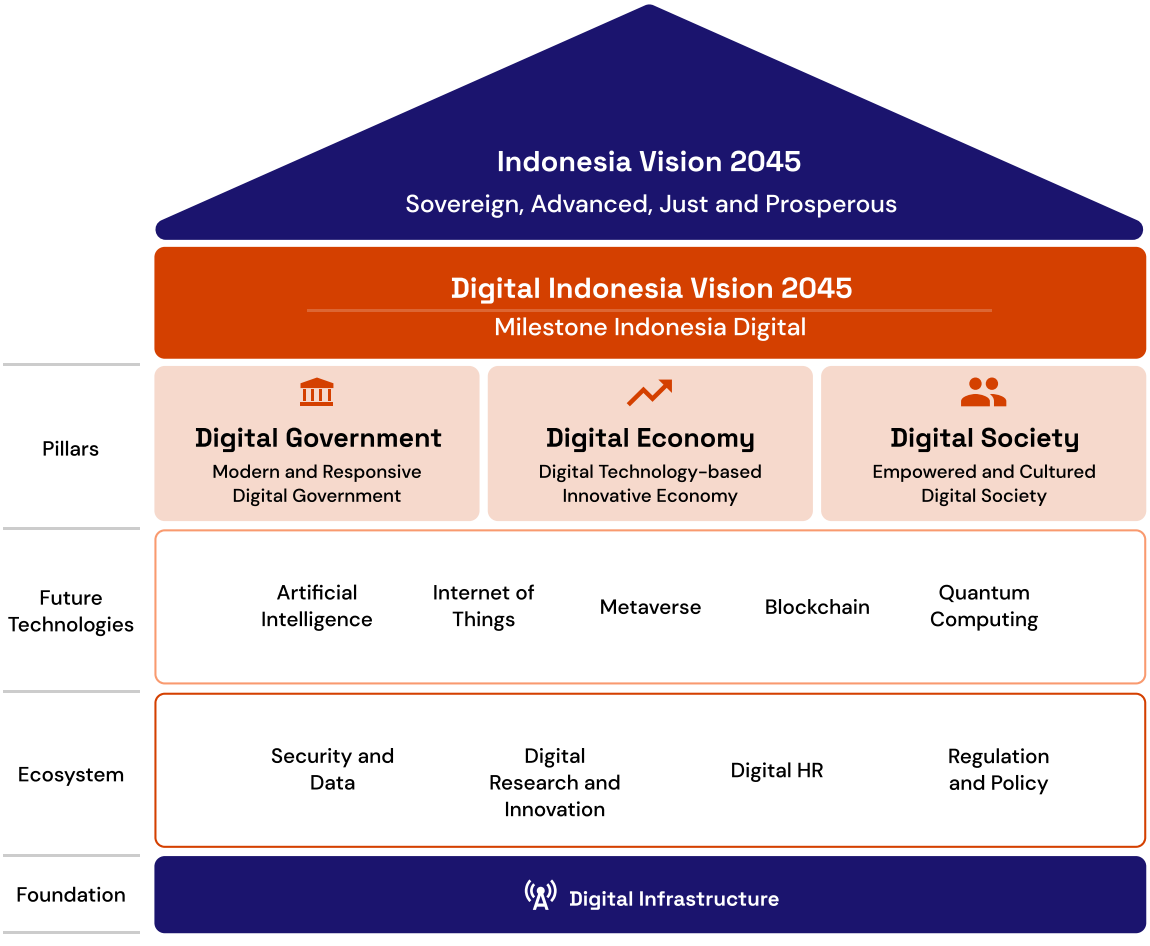
3

Make adaptive and accommodating regulations for the development of digital technology.

4

Promote the strengthening of social institutions (educational, religious, community/family institutions) as a massive effort to increase digital understanding to optimize the benefits of digital technology and minimize its negative impacts.

3.1.1. Framework for Digital Indonesia Vision 2045



▲ **Figure 3.1** Framework for Visi Indonesia Digital 2045

The Framework of Indonesia Digital Indonesia Vision 2045 illustrates that the realization of digital Indonesia is seen through three pillars: digital government, digital economy, and digital society. Goals are set to be the achievement target for Indonesia Digital 2045 across all pillars. To achieve these goals, it is necessary to build the main foundation of digital development, i.e. digital infrastructure, and develop a national digital ecosystem consisting of regulations and policies, digital human resources, digital research and innovation, as well as security and data. With a strong digital foundation and ecosystem, future technological developments will be controlled and utilized properly, meaning that social and economic benefits can be achieved, and potential threats can be minimized.

3.1.2. Goals of Digital Indonesia Vision 2045

Indicator	Definition
Digital Infrastructure	
Mobile Broadband Coverage per Population	Percentage ratio between mobile broadband network signal coverage (at least 4G) received by the public compared to the identified population of Indonesia. (Source: Ministry of Communication and Information, 2023)
Number of gigabit city	Number of cities that have an average internet speed of 1Gbps (Source: Ministry of Communication and Information, 2023)
Average mobile broadband download speed	Average mobile broadband internet download speed in 43 zones. (Source: Ministry of Communication and Information, 2023)
Digital Economy	
Contribution of Digital Economy towards GDP (%)	Percentage ratio of digital contribution to national economy to overall GDP value. (Source: Kajian VID2045, 2022)
Digital Economy Value (IDR)	The estimated amount of total sales and transaction volume conducted through the platform over a compound annual growth rate (CAGR) in IDR. (Source: Coordinating Ministry for Economic Affairs of the Republic of Indonesia., 2021)
Digital Society	
Digital Society Index Ranking (APAC)	Indonesia's global ranking that measures the progress of the digital society based on important components such as digital lifestyle, digital trade, and so on. (Source: Global System for Mobile Communications Association (GSMA), 2020)
ICT sector employment to total employment	Percentage ratio of the number of people working in the ICT sector to the total number of people working overall. (Source: National Labor Force Survey (Sakernas), 2022)
Digital Government	
E- Gov Index (EGDI) Rating	Indonesia's global ranking that assesses the effectiveness of e-government design and implementation across 193 countries. (Source: United Nations, 2022)
Global Cybersecurity Index Ranking	Indonesia's global ranking that assesses the quality of a country's national cybersecurity. (Source: International Telecommunication Union (ITU), 2020)

▼ **Table 3.1** Target of Indonesia Digital by 2045

Baseline	2025 - 2029	2030 - 2034	2035 - 2039	2040 - 2045
89%	98%	100%	—	—
N/A	98	237	376	514
38,91 Mbps	100 Mbps	190 Mbps	380 Mbps	760 Mbps
4%	10%	13%	15%	19%
IDR 1.490 T	IDR 3.995 T	IDR 9.700 T	IDR 14.700 T	IDR 22.513 T
Rank 8	Rank 7	Rank 6	Rank 5	Rank 4
0,81%	1,06%	1,14%	1,28%	1,45%
Rank 77	Rank 64	Rank 51	Rank 38	Rank 25
Score 94,88 (Rank 24)	Score 99	Score 100	—	—

A. Digital Infrastructure

As a foundation in realizing Indonesia Digital 2045, the digital infrastructure goals are to ensure quality broadband connectivity reaches all corners of Indonesia, increase high-capacity networks especially in urban areas and priority areas, increase data center and cloud growth, and create a strong infrastructure and technology ecosystem foundation for inclusive and innovative future technology applications.

The indicators used to see the success of the objectives to be achieved in digital infrastructure include:

1. **Mobile Broadband Coverage per Population:** Measured by the percentage ratio between the coverage of mobile broadband network signals (at least 4G) received by the public compared to the identified population of Indonesia. Source of measurement from the Ministry of Communication and Information.
2. **Number of gigabit city:** Number of cities that have an average internet speed of 1Gbps. Source of measurement from the Ministry of Communication and Information.
3. **Average mobile broadband download speed:** Average mobile broadband internet download speed. Source of measurement from the Ministry of Communication and Information.

B. Digital Economy

The goal of digital economy development is innovative economic growth based on sustainable digital technology. This will be driven through the development and implementation of digital innovations that have a positive social and economic impact.

To make the economy competitive, it is necessary to advance the national digital economy ecosystem, strengthen research and innovation, and strengthen cross-sector partnerships for the adoption of technology to all sectors of the national economy.

Two indicators are used to see the success of the goals to be achieved in the digital economy, namely:

1. **Digital Economy Contribution to GDP:** The ratio of the percentage contribution of digital to the national economy to the overall value of GDP.[125]
2. **Digital Economy Value:** The estimated amount of total sales and transaction volume conducted through the platform over a compound annual growth rate (CAGR) in IDR. Source of measurement from the Coordinating Ministry for Economic Affairs of the Republic of Indonesia.

[125] The calculation is based on Kearney's analysis, by summing the contribution of digital sectors such as Ed-Tech, health-tech, e-commerce, e-logistics, manufacturing, and fintech, in the calculation of market size and government spending on ICT, compared to the total contribution of all sectors to GDP.

C. Digital Society

In the digital society, the goal is to create an empowered and cultured Indonesian society. This includes developing skilled and competitive national digital human resources with mastery of technology, and forming a productive society utilizing digital technology, while still holding Pancasila values, cultural values, and social community norms together as a foothold in facing digital transformation going forward.

The utilization and mastery of digital technology is expected to increase community productivity, while maintaining a balance and continuity between technological development and local customs.

To measure the success of these goals, the indicators used in the digital society include:

1. **Digital Society Index Ranking (APAC):** Indonesia's global ranking that measures the progress of the digital society based on important components such as digital lifestyle, digital trade, and so on. Source of Measurement from Global System for Mobile Communications Association (GSMA)
2. **ICT sector employment to total employment:** Percentage ratio of the number of people working in the ICT sector to the total number of people working overall. Source of Measurement from National Labor Force Survey (Sakernas)

D. Digital Government

The goal of digital government is to realize a modern and responsive digital government, through the establishment of a government ecosystem based on service innovation with the application of advanced technology, establishing a national data-based policy formulation process, increasing the efficiency and transparency of public services, while ensuring the security and protection of all citizens' data.

Indicators used to see the success of the goals to be achieved in digital government, namely:

1. **E-Gov Index Ranking (EGDI):** Indonesia's global ranking that assesses the effectiveness of e-government design and implementation across 193 countries. Source of Measurement from United Nations.
2. **Global Cybersecurity Index Ranking:** Indonesia's global ranking that assesses the quality of a country's national cybersecurity. Source of measurement from the International Telecommunication Union (ITU).

3.1.3. Milestones of Indonesia Digital 2045

I. 2025 - 2029	II. 2030 - 2034	III. 2035 - 2039	IV. 2040 - 2045
Digital Foundation Strengthening Phase This phase is to develop and ensure the availability of equitable, reliable, high-capacity, stable-quality digital infrastructure, and accelerate the development of the national digital ecosystem.	**Development Phase of Competitive Digital Ecosystem** This phase focuses on strengthening a competitive digital ecosystem, to increase productivity and economic competitiveness.	**Sustainable Innovation Development Phase** This phase aims to foster sustainable innovation and the achievement of national digital technology excellence, with a commitment to environmental sustainability goals.	**Global Technology Leading Phase** This phase focuses on pursuing a position as a developed country by applying global technology and prioritizing environmental sustainability.

▲ **Figure 3.2** Milestones of Indonesia Digital 2045

A. Digital Foundation Strengthening Phase: 2025-2029

This phase is to complete and ensure the availability of equitable, reliable, high-capacity, stable quality digital infrastructure, accompanied by the accelerated development of the national digital ecosystem.

- Digital infrastructure: widespread distribution of national broadband networks, increased penetration of 5G networks, and preparation of the next generation connectivity technology ecosystem.
- Research and innovation: increased allocation of future digital technology research funds.
- Human capital: universal access to digital literacy and STEM education, inclusive of all Indonesians.
- Security and data: increased fortification of cybersecurity infrastructure and massive expansion of cyber threat awareness.
- Regulation: formulate regulations that facilitate technological growth without compromising privacy and security.

B. Development Phase of Competitive Digital Ecosystem: 2030-2034

This phase focuses on strengthening a competitive and innovative digital ecosystem, to improve economic productivity and competitiveness.

- Digital infrastructure: providing next generation connectivity for Smart City implementation, and integrating the latest technologies such as edge computing with IoT technology.
- Research and innovation: encourage R&D collaborations that lead to high-impact technological innovations and increase investment into research.
- Human Capital: provide continuous digital training for skills as per relevant technological developments
- Data and security: adoption of reliable technologies such as blockchain to secure data and transactions.
- Regulation: develop regulations that support innovation and prioritize public safety and protection.

C. Sustainable Innovation Development Phase: 2035-2039

This phase aims to drive sustainable innovation and the achievement of national digital technology excellence, with a commitment to environmental sustainability goals.

- Digital Infrastructure: Increase national data center capacity, ultra-fast network speed and capacity, along with the use of environmentally friendly technology and renewable energy sources.
- Research and innovation: Enhance cross-sector collaboration in R&D to generate technological solutions that contribute to environmental preservation and regeneration.
- Human capital: Develop sustainable skills and open up broad access to education and training to produce a responsive and environmentally conscious workforce.
- Security and data: Implement security with large-scale blockchain technology.
- Regulation: Design regulations to accelerate the development of new technologies and prioritize the use of sustainable technologies.

D. Global Technology Leading Phase: 2040-2045

This phase focuses on pursuing a position as a developed country by applying global technology and prioritizing environmental sustainability.

- Digital infrastructure: delivering energy-efficient and sustainable digital infrastructure to serve future technology needs.
- Research and innovation: Continue to be a pioneer in sustainable technology innovation and play an active role in technological solutions for the future of the environment.
- Human capital: Become one of the higher education destinations for technology and innovation.
- Security and data: Become a country that helps set global standards in cybersecurity and data privacy.
- Regulation: Become one of the strong position countries that participate in efforts to harmonize technology and environmental regulations at the international level.

3.1.4. Imperative Strategy

In realizing the Vision and Mission of Indonesia Digital 2045, 8 imperative strategies were designed that need to be carried out together to encourage growth and development of innovation for a competitive national digital ecosystem, namely:



1 Providing even, high-quality, high-capacity connectivity, along with its infrastructure and technology ecosystem

Digital infrastructure is the foundation for the implementation of national digital transformation going forward. Along with technological advances, the preparation of digital infrastructure in accordance with the development and needs of the Indonesian regions is very important. The extent of efforts to provide reliable and quality connectivity will determine the level of digital maturity that Indonesia will achieve in the future. Such reliable connectivity translates into the provision of national broadband internet that is affordable, with excellent Quality of Services (QoS), and spread evenly with strong signals throughout Indonesia. The provision of broadband internet access needs to be completed so that it can reach all villages, all households, and schools throughout Indonesia. Not only talking about equal access, gigabit-capacity broadband internet networks also need to be made available in urban areas or prioritized areas, so that the application of developing technology in the future can immediately penetrate widely.

The strategy carried out on digital infrastructure will be on two sides, namely supply and demand.

On the supply side, it is realized by developing policies on all elements of infrastructure, including network infrastructure development, provision of radio frequency allocations, healthy and sustainable management of the telecommunications industry, development of the domestic ICT device industry, and adaptive regulations to accommodate the application of future technologies.

On the demand side, among others, with policies that can encourage the growth of national data centers and clouds, as well as encourage the growth of local content and applications.

Judging from the trend of increasing demand for network speed and capacity in the next 10-20 years, to be able to achieve 2-3 times the growth of network speed per five years, an important strategy to do is to free up and allocate frequencies, both in high-band, mid-band, and low-band according to the future technology ecosystem development plan. Accelerating the allocation of new frequencies and preparing the necessary technology ecosystem will be able to encourage the penetration of new technologies, such as 5G, 6G, Wifi 6 and beyond.

However, if there are dynamics in the allocation of new frequencies that face various obstacles and constraints, it is also necessary to prepare other strategies to still be able to realize the provision of gigabit networks to various cities in Indonesia. This connectivity can also be improved by increasing the penetration of broadband internet networks throughout Indonesia. A step that needs to be taken is the improvement of international connectivity lines, namely by improving the infrastructure of submarine cables that connect Indonesia with international routes. The necessary efforts need to be prepared not only to encourage the availability of infrastructure networks from the backbone side, but also backhaul networks to all villages, and to the last mile access side. Network penetration to the last mile also needs to be accelerated by encouraging the use of various technology combinations, namely Fiber to the Home (FTTH), Fixed Wireless Access (FWA), and cellular.

Overall network penetration will be easier if supported by several policies, including the implementation of infrastructure sharing in all regions, and synchronization of electricity and energy supply plans with telecommunications network development plans.

To support the development of telecommunications infrastructure throughout Indonesia, the existence of a reliable and sustainable electricity supply is an aspect that must be guaranteed.

Especially for broadband internet network penetration in universal areas or non-commercial areas, Universal Service Obligation (USO) policy schemes will be needed that are able to provide not only quality internet access, but also complemented with programs and policies for internet utilization in penetrated areas so that they can be directed in a productive direction. The determination of development plans and the use of infrastructure technology to fulfill connectivity in these hard-to-reach areas also needs to be designed effectively by prioritizing joint planning between the government and telecommunications operators. Furthermore, the strategy for the provision and management of telecommunications infrastructure in non-commercial areas must be designed in a comprehensive and sustainable manner, including the calculation of management transition scenarios from the government to the telecommunications industry. The use of a combination of fiber networks, wireless, GSO and NGSO satellites, and other Non-Terrestrial Network (NTN) technologies needs to be carefully considered, prioritizing the most efficient implementation and taking into account the broad impact on the development of the national telecommunications industry.

Going forward, the penetration of gigabit networks and the implementation of various new business models that follow technological developments will require business models driven by telecommunications industry players and their ecosystems. Therefore, the telecommunications industry needs to be maintained in order to keep performing positively, by implementing policies and regulations for the telecommunications industry with the aim of maintaining the sustainability of the industry, and maintaining a fair level playing field, including policy treatment for Over-The-top (OTT) providers or digital platforms as a whole.

The formulation of policy and regulatory frameworks to support telecommunications infrastructure development needs to be ensured to be effective and supportive, and able to create a healthy competition climate for telecommunications industry players. Support can be through various regulations and policies, and incentive schemes provided for the purpose of improving national connectivity. Examples of this support include incentives to reduce regulatory costs and efficient and productive frequency resource allocation policies. However, the policies and regulations implemented still need to be balanced between industrial development and providing space for technological evolution and utilization of the latest technology, as well as providing maximum benefits for society as a whole.

The penetration of technology utilization in gigabit networks also requires the development of a secure and reliable infrastructure technology ecosystem. To support gigabit connectivity, technologies such as IPv6, must be systematically deployed. IPv6 adoption is one of the important steps to increase the penetration of using future technologies safely and conveniently. IPv6 offers a higher level of security compared to previous generations, and this is an important element when it comes to massive penetration of future technologies.

Furthermore, the development of telecommunications infrastructure and the application of its technology is not only important to ensure safety standards, but also safe for the future of the environment.

The development and use of technology needs to be controlled so that it is in line with the principles of environmental sustainability, uses green technology, and supports global efforts to reduce carbon footprints.

Telecommunications infrastructure deployment will not happen quickly, easily and successfully if there is no demand for the technology. Hence, on the demand side, it is necessary to implement various strategies aimed at building community demand in a targeted manner. The strategies include increasing the number of killer applications, developing the domestic ICT device industry, and increasing the growth of national data centers and clouds.

Increasing the demand side can be supported through efforts to implement various use cases that have social and economic benefits, increase the growth of innovative and interesting local content, and encourage the birth of many killer applications in various sectors. This killer application can be a catalyst for leveraging internet user penetration, such as gaming and entertainment applications, the health sector with telemedicine, and the agriculture sector with precise smart agriculture. With these various approaches, demand will be created and will directly drive the acceleration and success in the utilization of digital infrastructure, and lead to economic improvement in various sectors.

In addition, the growth of the domestic ICT device industry also needs to be given breakthrough steps, so that Indonesia is gradually able to increase the production and competitiveness of national ICT devices to meet the growth trend of national data demand. Policies to protect and incentivize the industry can be implemented to stimulate the growth of the national ICT device industry.

One policy instrument that can be the first step to protect while stimulating the growth of the local ICT device industry is the Domestic Component Level (TKDN) policy.

In an effort to reduce dependence on foreign technology, so that Indonesia can gradually achieve technological independence, a sustainable and strategic approach involving the government, industry, education and research sectors will be required. This strategic step will require effective implementation of strategy 2, which prioritizes research and innovation to encourage the growth of domestic technological innovation and improve the competitiveness of local digital products. In addition, it is necessary to identify strategic key sectors to be developed independently such as health technology, agricultural technology, and renewable energy. Regulatory favoritism, incentives, and relaxation of regulations towards these key sectors are needed to encourage the growth of domestic products. An ecosystem approach is also needed, such as ensuring material supply, production, and vertical integration within the local tech industry.

Accompanying the above industrial protection policies, it is simultaneously necessary to carry out the transformation of the ICT industry to be able to independently produce, streamline the supply chain, in order to meet the market potential of domestic technology users. This can be realized by building collaboration with global industries, building strategic partnerships with global technology players, and promoting cross-border cooperation to help open market access for Indonesian ICT products to the international market. Another strategy that can encourage the growth of the local industry is to increase demand from the community side, such as efforts to increase public awareness of the potential and benefits of using digital technology, education and creating an ecosystem that supports increased adoption, and encouraging public purchasing power by creating affordable ICT devices.

The various efforts above in increasing the growth of demand for the use of digital technology will certainly encourage a surge in the need for national data centers, so a strategy is needed to increase the growth of national data centers and clouds to grow with the growing data needs.

Some important steps to take include providing alternative green technologies and efficient energy to support the provision of energy for the development of domestic data centers, encouraging domestic investment to build data centers with various schemes both carried out by the government and through cooperation with the private sector, arranging various incentive policies that encourage the entry of domestic data center investment, and various combinations of policies and programs aimed at increasing the competitiveness of the national cloud and data center industry.

In addition to the aforementioned strategies aimed at the provision of telecommunications infrastructure in general, there are various infrastructure development needs for special needs. The infrastructure development in question is the development of telecommunications specifically for the purposes of resilience, security, emergencies and disasters, which can be in the form of infrastructure networks, radio spectrum, as well as the application of integrated telecommunications systems. In the future, it is necessary to develop an integrated infrastructure and system for organizing all the needs of the disaster, resilience and national security systems.

2 Mastery of future digital technology based on research and innovation to strengthen sustainable economic, social, and governance



In order for Indonesia to become an advanced and competitive economy, a controlled mastery of digital technology is required. Controlling digital technology in the future will not only play an important role in stimulating national economic growth, but also in improving people's quality of life and environmental sustainability. To be able to direct the application and development of digital technology appropriately and optimally for the good of the nation and state, the mastery of future digital technology must be encouraged to be based on research and innovation.

This innovation ecosystem needs to be developed along with the startup ecosystem to be able to create various technological solutions that are appropriate for problems in various sectors.

Governance and other supporting elements also need to be prepared to provide an adequate growth climate for the various digital innovations created, including cross-sector research collaboration, the implementation of regulatory sandboxes, the development and implementation of technological innovations for economic, social and environmental interests, and strengthening intellectual property rights for the nation's innovations.

In fostering innovation in the application of future digital technology, it is necessary to support the development of innovation hubs and makerspaces that aim to stimulate the growth of innovation and creative solutions that are able to answer various strategic issues in economic and social aspects. The hub's role is to bring together various stakeholders, ranging from regulators, the private sector, academia to the community, to collaborate with each other to produce sustainable innovations and accelerate the development and adoption of innovative digital technologies.

To develop a sustainable research and innovation ecosystem, it is necessary to strengthen professional research networks, both domestic and international. In addition, domestic research capabilities also need to be improved, including by providing incentives for individuals, universities, and organizations involved in research and development of digital technology solutions that have a positive impact on society. Cross-sector research collaboration is also an important element that bridges the application of digital innovation to priority sectors.

The development of these innovation centers will need to be accompanied by the strengthening of the startup ecosystem or the development of a new startup city ecosystem in Indonesia. The more new cities that transform into vibrant and productive startup ecosystem centers, the better it will be for the regional economy, and the growth of the national digital economy as a whole. Local governments can also be more active in encouraging the development of startup ecosystems in their regions, encouraging the development and application of technological solutions based on local needs, and the use of high technology that can improve the quality of life and welfare of their communities.

At the national level, to support the development of the ecosystem, central government policies also need to be directed to support the growth of national startups, such as providing licensing relaxation policies, providing a better business climate and investment ecosystem.

The digital innovations developed above will need to be geared towards the economic, governmental, social and environmental sectors.

In the economic sector, digital innovation is utilized to drive productivity improvements in priority economic sectors. For example, the application of sensors and mobile devices in the agricultural sector allows farmers to accurately manage soil moisture, ambient temperature, and crop conditions remotely. In addition, the use of advanced Artificial Intelligence (AI) in the trade and retail sector allows consumers to get a more customized shopping experience. Strengthening the economic sector through digitalization will encourage business growth, creation of new jobs, market expansion, and empowerment of business actors, especially in the e-commerce sector, which has great potential for the national digital economy going forward.

In the government sector, the development and implementation of digital technology is necessary to realize reliable and professional government services. These technological innovations include the use of smart technology to improve the quality of public services, the use of data and analytics to improve the efficiency and effectiveness of public services, and the use of technology to improve the security and transparency of government data.

In the social and environmental sectors, mastery of future technologies needs to be directed towards improving social welfare, improving the quality of life of the community, and environmental sustainability. For example, various applications of technology that are useful in helping the lives of people with disabilities, the elderly, or other special communities.

Meanwhile, efforts to encourage mastery of digital technology that prioritizes environmental sustainability and responds to climate change, need to be directed towards innovation to

develop more efficient and environmentally friendly solutions in various industrial sectors, where digitalization and the use of new technologies can help encourage decarbonization (reduce carbon footprint), or the use of environmentally friendly and renewable energy-based technologies in the provision of digital infrastructure supply.

In creating an ecosystem conducive to the development of research and innovation, the government needs to provide a favorable climate for industry players to develop, test, and launch products through a regulatory sandbox.

This regulatory sandbox acts as a platform for testing either in terms of policy, service or technology innovation and gives industry players the space to test new business models and technology solutions without being burdened by regulatory risk. During the trial period in the sandbox, the government can monitor the development and impact of the innovation on society and industry. This creates an exchange of information and experience between the government and industry and allows the government to strike the right balance between security and encouraging innovation, while maintaining the public interest.

The implementation of proper digital governance and expansion of access to funding are also important elements to realize the development of the digital economy, digital government and digital society according to the Digital Indonesia Vision 2045. Good cooperation and collaboration between academics, industry players, startup companies, and individuals is needed to expand the network and access to funding.

The expansion of access to funding can be done through the development of funding hubs that allow startups, MSMEs, and research institutions to interact with private investors, venture capital, and other collaborative funding mechanisms. In addition, various other strategic measures such as tax relaxation, visa passes, and protection of Intellectual Property Rights (IPR/HaKI), both for individuals and companies conducting research and innovation can be an effort to realize the development of an innovative and growing digital ecosystem.

To achieve these goals, national strategies in the context of digital economy development need to be aligned with international forums that are concerned with the digital economy, such as WEF, G20, ASEAN, and other international organizations. The development of digital economy governance, regulations and policies needs to be aligned with international standards. With this step, Indonesia can increase the competitiveness of the digital economy in the global market, as well as utilize international cooperation opportunities to develop the national digital economy.

3 Maintain data sovereignty and protect people's privacy with comprehensive policies, regulations, and cooperation



In the ever-evolving digital era, maintaining data sovereignty and protecting people's privacy are top priorities. Maintaining sovereignty means implementing policies that enable the state to have control and ownership over the data generated and collected within its territory, and to create data independence.

To be able to have full control over data in Indonesian territory, there are various strategies that need to be carried out, including forming national policies and regulations on ownership, storage and access to data generated in Indonesia, building an independent data ecosystem, increasing protection of data privacy security, and strengthening partnerships with both private parties and international partnerships.

With the expected volume of data continuing to increase exponentially, it is necessary to design and implement policies to manage and control the data in circulation.

Establishment of clear and firm national strategic data regulations and policies regarding ownership, collection, and wise use of data.

Securing national strategic data requires the development of national infrastructure for strategic data storage and management, including secure data centers, reliable data storage devices, and efficient data management systems in accordance with high security and resilience standards.

Furthermore, implementing a data security policy strategy needs to be supported by strong accountability, which will ensure that those who manage data, including the government and the private sector, are responsible for the use and protection of data so that people can have confidence that their data will be managed properly and will be used in accordance with legitimate purposes.

In order to maintain control and security over strategic data that is important for national interests, a balanced data localization policy needs to be designed. This means that this policy needs to strike a balance between the need to maintain data sovereignty and ensure that data localization does not hamper economic growth, investment, innovation and harmony in international cooperation.

Data localization or storage of important data on domestic cloud infrastructure, will facilitate regulation if vital and sensitive data is under jurisdiction and supervision within the country.

In its implementation, this policy requires various comprehensive policy accompaniments, such as policies that encourage the growth of domestic data centers and infrastructure in order to meet the growth of national data needs. Strategies that need to be carried out include strengthening local partnerships, collaboration with the private sector, and incentive policies to stimulate the growth of domestic data center and cloud investment. It will also be necessary to align on an efficient and environmentally friendly power supply plan, to meet the power needs of the growing domestic data centers.

The future development trend of data traffic does not necessarily mean that data must be stored and protected without being utilized for the benefit of the general public. For this reason, it is necessary to implement an open data policy, which is a policy that allows public and non-confidential data to be accessed and used freely by the public, including by the private sector, researchers, and other entities. This provides great opportunities for economic growth, innovation and community participation in decision-making processes. The implementation of open data policies needs to be accompanied by appropriate efforts to balance transparency with the protection of individual privacy data.

To support the success of open data policies, it is necessary to empower the government to play an active role in managing and utilizing data for national interests. The government, with its policy of transparency and information disclosure, also needs to direct all public institutions to actively publish public data openly and routinely. On the government side, strategies that need to be carried out to support the implementation of open data include the development of government systems and data that apply the principles of integration, interoperability, and data integration. This is also in line with the process towards developing data-driven-policy-making. Furthermore, strategies that need to be carried out include preparing the platform and infrastructure side that supports data publication, implementing strict privacy and security policies, and encouraging innovation collaboration with the government and the private sector for the development of various technology-based services.

With the increasing penetration of the use of various applications and new technology devices, it will increase the risk of misuse and violation of data privacy.

Public data privacy protection policies need to be implemented accountably, to ensure that personal data and sensitive data are protected from misuse and unauthorized access.

In addition, data security threats, such as data leaks or hacks, can have serious repercussions for individuals, entities, and the public sector.

Strengthening regulations on data protection, data privacy and data security needs to be done thoroughly. The strategic framework for implementing community data protection involves a number of policies that need to be implemented in an orderly and controlled manner.

These policies include developing a series of laws and regulations and technical implementation rules for strong data privacy protection, developing strict security policies and standards with data management bodies that have strong controls, and aligning national policies with international policies or global norms. The implementation of regulations also needs to be followed by the implementation of effective supervision, control and law enforcement against data violations within Indonesian jurisdiction.

In addition, what is very important to develop is the public's own awareness of privacy rights and personal data protection.

In its implementation, the data protection policy will require alignment with various policies applicable in other countries. Different countries have different regulations and policies related to data protection and cross-border data flows.

Therefore, policies regulating the transfer of data overseas need to be carefully designed to regulate how data can be transferred and shared with outside parties. In helping to facilitate cross-border data flow, strategies that can be carried out include updating data protection policies periodically following global developments, strengthening collaboration and cooperation with other countries (bilateral or multilateral), establishing supervisory organizations that have the authority to control cross-border data flow activities, and implementing clear and effective mechanisms in handling legal conflicts. Furthermore, harmonization of international data regulations and standards is an important focus in achieving a balance between national data sovereignty and supporting data exchange for innovation and economic growth.

4 Strengthening technology and the cyber security ecosystem to support safe digital transformation

In preparing to develop the digital economy and protect all Indonesians in the future, it is necessary to build a strong cybersecurity ecosystem. Strengthening cyber security is carried out through a holistic approach to the preparation and implementation of regulations, policies, technology, and collaboration which is carried out dynamically and adaptively following current cyber security developments and challenges. Strengthening cyber security here means deveoping a secure and resilient national digital infrastructure, creating a safe and healthy digital space for the public, and strengthening international collaboration to create a safe global cyberspace for all.

Strengthening cybersecurity starts from internal measures in the government, which then extends to the private sector to create a robust national cybersecurity ecosystem. In implementing cyber risk monitoring and control, relevant regulations are developed to provide clear guidance in cyber risk management and mitigation for the government itself, the private sector and the general public.

Strengthening cybersecurity in the government becomes the foundation that leads to similar efforts in the private sector and society, creating an effective synergy in maintaining national cybersecurity.

To build a secure national digital infrastructure, the use of the latest high-capability technology is supported. In terms of digital infrastructure, for example in telecommunications connectivity, the application of new technology must have the principle of prioritizing security aspects. The utilization of technologies such as Artificial Intelligence needs to be enhanced to streamline surveillance actions, such as automating the search, detection, and removal of threats. The development of cyber hubs and capacity building for the Computer Security Incident Response Team (NCSIRT) in particular needs to be done for security resilience in the adoption of e-government, adoption of the use of quantum computing, and increased uptake of digital goods and services especially antivirus software.

For protection needs in vital sectors such as resilience and security, energy, transportation, and telecommunications, efforts need to be made to improve readiness in dealing with cyber insiders on vital information infrastructure. These critical infrastructures also need to be ensured to have international-level security standards, implement monitoring and early detection systems and conduct regular security tests and audits to ensure high compliance with established security standards. In terms of personnel, it is necessary to prepare for the staffing of various professionals, both for protection in government and private sector representatives.

The handling of cybersecurity threats must be anticipated by creating and clarifying the duties, functions, and structure of law enforcement agencies down to the regional level in handling cybercrime. This step will provide convenience to the public and speed up the response of law enforcement to deal with cybercrime. A good regulatory order is necessary for the handling of cybercrime to be more optimal and effective. Adequate regulations need to be developed to govern cybersecurity issues, data protection and privacy, incident reporting and handling, certification and security standards for digital products and services.

This regulation will need to regulate the procedures for handling attacks, prevention, detection, response, recovery, and the obligations of each party involved. The government also has a role to play in maintaining the quality of resilience standards against technical cyber threats.

With the complexity and breadth of cyber threats, it is necessary to develop international cooperation in maintaining cyber security.

Strategies that need to be carried out include collaboratively developing an international cooperation framework regarding mechanisms, principles, rights and obligations between countries in handling cyberspace. In addition, there will be a need for a mechanism to exchange intelligence data and information for the updating of incident response techniques and strategies, the development of a digital extradition treaty, and the establishment of an international cross-border security response team.

International cooperation is a very important part of maintaining cross-border security, there will be various international forums and conferences needed to share best practices, cooperate in legal investigations and prosecutions, and cyber security diplomacy, among others. In addition, this will encourage the alignment of national cybersecurity policy directions with international policies.

In addition to the important role of the government, cybersecurity will also be the responsibility of the private sector and society in general.

All organizational entities, non-government institutions, industry players, and communities need to build and implement risk management to improve cybersecurity in all aspects. People need to be aware and practice cyber hygiene and always act vigilantly in protecting cybersecurity on the individual side. Furthermore, in an effort to increase public awareness about cybersecurity, the strategy that needs to be carried out is a national campaign for education about cybersecurity risks, and safe actions that need to be instilled in the public. In addition, it needs to be incorporated into the curriculum and teaching and learning process in schools and colleges.

This education must be able to reach and touch all levels of community groups, from children, productive age to the elderly, and reach people in remote areas of the archipelago. The national education and campaign activities also require an emphasis on digital ethics so that in addition to avoiding cybercrime but also minimizing the risk of becoming a perpetrator of cybercrime. the most important is from the side of the community as the owner of the personal data.

5 Formation of a digital society that is cultured, competitive, and productive in facing future challenges

Facing the challenges of digital transformation in the future, comprehensive efforts are needed to create a society that is competitive, productive, and has digital ethics in accordance with the values of Pancasila, the culture of social norms that are believed in facing the evolving digital era. The implementation of appropriate strategies in supporting the digital society will be carried out through improving the quality of education and culture, equitable distribution of training ecosystems to all regions of Indonesia, providing access to digital training for the community, digital literacy, and strengthening collaboration between educational institutions and industry.

Strategies in building competitiveness and competence of national human resources can be done with short-term and long-term plans. In the short term, strategic steps are needed to accelerate the skills and competencies of national human resources, while in the long term, transformative changes need to be made to formal education in Indonesia.

To accelerate the digital skills of the national workforce, upskilling and reskilling of workers throughout Indonesia is carried out systematically, starting from prioritized sectors or regions. The government will provide and expand access to up-to-date training and certification in accordance with the development of technology implementation trends.

Access to training can be improved by encouraging the development of a digital training ecosystem across Indonesia. To encourage the acceleration of the right skills, the government needs to develop a mechanism for updating digital-related job occupation maps so that they can quickly adjust to the development of industry needs. In remote and hard-to-reach parts of Indonesia, mobile and online training delivery models need to be implemented. This means that good quality internet infrastructure needs to be in place first.

To accelerate the penetration of access to training, Massive Open Online Course (MOOC) should be organized. With the empowerment of this massive platform, various disciplines, and the latest digital skill updates can be widely accessed by all regions.

Increasing access to training will also require the application of technology to be more effective and provide quality educational content.

By encouraging increased penetration of online learning platforms, it can provide wider access to quality training that reaches remote communities.

The improvement of national skills will also be encouraged by organizing various programs in the form of scholarships or digital training assistance aimed at students, teaching staff, professionals. This program needs to be implemented massively, not only encouraged by the central government, but structurally organized by local governments. Providing training assistance can also take the form of providing incentives and subsidies in obtaining certification. In addition, it is also necessary to prioritize the provision of assistance to potential remote areas of Indonesia. In supporting the implementation of the program, it will require the active participation of stakeholders including universities, educational institutions, digital industry players, global tech companies, and international/foreign institutions.

The development of various forms of partnerships needs to be improved so that access to training to the community can be increased.

Increasing labor absorption into industry can be done through several inclusive and sustainable strategies. Educational institutions can create synergies and strong partnerships with industry players, such as the implementation of internship programs that can provide opportunities for the workforce to gain insight into the real world of work while identifying the skills that workers need to have. The program needs to be implemented by providing incentives, either in the form of financial support, recognition of achievements, or other benefits that can provide added value to educational institutions and students.

Facilitation of soft skills training is also needed to form a competitive workforce. The training needs to be designed in an interactive manner, allowing participants to develop interpersonal, thinking and leadership skills. In addition, the provision of industrial certification must also be integrated in the strategy to increase employment. This certification can be concrete evidence of the skills and knowledge possessed by prospective workers, as well as increase industry confidence in the potential of the workforce.

In addition to improving digital skills for the general public, it is also important to improve skills for human resources in government.

To support this, providing training programs and scholarships can be an effective solution. Scholarships can provide financial support to government workers who want to develop new skills. Close cooperation with the private sector is an important cornerstone in the implementation of this program, ensuring that the training provided is in line with the needs of the job market and the

dynamics of technological development. Through these efforts, improving the qualifications of human resources in the government sector can be a strategic investment in improving the quality of public services and ensuring that government workers can adapt to dynamic changes.

The creation of competitive national human resources needs to be accompanied by transformative improvements towards the implementation of formal education. Digital-based curriculum alignment is a crucial step that needs to be taken in realizing education that is appropriate and responsive to the dynamics of the digital era.

The curriculum needs to be formed by considering the learning process as a whole, starting from digital literacy, technology skills, to the application of digital ethics. In addition, curriculum integration with digital skills certification is also necessary.

The government needs to map the competencies required by industry, so that formal education institutions can adjust the development of appropriate skills. Not only in the digital aspect, education also needs to integrate soft skills such as creativity and problem solving through a case study-based learning approach that encourages students to think critically and creatively.

To support the implementation of this education, the government needs to encourage technology learning centers so that students are more actively involved in interactive learning that encourages the application of digital concepts and the development of soft skills.

The development of future technology needs to be accompanied by the ability of the community to be able to utilize the technology.

Improving digital literacy is an important agenda for the government, especially for people who are newly connected to the internet. It is important to develop sectoral and regional digital literacy so that people can optimally utilize technology according to local needs. In addition, literacy should be done with Pancasila values in mind, ensuring that the use of technology does not damage or threaten these values. Digital literacy also plays a crucial role in building a healthy and productive internet culture, where people can access information critically and responsibly.

In addition to the information consumption aspect, literacy should also focus on sectoral technology adoption, so that businesses and workers can utilize technology to increase productivity and competitiveness. Strategies also need to be carried out through the preparation of digital literacy modules and curricula that can be accessed online, and ensuring that digital literacy can be reached by all levels of society and all segments.

By improving digital literacy, people can be better prepared to face the challenges and opportunities that arise in the digital era, while maintaining cultural values and local wisdom.

6 Formation of adaptive regulations and institutions in the national digital ecosystem

The rapid development of digital technology demands adaptive and responsive regulations to support national digital transformation. Indonesia should encourage the implementation of 5th Generation (G5) ICT Regulations that are more collaborative, inclusive, and aligned across sectors. These regulations cover various aspects, including new technologies and their use cases, regulations in various economic sectors, as well as regulations with other cross-sectoral themes.

A flexible and adaptive regulatory approach to keep up with the rapid pace of technological innovation needs to be adopted by regulators.

Instead of focusing on prescriptive rules, regulators should shift to outcome-based regulation that specifies desired outcomes while providing flexibility in achieving those outcomes.

In addition, regulators should engage in collaborative efforts with stakeholders such as industry, experts, and other regulatory bodies to comprehensively understand emerging technologies and their potential impacts.

In the entire process of developing regulations and policies, the government must formulate a long-term vision regarding the direction of Indonesia's digitalization. This long-term vision will guide the development of digital regulations and policies.

With solid guidelines in place, policies and regulations will not be reactive and can also serve as the basis for a sustainable, inclusive and empowering digital transformation, which will ultimately have a positive impact on society and the environment.

In digital government, regulation plays an important role in realizing a modern and responsive government. This regulation needs to be developed by prioritizing the principles of effectiveness, integration, accountability, and interoperability in utilizing the latest technology. This includes aspects of the implementation of e-government, utilization of open data, service platforms, and various government activities and systems aimed at providing optimal services to the community. In addition, the regulation also aims to improve the capabilities of the state civil apparatus in utilizing technology to support the government's vision.

In the context of the digital economy, regulation plays an important role in encouraging digital technology-based innovation with a focus on adaptive principles. Reforms on various regulations to support the development of the digital economy need to be carried out, especially those directly related to the development of digital products and services. This includes regulating the use and implementation of new technologies, production and provision of digital content, data usage, copyright, and other relevant aspects. In addition, in the context of the digital economy, regulation plays an important role in supporting digital technology-based innovation through an adaptive approach. The government can act as a facilitator for various digital innovation actors, including startup companies and other industries that encourage digital research and development activities.

Through policies that support and protect intellectual property rights and provide access to resources necessary for innovation, the government can encourage the growth of a diverse and competitive digital industry ecosystem, as well as create healthy competition and a fair playing field in the digital ecosystem.

In the digital society, regulations encourage digital inclusiveness for all digital communities by prioritizing community competence and collaboration, and encouraging increased training for human resource development. These regulations should also be enforced to support the provision of equitable, reliable and secure digital infrastructure through affordable and universal access to telecommunications networks, services and applications and their use for socio-economic growth and development.

To ensure that digital transformation does not have a negative impact on the environment, regulations need to be encouraged so that the digital industry can adopt environmentally friendly technology. Measures such as the use of renewable energy, e-waste management, and the use of environmentally friendly materials should be integrated in regulations to maintain a balance between technological advancement and environmental impact. This approach also includes other policies, such as providing financial incentives for renewable energy, implementing a carbon tax, developing standards for environmentally friendly technology products, and participating in international cooperation to address climate change.

7 Creating a conducive climate for increasing investment in the digital sector



To increase investment in the digital sector in Indonesia, a strategy covering various aspects is needed, including improving the ease of doing business and ease of licensing, including encouraging alternative financing schemes for the ICT sector and partnerships between the government and the private sector.

Ease of the licensing process can reduce administrative and bureaucratic obstacles which often become obstacles for investors, especially in the dynamic ICT sector. To simplify licensing, strategies need to be implemented, including streamlining the licensing process, with the hope that this will provide opportunities for digital business actors who want to launch new digital products or services more quickly and operate earlier.

Apart from that, it is necessary to complete the digitization of the licensing process and continue to develop an online platform where the application process, tracking status, and approval can be done online so that the licensing system becomes more efficient.

The government can also consider a one-stop service approach to simplify and integrate various licensing processes more concisely. Processes that can be automated need to be encouraged by implementing the latest technology such as using AI and Big Data, so that processes can be quantified accurately. By adopting digital technology in licensing, digital industry players can reduce the time and costs of obtaining permits.

In the financing aspect, the government must be able to encourage alternative financing schemes so that it does not only rely on the state budget but also on untapped resources. The government can help connect venture capital with digital industries or startup companies that need funding, especially those located outside Java and Bali.

On the licensing and incentives side, in fact, most venture capitalists do not dare to invest in high-risk sectors, so the government must prepare a scheme that is mutually beneficial to both investors and the government. To encourage investment, the government can also provide fiscal incentives, such as tax cuts or tax breaks, while still paying attention to a clear scheme by calculating costs and benefits for each type of company, startup, and industry.

In the aspect of partnerships between the government and the private sector, it is important to encourage collaboration that can create a conducive environment for the growth of the ICT sector. Strategies that can be implemented include establishing partnerships in innovation and research, developing business incubators and accelerators, policy making, and creating incentive schemes both fiscal and non-fiscal, including developing domestic and international markets to increase the visibility of national digital products.

8 Increasing collaboration between stakeholders in the development and use of digital technology throughout Indonesia

In realizing digital governance and encouraging a synergistic and reliable digital ecosystem in Indonesia, it is necessary to create an inclusive and equitable ecosystem, where stakeholders play an active role in collaborating on the development and use of technology. Through strong synergy between pentahelix (government, society, business institutions, NGOs, and academics) to build an environment that supports innovation and development of digital technology. The government's role is responsible for developing policies, regulations, and strategic directions that encourage technological growth, where the central government plays a role in building a reliable ecosystem and synergy for digital development. Meanwhile, regional governments play a role in encouraging digital transformation not only in government systems but also encouraging digitalization in other sectors in the region and providing support for the development of digital ecosystems within them.

However, synergy between the two is needed to achieve the common goal of accelerating digitalization across Indonesia. Communities play a role as end users of technology who can also provide feedback and perspectives in designing relevant and useful technological solutions, business institutions have a role in developing and providing technological solutions that suit market needs and advance technological innovation, the role of NGOs can encourage transparency, participation public, and sustainable decision making, as well as the role of academics in conducting research and technological development, and also as transfer of knowledge related to various technologies.

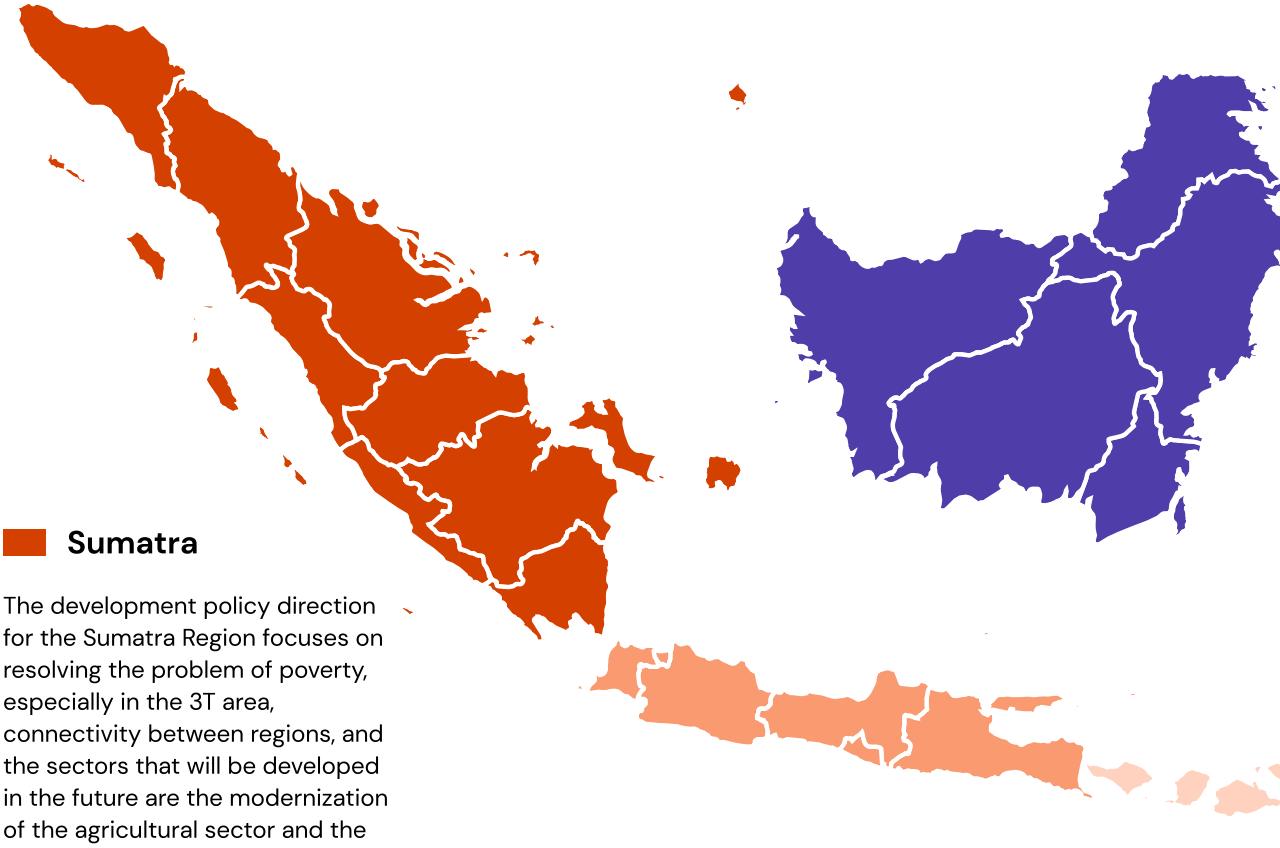
The strong synergy among these five pentahelix elements enables collaboration in designing, developing, and implementing comprehensive and sustainable digitalization. Building collaboration and strengthening partnerships in building a digital ecosystem can be done by collaborating between stakeholders, making agreements including technical support such as mentorship/training, establishing and increasing the availability of training centers in each region, entering into government-private cooperation contracts to increase digital acceleration, and voluntary assistance between domestic stakeholders, close integration at the regional level, and partnerships with overseas stakeholders. Strategic partnerships also need to be carried out with international bodies/organizations such as the UN, including standardization bodies, to increase cooperation across the telecommunications/ ICT sector.

Other collaborations that have been carried out in various countries include collaboration by bringing in other stakeholders (apart from both central and regional governments) in the collaboration hub concept as an experiment in forming policies that will later become a formal reference that will later be determined by the government.

Through these various partnerships, an environment will be created that supports innovation, policy development, digitalization, more inclusive technology, and the use of technology to overcome the social and economic challenges facing society as a whole. This partnership will also ensure wider access to technology and enable optimal use of technology to overcome various challenges faced by society. In essence, the formation of the existing collaboration aims to create equal opportunities for all citizens in the development and utilization of the digital economy.

3.1.5. Direction of Regional Development

The regional policy directions that will be outlined take into account the policy directions per island in the 2025-2045 national long-term development plan (RPJPN 2025-2045) including the mapping of selected/ priority sectors on each island. Following are the policy directions per island:



Sumatra

The development policy direction for the Sumatra Region focuses on resolving the problem of poverty, especially in the 3T area, connectivity between regions, and the sectors that will be developed in the future are the modernization of the agricultural sector and the systematic development of electricity.

Jawa

The transformation of digital development in the Java Region will be directed towards the development of ultrafast technology, strengthening and supporting the mastery of global technology.

Bali - Nusa Tenggara

Increasing the implementation of fiber optic to support the availability of high-capacity networks for all regions to remote areas and leading sectors in the Bali-Nusa Tenggara Island region.

Furthermore, strengthening the economy is also carried out by implementing digitalization in the development of selected priority sectors and superior potential which have been adapted for each region

Kalimantan

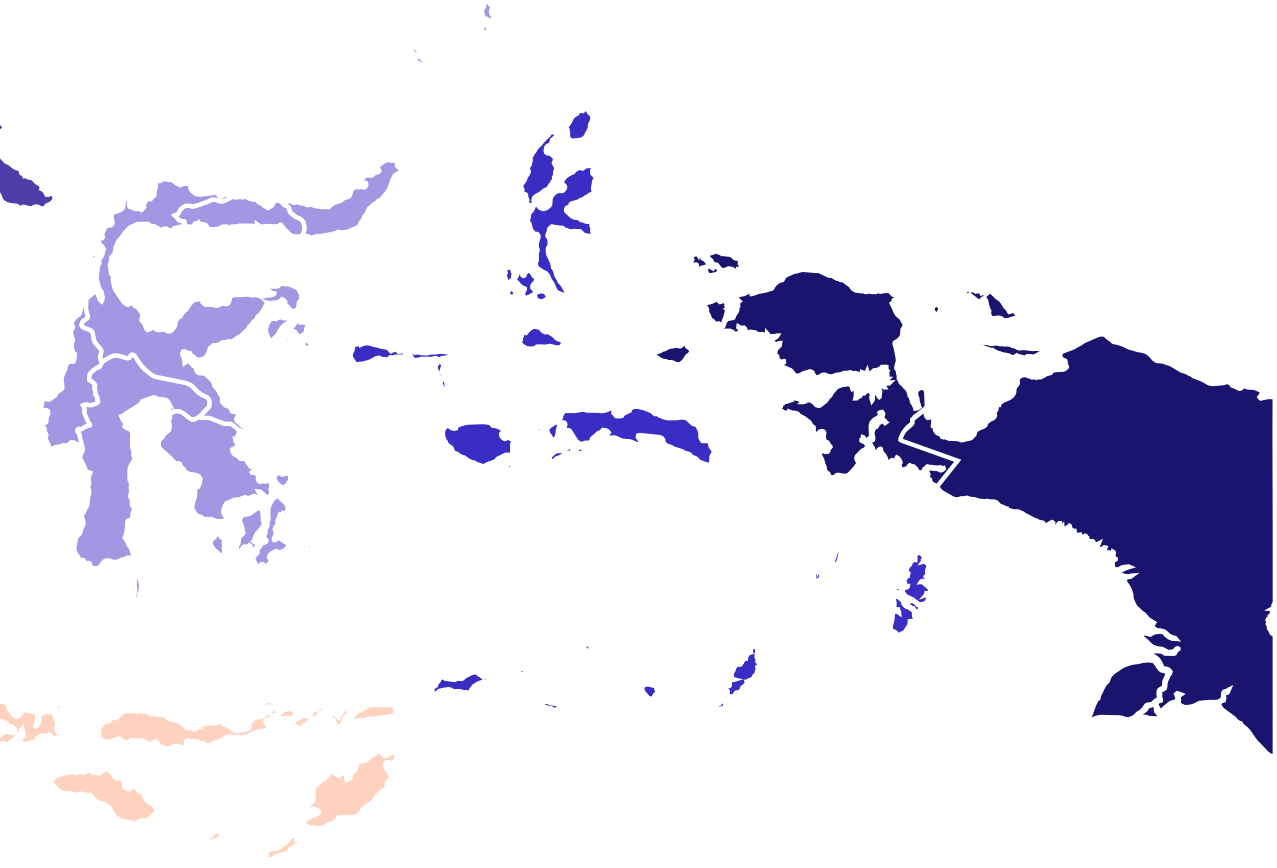
The development of the IKN (Indonesian Capital City) is the focus of future development policy for the Kalimantan region by considering the impact on the environment and sustainability, as well as supporting smart city

Sulawesi

The development policy direction for the Sulawesi region will focus on resolving the problem of poverty, especially in the 3T area, inter-regional connectivity, strengthening health, and developing mineral-based industries.

Maluku

The development policy direction for the Maluku region will focus on resolving the problem of poverty and strengthening health in the 3T region.



in the Bali-Nusa Tenggara region, especially in the tourism sector and the creative economy which is carried out by increasing the role of technology in production activities/processes and Other supporting activities include the use of supporting applications.

Papua

The development policy direction for the Papua Region will focus on resolving the problem of poverty, especially in the 3T area, connectivity between regions, developing food production centers, strengthening health and equitable education.

Sumatra

The development policy direction for the Sumatra Region focuses on resolving the problem of poverty, especially in the 3T area, connectivity between regions, and the sectors that will be developed in the future are the modernization of the agricultural sector and the systematic development of electricity.

In supporting this development, the direction of ICT policy in terms of infrastructure will encourage improving the quality of broadband networks that can provide fast, stable, and affordable internet access that can reach rural areas that are not densely populated. Support for the implementation of digitalization will also be encouraged towards development in the agricultural and plantation sectors which are the leading priority of these sectors by encouraging the implementation of smart agriculture through assistance and incentives for farmers and stakeholders in related ecosystems and the development of smart logistics to increase efficiency, reliability and transparency in the chain. supply or logistics of goods and services, especially ports in the Lampung and Riau Islands regions.

On the ecosystem side, increasing digital talent capabilities is carried out through inclusive digital education, digital leadership training, and improving ICT-supporting facilities throughout the Sumatra region. Interventions to increase digital human resource capacity in the Sumatra region will focus on certification and curriculum that produce workers in the ICT sector. This is a focus considering that the IMDI score for the employment pillar of the island of Sumatra is one of the lowest among other islands. Apart from that, in provinces with low IMDI scores, a basic understanding of digital literacy is needed. Meanwhile, in provinces with high IMDI scores, it is assumed that they can absorb intermediate and advanced-level digital talent training material as well as digital leadership.

Jawa

The transformation of digital development in the Java Region will be directed towards the development of ultrafast technology, strengthening and supporting the mastery of global technology.

The Island of Java has become a leading region for the provision and use of ICT. Therefore, the direction of digital development transformation will be directed at developing ultrafast technology, strengthening and supporting mastery of global standard technology, by encouraging the study and implementation of various use cases such as the development of smart cities in all provincial capitals on the island of Java, especially DKI Jakarta area as a leading city through development of technology hub or hall. Other use cases can be implemented in line with efforts to increase distribution connectivity, productivity, and efficiency with surrounding islands which can be encouraged by building smart ports at large ports on the island of Java such as Tanjung Priok Port, Jakarta and Tanjuk Perak Port, Surabaya.

Strengthening infrastructure also leads to increasing the provision of fiber optics to support the availability of high-capacity networks for all regions to remote areas, encouraging all provincial capitals on the island of Java to adopt advanced technology and push to become gigabit cities.

Interventions to increase the capacity of digital human resources on the island of Java are no longer concentrated on literacy at the basic level but can increase to providing intermediate and advanced level literacy to adapt to the needs of the digital community on the island of Java who are digitally literate but not yet fully empowered.

One example of appropriate treatment is the creation of digital hubs that will accommodate various community innovations in an effort to increase their role in the economic sector and global competition. However, policies to increase the capacity of digital human resources on the island of Java must also reach the community segments in rural areas in Banten and East Java Provinces through various stimuli to accelerate the implementation of digitalization so that there is no greater disparity in digital literacy.

Bali - Nusa Tenggara

Increasing the implementation of fiber optic to support the availability of high-capacity networks and the application of digitalization in the development of selected priority sectors and superior potential, especially in the tourism sector and creative economy, is the focus of the development of the Bali Nusa Tenggara Region.

The direction of development policy in the Bali-Nusa Tenggara Province region has quite high complexity, considering that the Bali Region is already quite strong in terms of infrastructure and economic structure while the Nusa Tenggara Region is still weak. However, the three regions have the same development focus on improving the quality of human resources and strengthening the tourism and creative economy sectors. Therefore, in supporting digitalization, the first ICT policy direction is to increase the provision of fiber optics to support the availability of high-capacity networks for all regions to remote areas and leading sectors in the Bali-Nusa Tenggara Island region.

Furthermore, strengthening the economy is also carried out by implementing digitalization in the development of selected priority sectors and superior potential which have been adapted for each region in the Bali-Nusa Tenggara region, especially in the tourism sector and the creative economy which is carried out by increasing the role of technology in production activities/processes and Other supporting activities include the use of supporting applications.

Encouragement of digital utilization is also carried out by increasing the capabilities of digital talents through inclusive digital education, digital leadership training, and improving ICT supporting facilities throughout the Bali-Nusa Tenggara Island region. Interventions to increase human resource capacity can be carried out by looking at the IMDI scores in each region which are then adjusted to regional potential. For example, the island of Bali, which is famous for its tourism, can be given interventions to increase digital human resource capacity at the intermediate and advanced levels, while it is hoped that this can improve the creative economy of the island of Bali. In contrast to East Nusa Tenggara, where the IMDI level is still low, basic level digital literacy can be accelerated, for example through the use of teaching and learning applications in educational institutions and access to technological devices and the internet quickly, cheaply, and safely.

Kalimantan

The development of the IKN (Indonesian Capital City) is the focus of future development policy for the Kalimantan region by considering the impact on the environment and sustainability, as well as supporting smart city

The development of the IKN (Indonesian Capital City) is the focus of future development policy for the Kalimantan region by considering the impact on the environment and sustainability, as well as supporting smart city development while continuing to encourage strategies for inter-regional connectivity, accelerating the development transformation process, and utilizing technological advances. In supporting these efforts, the direction of ICT policy will focus on increasing the provision of fiber optics to support the availability of high-capacity networks in all regions and remote areas, in addition to encouraging connectivity and the application of high technology.

Digitalization is also carried out in selected priority sectors and superior potential in the Kalimantan region by implementing smart ports to support more effective distribution connectivity, productivity, and efficiency with the surrounding islands, increasing digitalization of manufacturing by implementing smart manufacturing for work efficiency, and smart agriculture to see. The potential of most areas on the island of Kalimantan is the agricultural sector (plantations).

Increasing digital talent capabilities through inclusive digital education, especially empowering digital technology for community economic activity, which is currently still low. Digital leadership training and improving ICT supporting facilities throughout the Kalimantan region are directed at fulfilling the three main goals of IKN, namely a symbol of national identity, a sustainable city in the world, and as a driver of Indonesia's economy in the future, as well as the application of digitalization in the development of selected priority sectors and superior potential that has been adapted for each region on the island of Kalimantan with a strong approach to adequate information and cyber security, while still prioritizing environmental aspects.

Sulawesi

The development policy direction for the Sulawesi region will focus on resolving the problem of poverty, especially in the 3T area, inter-regional connectivity, strengthening health, and developing mineral-based industries.

The development policy direction for the Sulawesi region will focus on resolving the problem of poverty, especially in the 3T area, inter-regional connectivity, strengthening health, and developing mineral-based industries. In supporting this development, the direction of ICT policy will focus on developing and improving broadband networks that can provide fast, stable, and affordable internet access for all regions to remote areas, the application of digitalization in the development of selected priority sectors and superior potential that has been adapted for each region in Sulawesi Island region with a strong approach to adequate information and cyber security.

As well as supporting and accelerating the implementation of digitalization, policies are also directed at increasing the capabilities of digital talents through inclusive digital education and focusing on basic level digital literacy for economic empowerment and digital skills. Digital skills on the island of Sulawesi have a low IMDI score, namely skills and abilities in the field of IT work, which can be started with the adoption of technology in educational institutions with the use of teaching and learning applications, the use of telemedicine for health inclusivity, the use of e-commerce to encourage the local economy, up to the application of smart mining for mineral mining productivity. Apart from that, digital leadership training and improving ICT supporting facilities have also begun to be carried out throughout the Sulawesi Island region, especially in schools.

Maluku

The development policy direction for the Maluku region will focus on resolving the problem of poverty and strengthening health in the 3T region.

The development policy direction for the Maluku region will focus on resolving the problem of poverty and strengthening health in the 3T region because currently, the achievement of access to health and the economy in Maluku is the lowest among other islands, the problem of stunting and fulfilling nutrition is the main focus in Maluku. Inter-regional connectivity development policies are also needed to optimize the maritime sector. In supporting this development, the direction of ICT policy will focus on developing and improving broadband networks that can provide fast, stable, and affordable internet access for all regions to remote areas by utilizing satellite technology in non-terrestrial areas.

Improving digital talent capabilities specifically in the basic level digital literacy segment in an inclusive manner is carried out both through educational institutions and private/government initiatives to reach the wider community regarding the distribution and provision of digital literacy information, as well as conducting digital leadership training and improving ICT supporting facilities and access to device or application.

The implementation of digitalization can also be carried out to resolve challenging issues on this island, such as the creation of telemedicine to strengthen health to reach all regions, apart from that, digitalization can also be carried out to strengthen the economy by implementing a blue economy-based application to optimize the sustainable maritime sector.

Papua

The development policy direction for the Papua Region will focus on resolving the problem of poverty, especially in the 3T area, connectivity between regions, developing food production centers, strengthening health and equitable education.

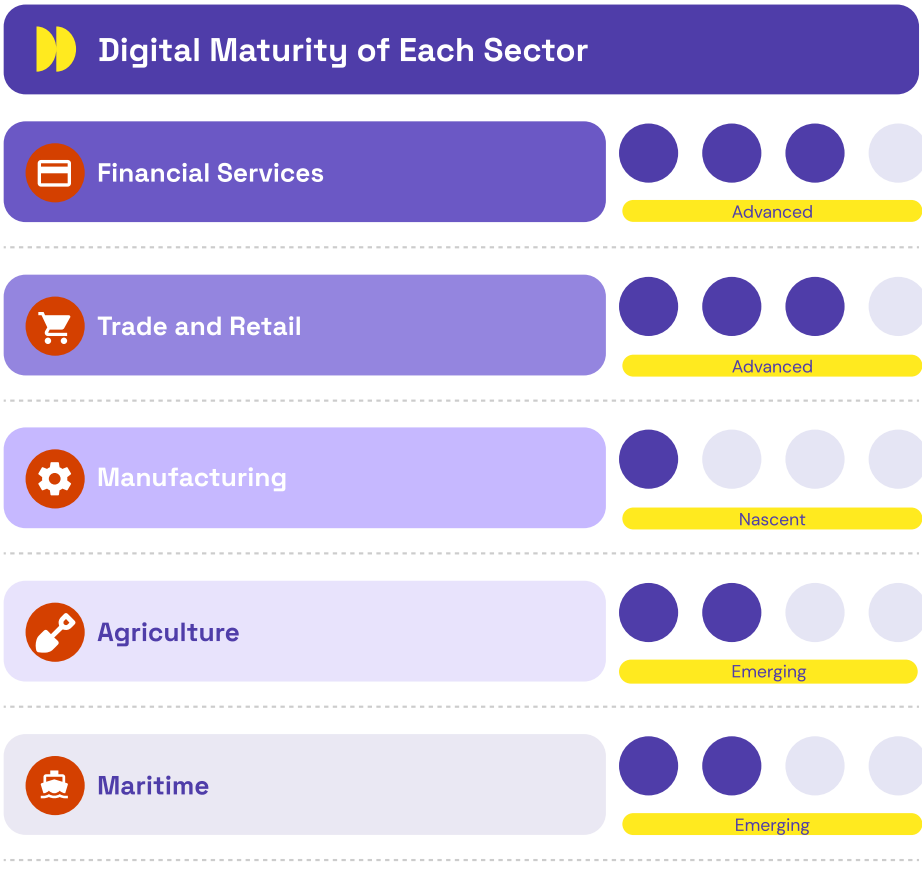
The development policy direction for the Papua Region will focus on resolving the problem of poverty, especially in the 3T area, connectivity between regions, developing food production centers, strengthening health and equitable education, especially to help fulfill traditional community food production and digital access in schools. In supporting this development, the ICT policy direction will focus on developing and improving broadband networks that can provide fast, stable, and affordable internet access for all regions to remote areas by utilizing satellite technology in non-terrestrial areas.

Increasing digital talent capabilities will focus on basic level digital literacy through inclusive digital education starting from the elementary school level, including by encouraging the use of applications to support teaching and learning activities which are expected to encourage increasingly proficient levels of digital literacy, conducting digital leadership training, and improving ICT supporting facilities throughout the Papua region as well as the application of digitalization in the development of priority sectors such as mining with smart mining, health with telemedicine, as well as efforts to increase the use of e-commerce applications to support local economic growth.

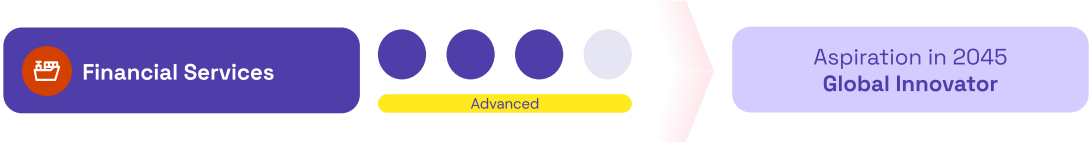


3.1.6. Direction of Sector Policy

Currently, Indonesia is still at the heavy consumer level. To increase the level of global innovation, Indonesia must focus on several strategic areas that are prioritized in future development planning. Five priority sectors were selected, namely financial services, trade and retail, manufacturing, agriculture, and maritime. Those chosen were based on Indonesia's potential now and in the next 20 years.



Financial Services



Digital maturity in financial services has reached an advanced level, to encourage aspirations by 2045 to become a global innovator. To realize this aspiration, support is needed from appropriate policies and regulations that lead to encouraging innovation in financial services through digitalization which is characterized by a smooth customer experience. So that it can increase financial accessibility and inclusion at all levels of society which can be done through:

- Formulation of a sandbox scheme to regulate and provide a way for innovation in the development of improving national financial services.
- Support financial service innovation with incumbents and non-incumbents with a combination of telecommunications, e-commerce, and transportation players who actively innovate in terms of financial services and also involve conventional banks and other non-bank financial services.
- Implementing strong and unified industry standards through the orchestration of industry standardization to encourage the creation of financial services that are inclusive, safe, and easy.

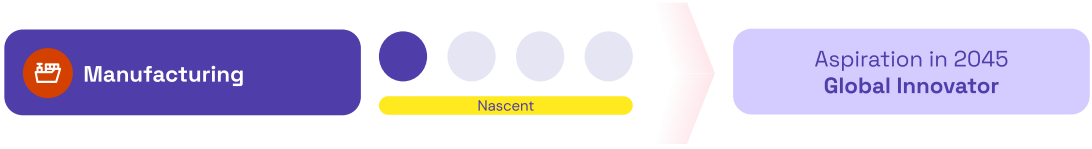
Trade and Retail



The digital maturity level in the trade and retail sector is currently reaching an advanced level towards the aspiration of being a global innovator by 2045. The target in the trade and retail sector is to increase MSME productivity and affordable costs, characterized by strong global sales and operations as well as widespread digital adoption. mass. To support the implementation of digitalization in the trade and retail sector, here are several strategies that the government can implement:

- Encourage large players to adopt highly digital solutions across the value chain, such as automated end-to-end processes using robotics & and AI, seamless online-to-offline (O2O) integration, and integrated self-checkout systems latest payment methods.
- The government needs to provide complete guidance regarding digitalization for MSMEs, including digital competency training, approved solutions, free technical consultations, and special guidance regarding e-commerce adoption. Thus, MSMEs can more easily adopt technology in their business, especially in integrating e-commerce into their business model.
- It should also be emphasized that logistics and supply chains act as the backbone of trade in the e-commerce industry. Therefore, digitalization is needed to support the growth of the e-commerce sector and ensure efficient and reliable delivery for MSME business players.
- The government must establish clear governance and supportive regulations, including providing incentives for private investment and demand acceleration initiatives, such as tax credits for digital adoption by large companies and subsidies for digital adoption by MSMEs.
- Establish a national logistics platform that is connected and integrated through the establishment of supply chain 4.0 to be able to produce comprehensive data analysis for trade and retail product data needs.

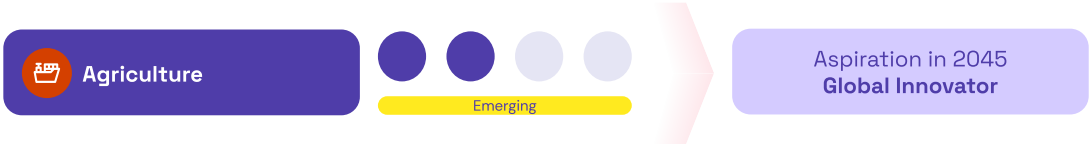
Manufacturing



Overall digital maturity in the national manufacturing sector is currently still at the nascent level towards technology prosumers in 2045. The target to be achieved is an advanced and competitive manufacturing sector characterized by a complex manufacturing portfolio, broad adoption of Industry 4.0 technology, and regulations. which is supportive of developing local capabilities. Several things the government can do with strategies such as the following:

- The manufacturing portfolio focuses on complex and technological manufacturing, by supporting the adoption of digital technology such as 4IR technology (Fourth Industrial Revolution, AI, robotics, etc.).
- Development of technology-based industrial areas by building special economic zones with adequate infrastructure, as well as funding assistance for both R&D development and incentives.
- Establishment of supportive regulations to encourage transfer of technology, development of local technological capabilities, and incentives for purchasing technological assets for various factories.

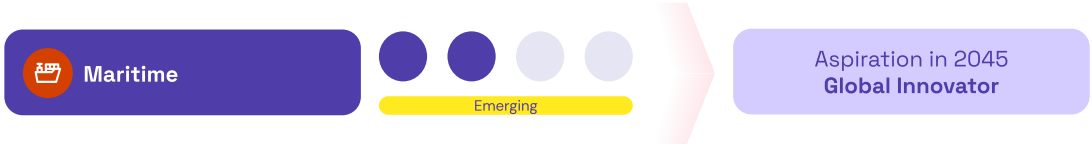
Agriculture



Digital maturity in the agricultural sector is still at an emerging level, in achieving aspirations in 2045 as technology consumers. The agricultural sector in Indonesia has a level of digital maturity that is still developing in achieving its aspirations as a technology prosumer. In the agricultural sector, the target to be achieved is sustainable agriculture through the application of technology. In supporting this target, regulations, and strategies that the government can implement in the agricultural sector include:

- Increasing the adoption of advanced technology in agricultural activities, such as the use of sensor technology, drones, and transgenic seeds.
- Establishment of an agricultural land database, aimed at improving the efficiency and quality of agricultural areas and providing advice on the types of plants suitable for planting on each plot.
- Increase and assist the adoption of optimizing agricultural products and selling agricultural products through the development of agricultural start-ups including funding assistance for start-up development.

Maritime



The maturity of the national maritime sector is currently at an emerging level to encourage aspirations in 2045 as a technology consumer. In the marine sector, the targets to be achieved are efficiency in the marine logistics sector and transparency in the fisheries sector. The blue economy approach needs to become a new thinking paradigm in determining maritime strategies. The blue economy emphasizes balancing the use of marine biota resources and environmental preservation, as well as increasing economic growth in the marine sector. Several strategies that can be implemented to strengthen the blue economy include:

- Use of advanced technology for fishing and aquaculture activities, such as the use of satellites, robotics, and sensors.
- Establishment of a platform to strengthen the foundation of the digital industry which is used for monitoring catches, sales (liaison between fishermen and distributors/ consumers), and national maps of fisheries cultivation.
- Implementation of port digitalization through comprehensive smart port development.

3.1.7. Economic Impact and Potential

GDP Component Improvement from Digital Indonesia Implementation	2045 Base		2045 Enhanced
Government Expenditure	**IDR 150 T** digital investment (0.1% of PDB)	*6-7x* ▶	**IDR 900—1.100 T** digital investment (0.9-1.2% of PDB)
Investment	**IDR 750 T** digital investment (0.8% of PDB)	*5-7x* ▶	**IDR 4.000—5.200 T** digital investment (4.2-5.5% of PDB)
Consumption	**IDR 10.500 T** digital investment (11% of PDB)	*1.2-1.5x* ▶	**IDR 13.500—15.700 T** digital market (14-16% of PDB)
Net Exports	**IDR -600 T** hi-tech net exports (-0.6% of PDB)	*n.a2* ▶	**IDR 7.000—8.774 T** hi-tech net exports (7.4-9.2% of PDB)
Employment	**137 Mio** job demands (43% of populasi)	*1.2-1.3x* ▶	**170—182 Mio** job demands (57% of populasi)

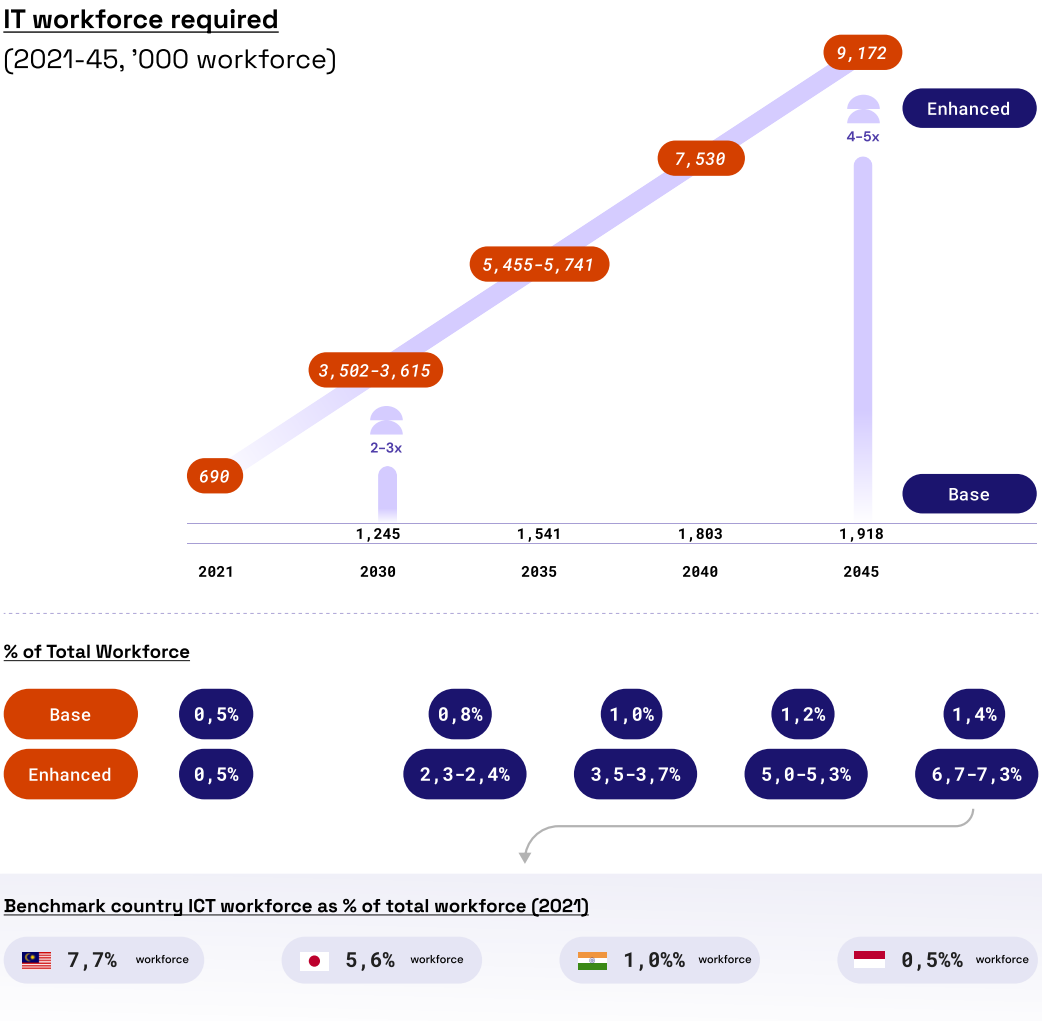


▲ **Figure 3.3** Projected Economic Impact from the Implementation of Indonesia Digital 2045

Digital transformation can create better access to markets, increase competitiveness, and open new jobs, which ultimately increases Indonesia's economic output (GDP). Implementing the Indonesia Digital 2045 strategy nationally will enable Indonesia to significantly increase the value of each GDP component, namely government spending, investment, consumption, net exports, and job creation. The projected economic impact due to the use of digital technology until 2045 is as follows:

- The government is expected to increase investment in the information and communications technology (ICT) sector by 6-7 times the base scenario or equivalent to IDR 900–1,100 trillion
- From the private side, investment is expected to increase 5-7x from the base scenario or equivalent to IDR 4,000 - 5,200 trillion
- To achieve maximum economic impact from digital transformation, industry and government in Indonesia need to increase investment in information and communications technology (ICT) by 5-7 times the base scenario or the equivalent of IDR 4,900–6,300 trillion
- Digital transformation will increase the use of technology among consumers. As a result, the size of the digital market for consumers in Indonesia is projected to increase by 20-50% or the equivalent of IDR 13,500–15,700 trillion
- Indonesia's exports of high technology goods will increase by IDR 7,000– 8,774 trillion, and
- From the perspective of resource needs, this economic achievement will require a workforce of 170-182 million.

Digital transformation has a significant positive impact on Indonesia's economic growth, especially in terms of increasing GDP. Economic growth will naturally require more labor. Likewise, with the acceleration of digital transformation, more digital workforce is needed, which can be reflected in the increase in the proportion of digital professional workers to the total workforce as a whole. Fulfilling the digital workforce will help maximize the resulting economic impact.



▲ **Figure 3.4** Projected ICT Sector Labor Demand

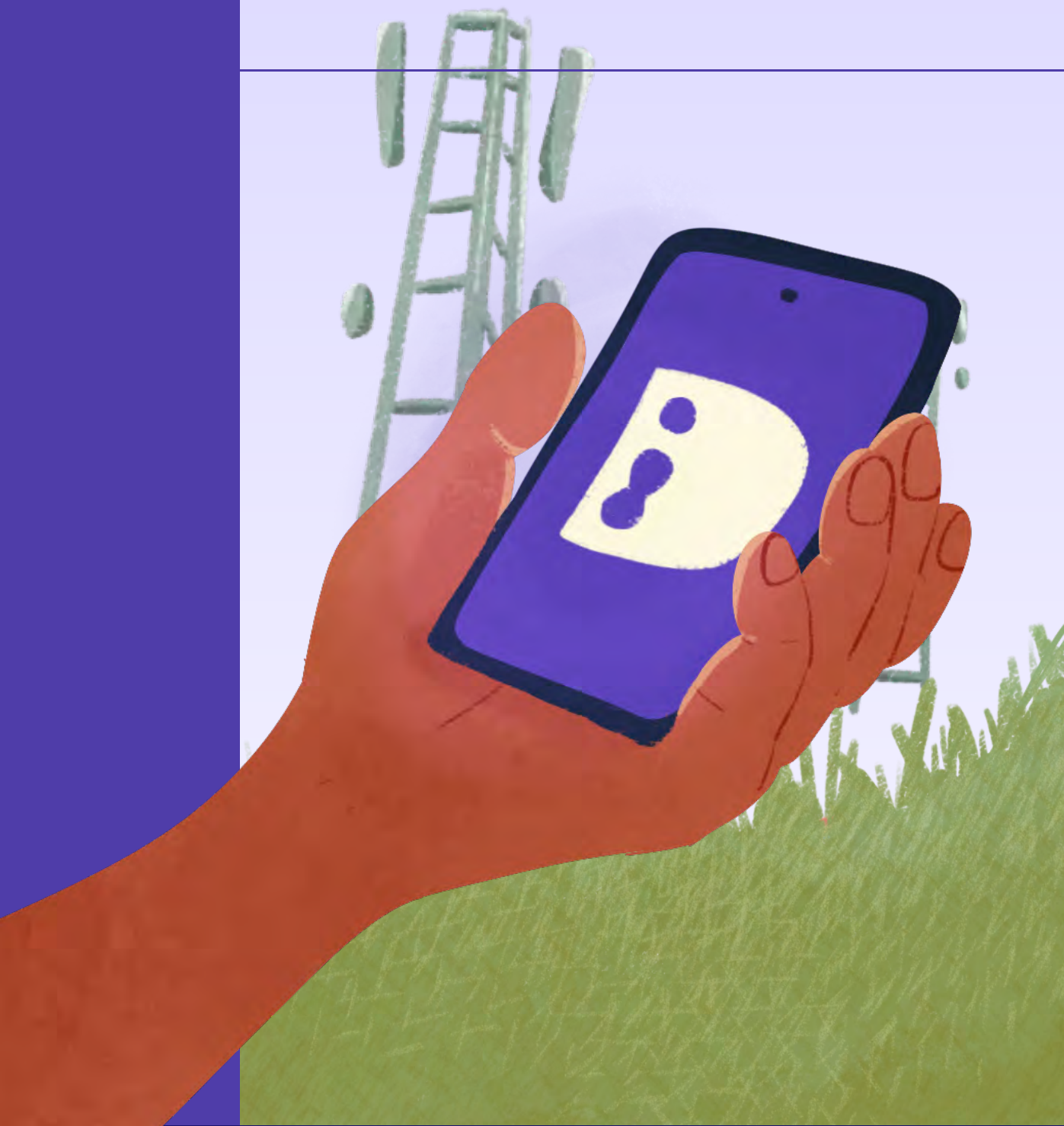
Projections until 2045 show that the **number of IT professionals in Indonesia will reach more than 9 million people, which is equivalent to around 7% of the total workforce as a whole.** This is very different from the current starting point, where there are only around 700 thousand IT professionals or only around 0.5% of the total workforce.

9 million

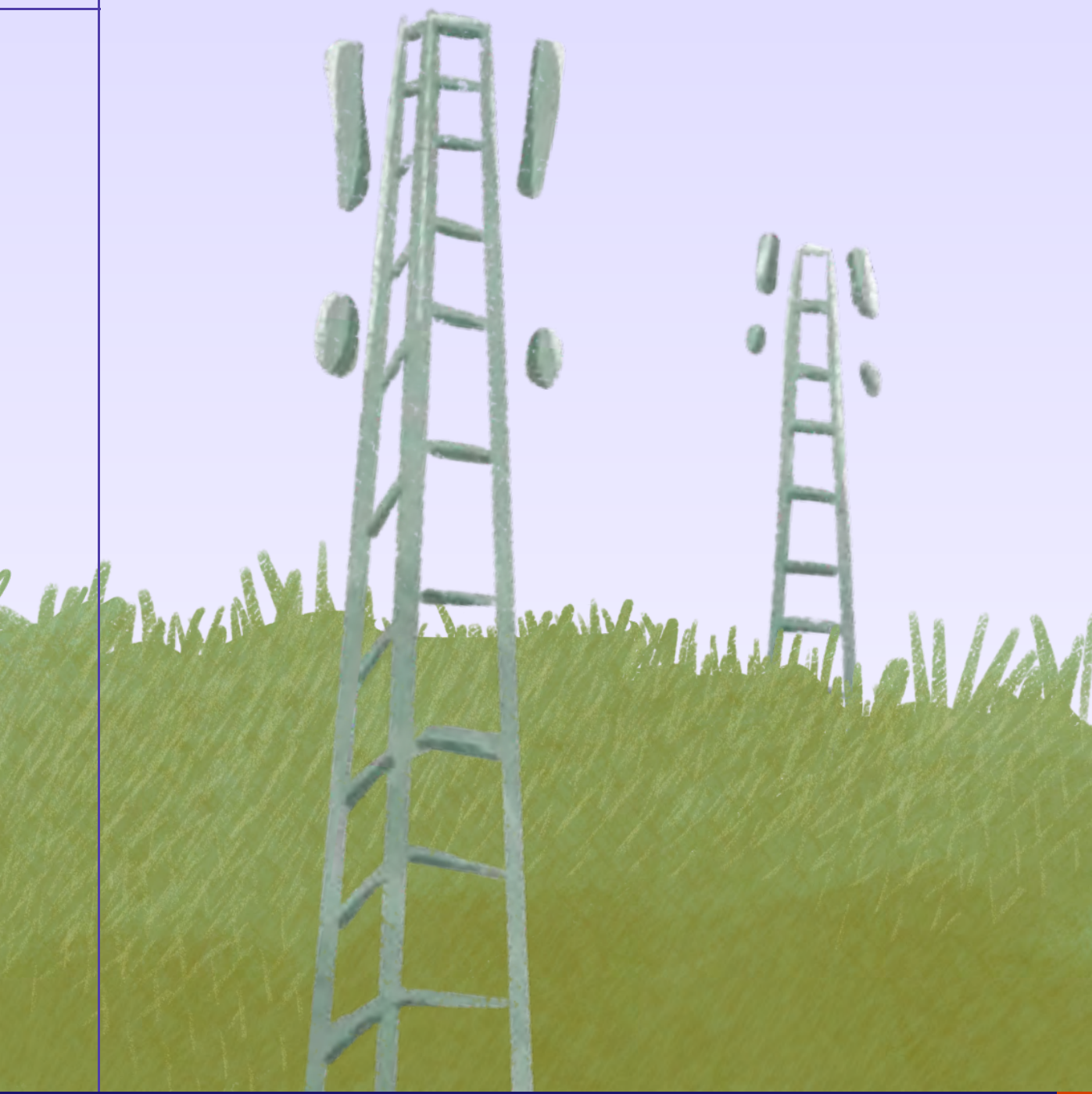
Number of IT professionals in Indonesia until 2045

= 7% of the total workforce as a whole.

04 Call-to-Action



To encourage the successful achievement of Digital Indonesia, steps are needed to operationalize VID2045. Strong institutions are needed to coordinate its implementation, and harmonious synergies between agencies and industry, especially in the planning and implementation of future programs and policies.



In the implementation and efforts to achieve Digital Indonesia Vision 2045, several things are proposed to be done as the next steps, namely:

- Each vision, mission, and strategic imperative listed will require implementation into strategic initiatives of various ministries and institutions. This initiative can be reduced to an action plan or roadmap that regulates more specifically according to the tasks and functions of each ministry and institution but still strives to be in line with the policy direction and targets aimed at Digital Indonesia 2045. Preparation of further strategic planning by the Ministry and institutions is expected to continue to prioritize collaboration between all stakeholders, including across ministries/institutions, as well as the active role of policy actors, the private sector, civil society organizations, and the academic community. It is hoped that the implementation of the planning can occur until it is included in the RPJMN, Strategic Plan, and annual Work Plan and Budget of the respective ministries and institutions.
- In encouraging the strengthening of digitalization at the national and regional levels in a clear and directed manner, it is necessary to measure digital transformation which includes aspects of infrastructure, government, economy, society, and digital ecosystem. This measurement can be done by looking at the extent to which digitalization has been absorbed, which can be seen in three stages, namely foundation, adoption, and acceleration.
- In supporting the smooth digital transformation going forward, the establishment of a legal foundation is an important step that needs to be taken. This legal foundation has a central role in regulating and directing all key aspects of digital transformation implementation, as well as ensuring the sustainability and implementation of digital initiatives in the future. The legal foundation that strengthens digital transformation can take the form of legal instruments in the form of formal draft regulations or be included in national strategic planning documents such as the National Long-Term Development Plan (RPJPN) and the National Medium-Term Development Plan (RPJMN). The legal foundation may include guidelines, objectives, strategies, and legal frameworks needed to coordinate the implementation of digital initiatives across government entities.

	Policy	Planning & Budget	Implementation
Digital Government	SPBE Committee, Satu Data	Bappenas and MoF	PAN-RB, Kominfo, BSSN, Bappenas
Digital Economy	CMEA, Kominfo, Ministry of Trade, Ministry of Industry, MSME, OJK, BI	Bappenas and MoF	Kominfo, MoT, MSME, SOE Ministry, MoI, OJK, BI
Digital Society	Kemenko Ekon, Kominfo, Kemenaker	Bappenas and MoF	Kominfo, OJK, BI, MoT
Digital Infrastructure	Kominfo	Bappenas and MoF	Kominfo, MoHA
Digital Security	Kominfo, BSSN	Bappenas and MoF	BSSN

▲ **Figure 4.1** Division of Roles for Digital Transformation Implementation

Source: World Bank Analysis

- To support the coordination of the action plans implementation that will be carried out by various Ministries and Institutions can run effectively, an institution is needed in the form of a ministry / institution / organization that functions to coordinate the implementation of National Digital Transformation. This institutional design should address some of the key issues that Indonesia currently faces in the implementation and management of national programs. The current structures mostly lack a permanent legal basis or are based on Presidential regulations/instructions or Ministerial regulations/ instructions, which can be changed or canceled. In addition, the division of roles and authorities between ministries is still not well coordinated. This hampers policy continuity, and makes structures, plans and implementation less effective.
- The institutional organization for implementing the National Digital Transformation aims to ensure that the digital transformation process in Indonesia runs in a directed and coordinated manner. To achieve these goals, the organization will coordinate central and local governments in implementing digital initiatives and developing the digital ecosystem. The organization will also monitor the synergy of digital transformation implementation, including the achievement of goals and KPIs.
- The National Digital Transformation Implementation Organization may also be proposed to be led by a national committee, the Coordinating Committee for Indonesia's National Digital Transformation / Komite Koordinasi Transformasi Digital Nasional Indonesia (KKTNDI) under the President. Supported by two Sub-Committees, the Industry and Society Digitalization Committee, and the Government Digitalization Committee. Each Sub-Committee has its own Implementation Office/PMO.
- This committee can be filled by a cross-section of bureaucrats and professionals representing the ecosystem and society.

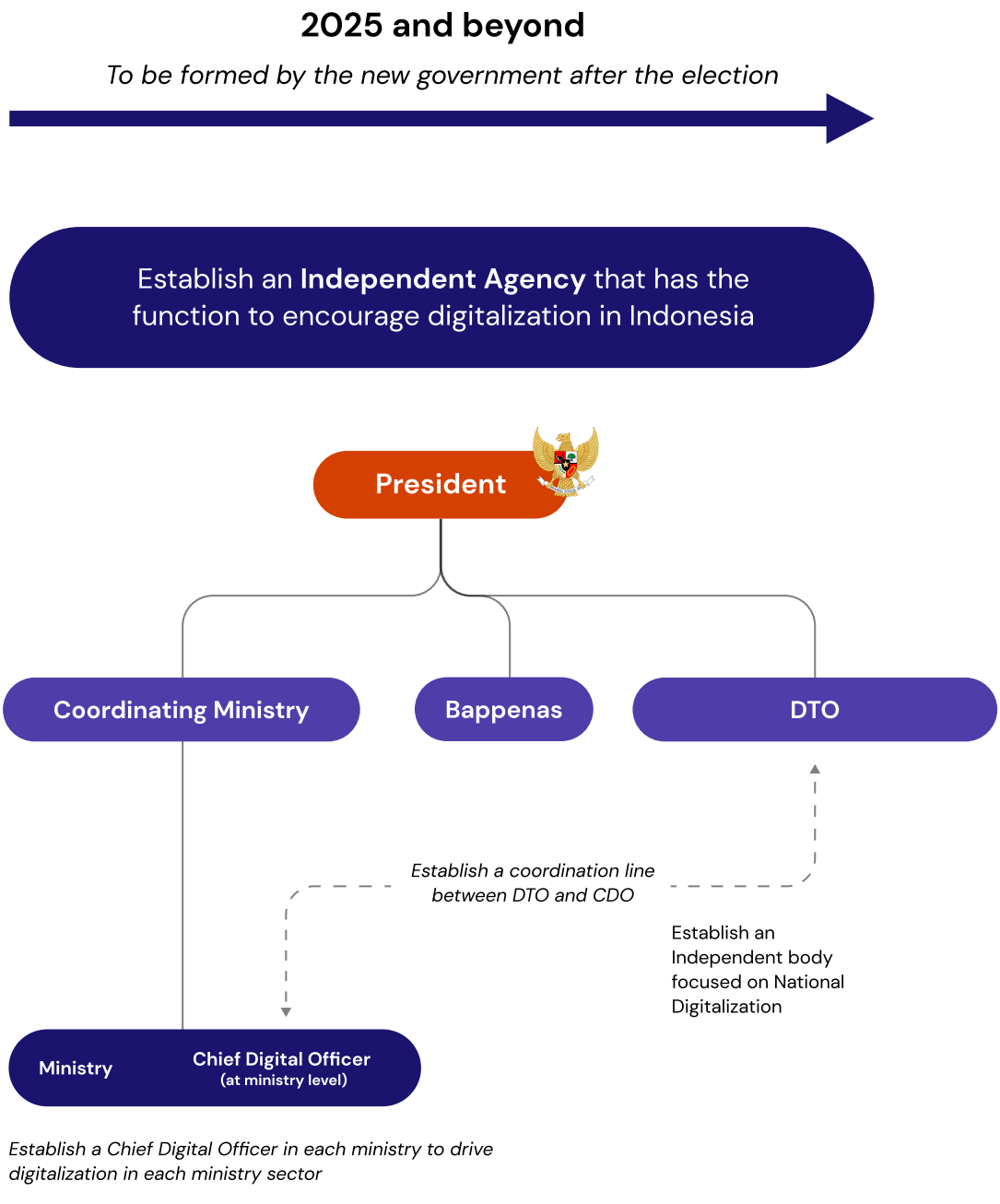


Figure 4.2 Digital Transformation Implementation Agency Transition Plan

Indonesia's New Digital Institution

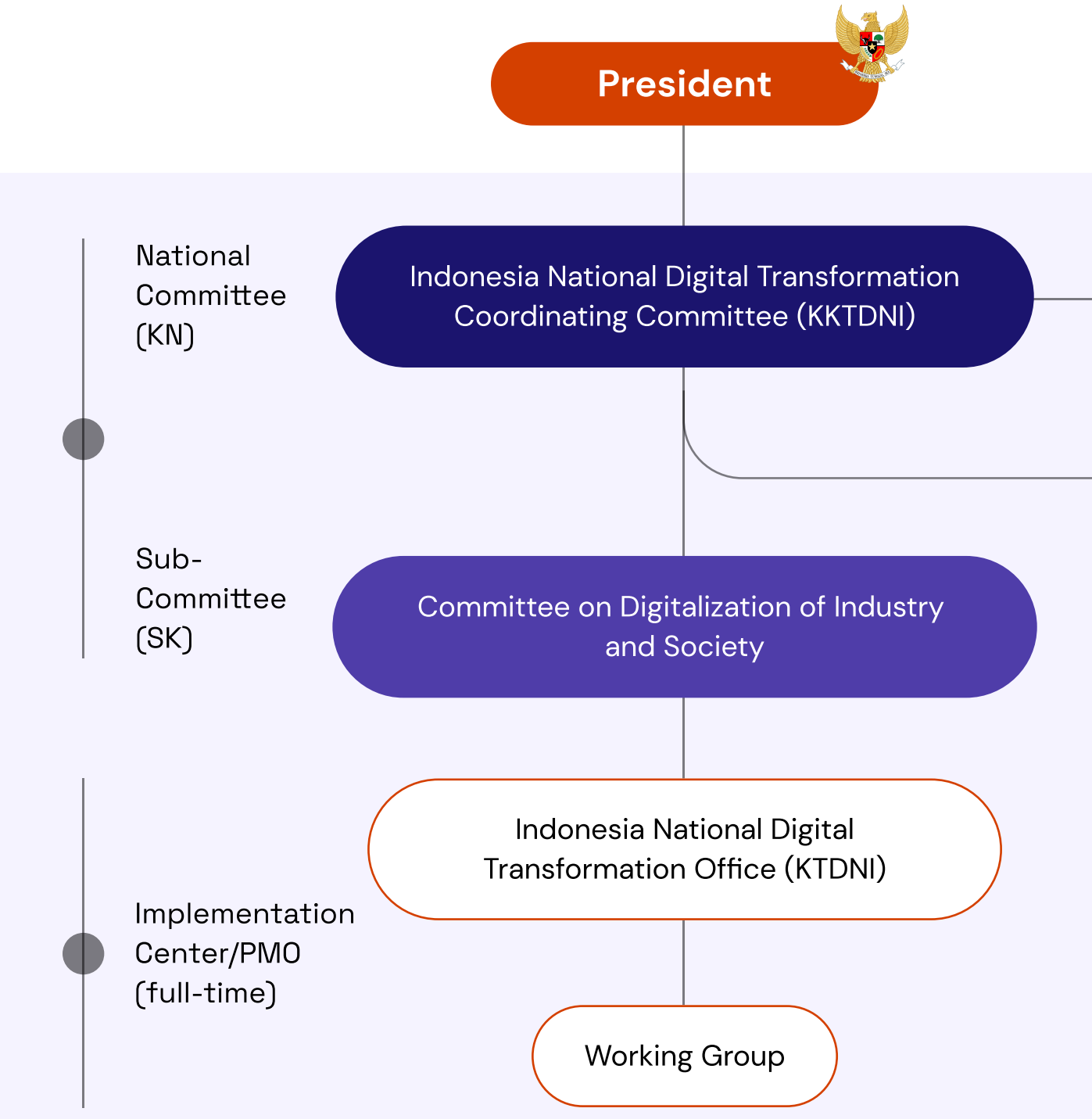


Figure 4.3 Design Concept of Digital Transformation Implementing Agency



Main Functions

- Direct & coordinate the overall digital transformation agenda
- Provide strategic direction & prioritization at the national

- Coordinate transformation for each vertical
- Provide strategic direction & prioritization at the vertical level

- Have permanent staff to carryout implementation based on KN and SK directives
- PMO daily initiatives (including tracking/ monitoring of regulations and policies)

KOMINFO

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