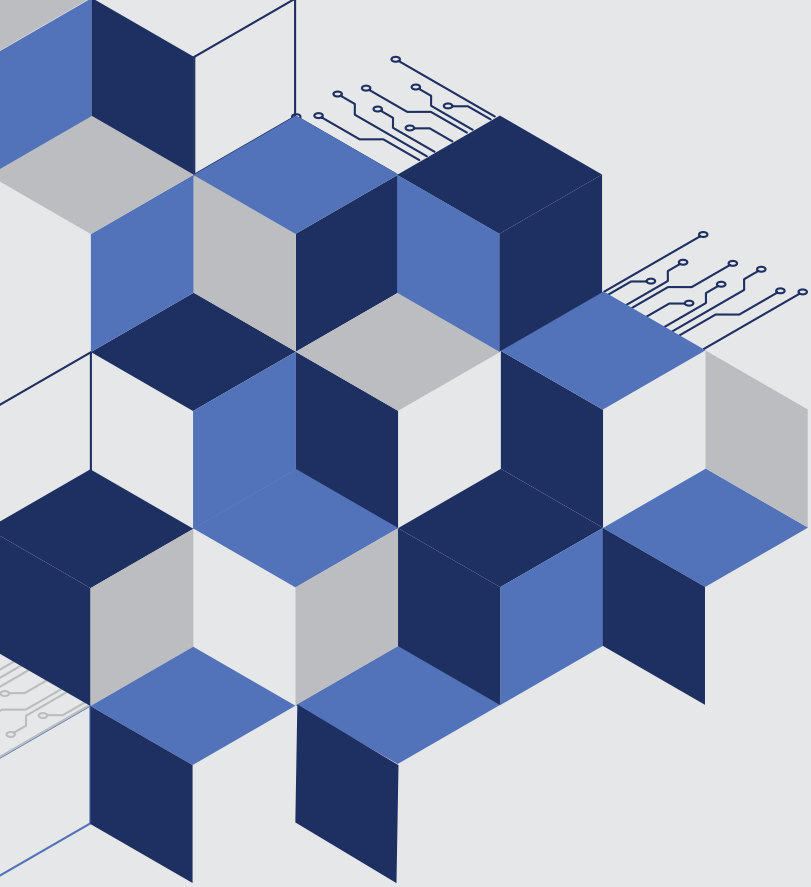

CHAPTER 2

POLICY DEVELOPMENT TO ACCELERATE DIGITAL TRANSFORMATION

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1. INDONESIA'S DIGITAL TRANSFORMATION AGENDA

Governments need to create a holistic view of digital transformation, including not only the public sector but also the key business sector. The country's digital transformation strategy equips the government with a vision of how to sustainably lead digital transformation and create impacts for all of society.

Indonesia has set up an important framework for its agenda for the Acceleration of National Digital Transformation. The government, through the Ministry of Communications and Informatics, is currently working on accelerating national digital transformation by outlining five priorities (Republic of Indonesia, Cabinet Secretariat, 2020). The agenda is depicted in Figure 2.1 (in Indonesian language).

The first priority is to accelerate the development of digital infrastructure, including adequate internet access for 12,548 villages/sub-districts and 150,000 public service points (including health services). The second is to perform radio spectrum re-farming for network efficiency and the development of 5G technology. Also is the start of work for the development of the National Data Center (PDN), which is necessary to implement the One Data Indonesia strategy. The third is to initiate comprehensive and sustainable human resource development in the digital sector, starting with talent and literacy in that area and progressing to leadership in the digital era . The fourth is to prepare a digital transformation roadmap in strategic sectors, such as the government sector, public services, social welfare support, education, health, trade, industry, and broadcasting. Fifth is the completion of primary legislation to support the digital ecosystem. These, in particular, are the Bill on Personal Data Protection (RUU PDP) and the Bill on Job Creation in the telecommunications/broadcasting sector, which are expected to speed up the digitalisation of national television.

Figure 2.1 Indonesia's Digital Transformation Acceleration Agenda

Source: Republic of Indonesia, Cabinet Secretariat (2020).

Related to the first agenda, the government should drive the implementation of 5G and Industry 4.0 infrastructure, which will enable digital transformation. Expected outcomes include new job creation from new industries as well as improved living standards and lifelong learning opportunities to build the knowledge and skills required for the new economy.

2. THE MAKING INDONESIA 4.0 PROGRAMME

The Making Indonesia 4.0 programme (Kementerian Perindustrian, 2018b), launched in April 2018, is designed to respond to the challenges of economic diversification and address trade imbalances. The initiative is Indonesia's effort to reduce reliance on extractive industries whilst growing high-value exports, which will enable the country to economically compete with the established 'Asian Tigers', such as Japan, the Republic of Korea, and Taiwan.

Through this programme, the Indonesian government also wants to raise Indonesia's competitiveness in the Industry 4.0 era by utilising the power of disruptive technologies to considerably boost national manufacturing performance and productivity. The programme is further expected to accelerate Indonesia's transition from a resource-based economy to a knowledge-based and innovation-driven economy.

2.1. INDONESIA IS COMMITTED TO BUILDING A STRONG MANUFACTURING INDUSTRY

The Making Indonesia 4.0 initiative offers great potential to significantly improve labour productivity and, in turn, enhance global competitiveness and increase the export market share. An increase in export volume will potentially create more jobs and, thus, strengthen national purchasing power.

2.1.1. To be in the top 10 of world economic powers based on gross domestic product

Indonesia plans to become one of the top 10 largest economic powers in the world based on the gross domestic product (GDP) by 2030. Indonesia's GDP growth is estimated to be 5.1% in 2022, even though the country's economy is still recovering. This is partly due to strong domestic consumption and investment. Going forward, Indonesia should explore its potential for net exports as an economic driver by improving productivity and implementing innovation in the industry.

2.1.2. Improving the productivity-to-cost ratio

Indonesia should focus on doubling output from the current basic labour cost. The resulting productivity and profitability would improve competitiveness in the global market. This conducive situation will encourage industry players to reinvest the profits they earn in productive assets, thus creating a useful economic cycle.

2.1.3. Boosting net exports to 10% of GDP

Indonesia was once one of the countries with the highest net exports in the Association of Southeast Asian Nations (ASEAN). However, this advantage seems to have decreased over the last period, with a decrease in the number of net exports as a percentage of GDP from 10% in 2000 to 1% in 2016. With the Making Indonesia 4.0 initiative, Indonesia wants to increase its share of the global export market, create more jobs, and reclaim the triumph of net exports by achieving net exports of 10% of GDP by 2030.

2.1.4. Budgeting 2% of GDP for research and development

4IR leverages advanced technologies, such as artificial intelligence (AI), the Internet of Things (IoT), advanced robotics, and 3D printing. Research and development, as well as design and innovation activities, are needed to improve the ability of the nation in mastering these technologies. Through Making Indonesia 4.0, Indonesia is committed to allocating 2% of GDP to encourage future technology adoption and development.

2.2. DEVELOPING FIVE MANUFACTURING SECTORS TO COMPETE IN THE REGIONAL MARKET

To increase exports and competitiveness on a global scale, the government plans to modernise five important industries under the Making Indonesia 4.0 initiative: electronics, food and beverage, textiles, automotive, and chemicals. These sectors were selected after an evaluation of the implementation feasibility criteria, which include the economic impact, size of GDP, trade volume, the potential impact on other industries, the size of the investment, and speed of market penetration.

The five industrial sectors contribute 60% to GDP and 65% to total exports (Kementerian Perindustrian, 2018a). Moreover, 60% of the industrial workforce is absorbed by these five sectors.

All of these industries benefit from the economies of scale of the domestic market, and hence, they can start their Industry 4.0 journey with a relatively solid foundation supported by established supply chains and solid trade. To review progress and address implementation challenges, the strategies for the focus of each of these sectors will be evaluated every 3–4 years.

2.2.1. Food and beverages: Building the food and beverage industrial powerhouse in ASEAN

In 2016, the food and beverage (F&B) sector contributed 29% of Indonesia's manufacturing GDP, 24% of manufacturing exports, and 33% of the manufacturing sector workforce (Hardjoeno, 2021). Compared to other countries, Indonesia's food and beverage sector is believed to have great growth potential because it is supported by abundant agricultural resources and large domestic demand.

Strategies for food and beverage 4.0 include (Kementerian Perindustrian, 2018b):

a. Encouraging productivity in the upstream sector – agriculture, livestock, and fisheries – by implementing and investing in advanced technologies, such as automated monitoring systems and autopilot drones.
b. As more than 80% of the workforce in this industry works in micro, small and medium-sized enterprises (MSMEs), including small-scale farmers and producers, Indonesia will assist MSMEs along the value chain to adopt technologies that can increase their production yields and market share.
c. Committed to investing in packaged food products to anticipate increased domestic demand in the near future.
d. Increasing exports by optimising access to agricultural resources and leveraging huge domestic economies of scale.

2.2.2. Textiles and clothing: Towards becoming a leading functional clothing manufacturer

In 2016, the textiles and clothing sector accounted for 7% of manufacturing GDP, 15% of manufacturing exports, and 20% of the manufacturing workforce (Kementerian Perindustrian, 2018b). Historically, this sector has been the second-largest contributor to manufacturing exports in Indonesia. The adoption of 4IR in this sector will enable Indonesia to maintain and increase its competitiveness in the global market share.

The textiles and clothing strategy 4.0 includes (Kementerian Perindustrian, 2018):

a. Improving capabilities in the upstream sector, focusing on the production of high-quality chemical fibres and clothing materials at lower costs.
b. Increasing manufacturing and labour productivity through the implementation of advanced technology, the optimisation of factory locations, and the upgrading of skills.
c. Along with economic growth and the shift in demand, from basic clothing to functional clothing, such as sportswear and surgical clothing, Indonesia must be able to build functional clothing production capabilities.
d. Increasing economies of scale to meet the growing demand for functional clothing, both in the domestic and export markets.

2.2.3. Automotive: Becoming a leading player in internal combustion engine vehicle and electric vehicle exports

Indonesia wants to become the largest auto producer in the ASEAN region, helped by a sizable domestic market and significant investment from top automakers. Currently the second-largest exporter of automobiles in the area, Indonesia still imports raw materials for manufacturing automobiles, including metals, chemicals, and other crucial electrical components.

As the penetration and demand for global electric vehicles (EV) are expected to increase sharply in the near future, Indonesia is focusing on supporting EV development.

The automotive 4.0 strategy includes (Kementerian Perindustrian, 2018b):

a. Increasing local production, in terms of volume.
b. Improving the production efficiency of raw materials and critical components by adopting new technologies and developing infrastructure, such as creating integrated industrial zones and more effective logistics systems.
c. Cooperate with global original equipment manufacturers (OEMs) to increase exports, with a focus on multi-purpose vehicles, low-cost vehicles that are environmentally friendly, and sport utility vehicles.
d. Building an ecosystem for the EV industry, starting with electric motorcycle manufacturing capabilities, then developing electric car capabilities based on the inevitable future adoption of EVs.

2.2.4. Chemical: Becoming a leading player in the biochemical industry

The development of the chemical industry is crucial since a variety of manufacturing industries, including the pharmaceutical, electronics, and automobile industries, heavily rely on its output. For the manufacturing sector to compete worldwide, the chemical industrial sector must be strengthened.

Indonesia is now importing basic chemicals but intends to develop its capacity to produce and export special chemicals. Indonesia can create a competitive advantage in the production of biochemical products by using its enormous agricultural resources as capital.

The chemical industry strategy 4.0 includes (Kementerian Perindustrian, 2018b):

a. Increasing the domestic petrochemical supply capacity to reduce dependence on imports.

b. Developing a more efficient and competitive chemical industry through the utilisation of oil and gas resources, as well as optimising the geographical location of industrial districts by constructing chemical manufacturing facilities near natural gas extraction sites.
c. Implementing Industry 4.0 technology and accelerating research and development activities to boost productivity, as well as developing next-generation chemical production capabilities, in particular, the production of biofuels and bioplastics

2.2.5. Electronics: Developing the capabilities of domestic industry players

The electronics market in Indonesia is still growing and is supported by both local manufactures from international suppliers and imported parts. Local production is still limited to simple assembly with little involvement in higher-level value-added processes.

The electronic strategy 4.0 is (Kementerian Perindustrian, 2018b):
a. Attract leading global players to invest through attractive incentive packages.
b. Improving capabilities in producing value-added electronic components.
c. Developing the capacity of the domestic workforce through intensive training.
d. Developing competent domestic leading industrial players to encourage further innovation and accelerate technology transfer.

2.3. PROMOTING 10 NATIONAL PRIORITIES

Indonesia's industry is frequently hampered by cross-sectoral issues. As a result, Making Indonesia 4.0 includes 10 cross-sectoral national projects to hasten the growth of Indonesia's manufacturing sector. Five of the initiatives (in bold) are the most relevant ones in this study. The 10 initiatives are as follows:
i. Improving the flow of goods and materials
ii. Redesign of industrial zones
iii. Accommodate sustainability standards
iv. Empowering MSMEs
v. Building a national digital infrastructure
vi. Attract foreign investment
vii. Improving the quality of human resources
viii. Development of an innovation ecosystem
ix. Incentives for technology investment
x. Harmonisation of rules and policies

To instigate the Roadmap for Making Indonesia 4.0, Indonesia is committed to speeding up the development of digital infrastructure, including high-speed internet and high-

throughput satellites. The government, through public and private partnership schemes, also plans to invest in digital technologies such as cloud computing, data centres, and security management. Indonesia, further, intends to align national digital standards to global norms and encourages collaboration between industry players to accelerate digital transformation

Human resources are an essential factor for achieving the successful implementation of the Making Indonesia 4.0 programme. Indonesia plans to update the educational curriculum to place greater emphasis on STEAM subjects (science, technology, engineering, the arts, and mathematics) and to better connect it with business demands. Further, Indonesia will work closely with industry players to improve the quality of vocational schools and the transfer of skills and knowledge and develop labour mobility programmes.

The innovation ecosystem is an important requirement for the success of Making Indonesia 4.0. A blueprint for a national innovation centre is to be developed; innovation centre piloting is to be prepared; and relevant policy and regulations, including the protection of intellectual property rights and fiscal incentives to accelerate cross-sector collaboration between private businesses and universities, are to be harmonised and optimised.

Incentives encourage innovation and technology adoption. In order to encourage enterprises to use Industry 4.0 technology, the Indonesian government has launched a scheme that includes subsidies, corporate tax breaks, and import tax exemptions. To give further assistance for investment and innovation efforts in the sector of high technology, Indonesia has also established a governmental investment fund.

Making Indonesia 4.0 is expected to promote real GDP growth of 1%–2% annually, increasing GDP growth from the baseline of 5% to 6%–7% in the period from 2018 to 2030, with the manufacturing sector accounting for 21%–26% of GDP in 2030 (Kementerian Perindustrian, 2018b). This GDP growth is to be driven by a significant increase in net exports, where Indonesia is expected to reach a net exports-to-GDP ratio of 5%–10% by 2030. Making Indonesia 4.0 also asserts that by 2030, higher export demand will result in the creation of 7 million–19 million jobs, both in the manufacturing and non-manufacturing sectors

With the above potential benefits, Indonesia is committed to implementing Making Indonesia 4.0 and making it a national agenda. In the first half of 2018, Indonesia began to compile a task force for five focus sectors (food and beverages, textiles and clothing, automotive, chemical, and electronics) and 10 cross-sector priorities. Each task force has clear duties and responsibilities. In the second half of 2018, this task force prepared the main plan and details of an action plan and began to carry out the initiatives and coordinate to ensure that the implementation of Making Indonesia 4.0 runs smoothly.

3. BUILDING NATIONAL DIGITAL INFRASTRUCTURE

Indonesia lacks a core digital infrastructure for the implementation of Making Indonesia 4.0. Amongst the core infrastructure required are fibre optic connections, the implementation of 5G technology, and data centre and cloud infrastructure.

Industry 4.0 is closely related to the provision of information and communication technology infrastructure, such as IoT, big data, cloud computing, AI, mobility, virtual and augmented reality, and sensor and automation systems. It will be a big challenge for Indonesia to adjust to the dynamics of Industry 4.0.

The success of Industry 4.0 – including the Making Indonesia 4.0 – will greatly depend on the success of the digital transformation process. To realise this, the recommended policies are proposed as follows:

1. The establishment of digital transformation enablement, especially the deployment of infrastructure and the utilisation of IoT, 5G, cloud computing, and big data technology must be accelerated and be on target.
   It should be accelerated in the sense that it is not left to the market mechanism, nor the supply-demand relationship, but there should be policies in the form of encouragement and convenience for the industry to deploy the infrastructure.
   Meanwhile, it should be on target in the sense that the deployment is prioritised in industrial areas or industrial centres – in particular, industrial areas where factories are included in the five priority sectors of Making Indonesia 4.0. More specifically, the deployment acceleration should be carried out at factories that already have the commitment and readiness to implement the Making Indonesia 4.0 programme.
2. Commitment to fulfilling international standards for digital infrastructure in industrial estates. For example, the quality of fixed fibre optic networks, 5G wireless networks, the availability of IoT services for smart factories, the availability of big data services, and cloud computing applications for business intelligence.

Furthermore, policy for digital infrastructure development in five priority industry sectors needs to be supported by the following propositions:

Proposition 1. The development of digital infrastructure that is needed is not the equal distribution of infrastructure and networks in all areas but the availability of adequate infrastructure and networks at factory points that are more ready to run Industry 4.0.

Proposition 2. The deployment of digital infrastructure and networks with a private network or industrial campus network approach to support smart factories is more feasible than deploying public networks to industrial areas in general with a smart city orientation.
Proposition 3. Based on the characteristics of IoT applications and services, the deployment of indoor digital infrastructure and networks to support smart factories or smart manufacturing needs to be prioritised over outdoor services
Proposition 4. The characteristics and types of digital infrastructure and networks required for each industry sector and smart factory will depend on the respective and applied 5G use cases.
Proposition 5. The selection of a 5G use case that is suitable for each sector and factory must refer to the readiness and peculiarities of each sector or factory to get optimal benefits from the implementation of Industry 4.0.

3.1. FIVE 5G IMPLEMENTATION READINESS ASPECTS IN INDONESIA

Until the end of 2020, many countries carried out 5G trials, including Indonesia. Some have launched 5G pilot projects. Pilot projects are very important for preparing for the arrival of 5G.

Countries that have traditionally been pioneers in research, development, and technology adoption are likely to continue to lead the '5G race', whilst countries that are traditionally technology buyers are also hoping for a share of the 5G economic pie. Overall, each country's 5G readiness depends on economic, operational, and social factors.

The readiness of a country to adopt technology can be viewed from five aspects. These aspects are infrastructure readiness, technological readiness, human capital readiness, regulatory and policy readiness, and market readiness. This ecosystem is illustrated in Figure 2.2.

In Indonesia, the deployment of the 4G network came into effect at the end of 2014. According to a report by Kementerian Komunikasi dan Informatika (2018), up to Q4 2018, 4G signal coverage had covered 95.84% of residential areas throughout Indonesia. By area, this was still slightly below 2G coverage, which reaches 98.06% of residential areas. However, 5G is supposed to be the key driver for a future manufacturing ecosystem called Industry 4.0 and, hence, Indonesia is expected to deploy 5G technology services selectively and carefully in order to avoid further deficits in the telecommunication operator business.

Figure 2.2 5G Adoption Readiness in Indonesia

Source: Author.

The migration of technology from 4G to 5G requires users to change their end terminals, known as customer premises equipment (CPE). The CPE must be universal to all services and be able to operate on a variety of wireless network platforms. It must also address the issue of device utilisation, in addition to the issue of selling price and performance of the battery.

The next challenge is how cellular operators can educate the market to increase the demand for 5G services, especially enhanced mobile broadband (eMBB), which targets general users. Likewise is the challenge of creating a new market for 5G or IoT, namely the massive machine-to-machine communication 5G service. This kind of service is thought to have much greater economic potential than eMBB and is expected to become a new source of revenue with a new business model. Whether the timing is right to start adopting 5G depends very much on the business considerations of each operator.

In terms of the CPE industry, Indonesia in general already has a complete supply chain, starting from the design house, system integrator, and manufacturer to the brand owner (Admaja, 2015). However, the immature ecosystem is causing high dependence on global markets. This is due to the limited number of manufacturers in Indonesia.

3.2 THE OMNIBUS LAW MAKES WAY FOR 5G IMPLEMENTATION

The operation of the 5G network connection requires an adequate radio frequency spectrum as a condition for achieving the expected quality. As a limited resource, the use of the radio frequency spectrum must be optimised in order to provide maximum benefit to people.

On 5 October 2020, parliament approved Law Number 11 of 2020 concerning Job Creation, i.e. RUU Cipta Kerja, commonly known as the 'Omnibus Law', which introduces key amendments to several sectors. The Omnibus Law is a legal breakthrough that amends more than 75 laws. As a follow-up, the central government is required to issue more than 30 government regulations and other implementing regulations.

The Omnibus Law covers the amendments to Law No. 36 of 1999 on Telecommunications ('Telecommunications Law') and Law No. 32 of 2002 on Broadcasting ('Broadcasting Law'), which impact the telecommunications and broadcasting sectors in Indonesia. Amongst others, the law regulates optimising the use of the radio frequency spectrum, including the use of 5G networks in Indonesia. This provision is contained in Article 71 number 5 of the Omnibus Law, which permits the shared use of a radio spectrum.

The sharing and transfer of the spectrum, infrastructure sharing, and the migration to digital technology broadcasting, also known as the analogue switch-off, are three of the important takeaways from the Omnibus Law for the telecommunications and broadcasting industries in Indonesia (Pardede et al., 2020). Telecom providers are permitted to exchange and transfer the spectrum under the Omnibus Law so long as they have first received authorisation from the government. Holders of frequency spectrum licences are allowed to work together in spectrum sharing to deploy innovative technologies. The owner of a frequency spectrum licence may also grant another telecommunications operator permission to use the spectrum.

The licence for spectrum sharing and transfer is required for legal certainty for the implementation of mergers and acquisitions (M&A) between telecommunications operatorsonce the M&A implementation is completed. Further, the government also needs to replace Government Regulation Number 52 of the year 2000 concerning Telecommunications Operations and Government Regulation Number 53 of the year 2000 concerning Use of Radio Frequency Spectrum and Satellite Orbit to eliminate rules that prohibit the transfer and sharing of the spectrum between telecommunications operators.

For telecom carriers, building passive infrastructure like towers and ducting has grown to be a considerable cost. The Omnibus Law mandates telecommunications companies to share passive infrastructure. The goal is to use the passive infrastructure as efficiently as possible. Small and medium-sized telecom providers might expect convenience and capital efficiency from this business strategy.

The Omnibus Law also specifies that local and national governments may collaborate on the development of passive infrastructure for shared usage by telecom carriers. It is also possible to share active infrastructure but only with mutual consent between the parties.

The Omnibus Law stipulates the migration of terrestrial television broadcasting from analogue technology to digital technology – known as the analogue switch-off – within two years of its enactment. This migration would result in spectrum efficiency. Part of the spectrum allocation currently used for analogue technology can be reallocated to other services, such as the future technology of 5G networks and high-speed wireless communications.

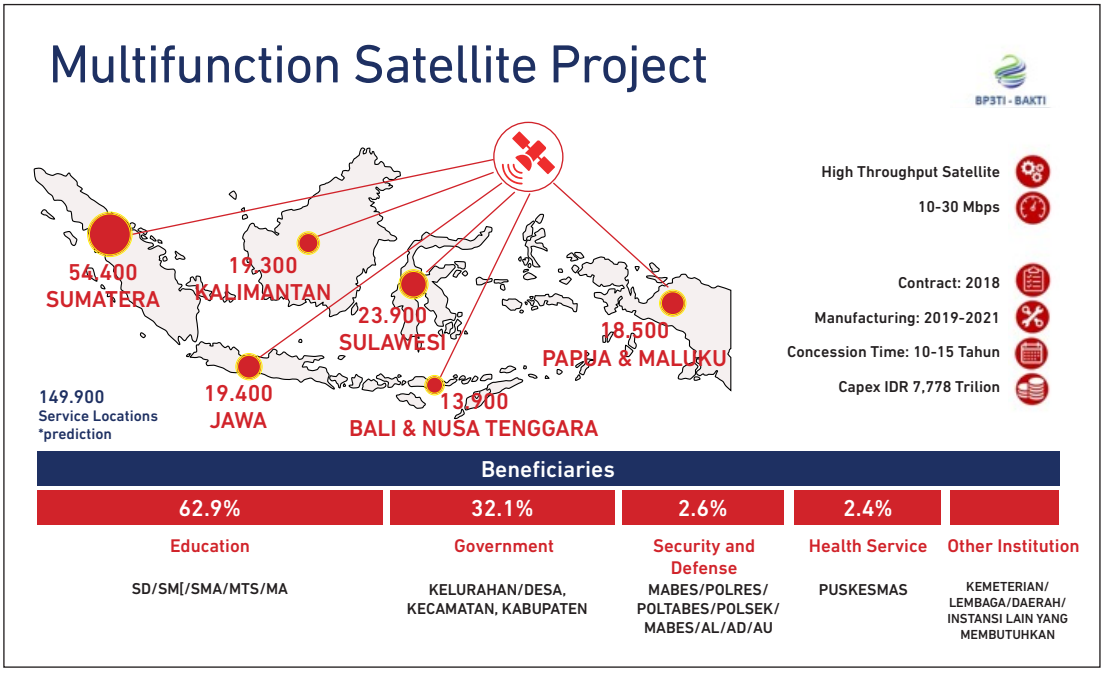
The provisions described above are amongst the government's efforts to prepare for the implementation of digital transformation in Indonesia, including the deployment of the 5G network.

3.3 SATRIA-1: HIGH THROUGHPUT SATELLITE FOR REMOTE PUBLIC SERVICE POINTS

The government has initiated the procurement of the SATRIA-1 multifunction satellite, which was carried out through a public-private partnership scheme. In March 2021, it had entered the stage of fulfilling project financing. The collaboration project with PT Satelit Nusantara Tiga uses the high throughput satellite technology produced by Thales Alenia Space from France, with a rocket launcher produced by Space-X from the United States, namely the Falcon 9-5500.

150,000 people in Indonesia will have access to the internet through the SATRIA-1 satellite from a total of 501,112 public service points that do not already have it. 3,700 health facilities, 93,900 schools and Islamic boarding schools, 47,900 village offices, and 4,500 other public service points make up the 150 000 public service points. An infographic of this programme is shown in Figure 2.3.

Figure 2.3 SATRIA-1 Project



Source: BAKTI (2020).

The total satellite transmission capacity is 150 gigabits per second. Each service point will get a capacity with a speed of 1 megabit per second. According to the agreed schedule, the SATRIA-1 satellite is expected to operate in Q3 2023.

4. A 5G USE CASE AND ITS RELEVANCE TO INDUSTRY 4.0

Indonesia is a technology follower in telecommunications. Whilst operators are still struggling to think of the most feasible business model for their business when deploying 4G, starting in 2014, 5G technology has begun to be adopted in the Republic of Korea and Japan since 2020.

With the massive growth in cellular data traffic, telecommunications operators will eventually run out of their bandwidth capacity, especially in urban areas. In addition to the need for an adequate spectrum, their networks will need to be upgraded using new technology — such as a new radio standard with higher spectrum efficiency, or

massive multiple-input multiple-output (MIMO) antennas that allow beam formation. These advantages are offered by 5G technology. To accommodate spectrum needs, frequencies occupied by older standards, such as 3G and 2G, will be re-farmed for 5G to meet traffic demands, whilst 4G/LTE-A will remain in the foreseeable future as a solid data layer with national coverage.

Many industry experts understand and think that new use cases will be the driving force behind the implementation of 5G technology. The most talked-about use cases right now are immersive media made feasible by augmented reality and mixed reality applications, autonomous driving made possible by real-time information, manufacturing moving towards Industry 4.0, and 5G fixed-wireless connectivity that is expanded to more houses.

Telecommunications operators should understand the use cases if they are to effectively invest in 5G. The considerations are twofold (Kearney, 2018). First, with their limited capital expense capabilities, they need to make the right trade-offs in launching the network in terms of coverage, capacity, and capability. Second, as more than just connectivity providers, they must develop the competencies needed to become better partners for customers and to turn the most promising use cases into reality.

Aside from 5G fixed wireless access, which can be implemented as soon as the frequency is available, on-site solutions for industrial campuses as well as the use of public spaces, such as stadiums for live event experiences and mobile mixed reality games, are the most likely use cases to be realised along with today's 4G. With Industry 4.0, factories will become increasingly automated and flexible, requiring a substantial and intensive flow of information on the factory floor.

Adding 5G coverage to industrial campus sites could enable the transformation to Factory 4.0, given the technology's throughput, latency, reliability, and mobility support capabilities. The potentially most relevant use cases for 5G here are remotely monitoring and controlling mobile and stationary equipment, product tracking, machine-to-machine closed-loop communication, and the use of augmented reality/mixed reality to support industrial design processes, as well as other manufacturing activities, such as maintenance and repairs.

Given the huge investment required in deploying 5G services and many options for first-place investment that need to be considered, mobile operators must engage deeply with their customer base – in particular, on the industry or factory side – and collectively

assess which use cases should be enabled, and by when. In order to optimise Factory 4.0, it is necessary to break down the major issues into specific use cases, analyse the requirements for effective digital infrastructure, assess the maturity of other necessary technologies, and establish a shared road map.

This way, telecommunications operators can be sure that their investment will pay off – either through connectivity fees or other business models. The same is true for industry players as they need to accept that many capacities, such as frequency, construction, and investment funds, are limited. They need to be highly selective about what to do first.

To illustrate the requirements along the supply chain and manufacturing network of the future generation of linked factories in manufacturing, five sets of use cases have been presented (5G-PPP, 2015). The factories of the future will not exist in isolation as closed systems but rather as a crucial component of a bigger value chain and ecosystem.

Table 2.1 depicts five use case families, each illustrated for a specific targeted application and representative scenario whilst highlighting the expected impacts on manufacturing as well.

Table 2.1 Factory Use Cases and the Expected Impacts (5GPP, 2015)

	APPLICATION	Representative SCENARIO	Expected IMPACT
Use Case Family 1	Time-critical process optimisation inside factory	Real-time closed loop communication between machines to increase efficiency and flexibility	Increased efficiency; Increased worker satisfaction; Increased safety/ security
		3D augmented reality applications for training and maintenance	
		3D video-driven interaction between collaborative robots and humans	
Use Case Family 2	Non time-critical in-factory communication	Identification/tracing of objects/goods inside the factory	Increased efficiency; Increased flexibility; Minimised stock levels; Increased eco-sustainability (e.g., emissions, noise)
		Non-real-time sensor data capturing for process optimisation	
		Data capturing for design, simulation and forecasting of new products and production processes	
Use Case Family 3	Remote control	3D augmented reality applications for training and maintenance	Increased product/ process quality
		3D video-driven interation between collaborative robots and humans	

	APPLICATION	Representative SCENARIO	Expected IMPACT
Use Case Family 4	Intra-/inter-Enterprise Communications	Identification/Tracking of goods in the end-to-end value chain	Increased efficiency (cost, time)
		Reliable and secure interconnection of premises (intra-/inter-enterprises)	
		Exchanging data for simulation/design purposes	
Bangkok	Thailand	Connecting goods during product lifetime to monitor product characteristics, sense its surrounding context, and offering new data-driven service	Increasing Sales (i.e., new products, services); Improved product/ process design

Source: 5G-PPP (2015).

5. NURTURING DIGITAL TALENTS

The modernisation of training and educational curricula is needed to produce highly competitive talent in the Industry 4.0 era. Such a programme is important for preventing job losses caused by technological advancement.

The availability of sufficient digital talent will be an important factor for economic growth in the future. A successful digital culture is reflected in the attitudes, values, and behaviours that adapt and are in line with the digital transformation agenda. It is at that time that the government should plan its vision for Indonesia 5.0 It draws inspiration from Japan's Society 5.0, one of whose objectives is to deploy Industry 4.0 uniformly throughout society so that everyone can benefit from it rather than just a select few. Upgrading talent skills is critical for preventing the replacement of human labour with machines. Humans are still required to maximise the advantages of Industry 4.0 technology despite the efficiency it offers. Whilst robots and machines handle tedious and repetitive jobs, humans must undertake higher-value tasks. Employees must therefore urgently develop their digital abilities if they want to remain competitive and relevant in the digital era.

The Ministry of Communication and Information Technology (Kominfo) provides the Digital Talent Scholarship (DTS) programme every year. The DTS aims to address the digital competency gap in Indonesia. Scholarship recipients acquire skills through digital training, including data analytics, AI, cloud computing, and cybersecurity.

A lack of digital skills, particularly in the technology sector, is a problem in Indonesia. According to the World Bank (World Bank, 2018), between 2015 and 2030, Indonesia will have a shortage of 9 million trained and semi-skilled personnel in the digital economy. This is a reason for the digital talent scholarship programme. Around 600,000 workers are required in the digital sector annually to meet the demand for skilled workers.

To carry out the training, the ministry has teamed up with more than 90 universities and polytechnics, regional start-ups, and international technological giants like Cisco, Google, and Microsoft. The training is designed for fresh graduates, teachers, and entrepreneurs. In addition to hard skills, the participants of the scholarship also obtain soft-skill training, such as in critical thinking, creativity, and communication. The first DTS programme in 2018 was attended by 1,000 participants and this increased to 25,000 recipients in 2019. This is illustrated in Figure 2.3.

Figure 2.3 Digital Talent Scholarship

DIGITAL TALENT SCHOLARSHIP 2018	DIGITAL TALENT SCHOLARSHIP 2019
Recipients • **1.000**	Recipients • **25,000**
Locations • **5** State Universities	Locations • **30** State and Private Universities • **23** Polytechnics
Training Topics • **5** Topics	Training Topics • **22** Topics
Certified Partners • **1** Partner	Certified Partners • **4** Mitra
	Academy • **4** Academy

Source: Kementrian Komunikasi dan Informatika (2019).

The ministry has also organised online academies to train people in advanced skills, such as data analysis, digital marketing, and programming. The programme is targeted at training 50,000 participants this year. So far, 43,500 people have participated.

The Digital Talent Scholarship consists of several academy programmes. Those programmes are the Fresh Graduate Academy, Vocational School Graduate Academy, Professional Academy, Thematic Academy, Government Transformation Academy, and Digital Entrepreneurship Academy.

The Fresh Graduate Academy Digital Talent Scholarship programme is a training program designed to improve competence in the ICT field. It aims to prepare graduates who have not or are not currently working to have professional competence, in line with the development of science and technology in the era of Industrial Revolution 4.0. They are expected to be able to compete in both domestic and foreign industries.

The Vocational School Graduate Academy programme is a national competency-based training and certification programme aimed at vocational school alumni and Diploma 3 and Diploma 4 graduates who have not worked. The programme consists of technical training and certification conducted both online and offline.

The Thematic Academy programme aims to create a skilled workforce in the field of ICT so that it can increase the productivity and competitiveness of the nation in the era of Industry 4.0. In its implementation, the Ministry of Communication and Informatics involves several related parties ranging from academia and industry to the community.

The Professional Academy programme provides online training for working people to create a more adaptive and productive Indonesian workforce. It also aims to improve the competitiveness of human resources in the ICT field. Professional Academy participants learn autonomously online. Participants also set study times independently according to the specified time.

6. TECHNOLOGY POLICY RECOMMENDATIONS

Recommendations that can be proposed from the discussion of this study are as follows.

6.1. DEPLOYMENT OF 5G INFRASTRUCTURE BASED ON OPERATOR BUSINESS PLANS AND DRIVEN BY THE READINESS OF PRIORITY INDUSTRY SECTORS

Telecommunications operators started the migration from 3G to 4G technology in 2015. Operators have not yet been able to get a return on their investments for 4G technology. Therefore, the implementation of 5G is highly dependent on the readiness of telecommunications operators in terms of their business calculations.

The deployment of 5G will be driven by the needs of the industrial sector. In this case, the five priority industrial sectors have been set out by the Making Indonesia 4.0 programme. The 5G network can be used as an overlay of the 4G network, which already covers 70% of residential areas in Indonesia. This means that 5G and 4G can co-exist and complement each other. The deployment of 5G can be started in areas where the priority industrial sectors are located.

6. 2. JOINT WORKING PLAN OF THE PROPOSED PALAPA RING NEXT LEVEL PROGRAMME

Policy synergy is needed between the Ministry of Industrial Affairs, with Making Indonesia 4.0, and the Ministry of National Development Planning, or Badan Perencanaan dan Pembangunan Nasional (Bappenas) in Bahasa, which are discussing the Indonesian Broadband Plan volume 2 with the Ministry of Communication and Information. This might be termed as the Indonesia Broadband Plan Next Level.

The key to the achievement of the Indonesian Broadband Plan, Presidential Regulation number 96 of 2014, in terms of deploying wireless broadband technology, is the conformity of the government's policy plans and the business plans of the telecommunications operators, particularly cellular telecommunications operators. A similar joint working plan needs to be reapplied for the establishment of similar policies and regulations in the present and future, including the proposed Palapa Ring Next Level programme.

The Palapa Ring programme has indeed succeeded in building a fibre optic backbone that connects all districts in Indonesia. However, there is still massive work to be done. This includes the construction of telecommunications networks within the district, such as a backhaul network, that connects all sub-districts in one district.

6.3. DEVELOPMENT OF POLICY AND REGULATIONS FOR THE ACCELERATION OF THE IMPLEMENTATION OF THE IOT IN INDONESIA

There are four main issues relating to IoT adoption in Indonesia. These are spectrum readiness, device standards, the level of local components (abbreviated as TKDN in Bahasa), and data security and privacy protection.

Regulations related to the above issues need to be framed carefully, taking into account the regulations of other countries as benchmark models, and the state of implementation of global IoT which is also still developing. With the careful handling of these four issues, it is hoped that the industry in Indonesia can innovate more progressively in the foreseeable future.

In general, there is no general standard regarding the use of IoT frequencies in the world that can be used as a reference. Globally, each of the major IoT players uses different frequency standards. Thus, the standard that is widely used is the standard of the dominant device maker, and in the end, this is also followed by other manufacturers. It is considered the de-facto standard set by a particular industry that dominates the market and users.

Currently, there are no globally referenced spectrums for IoT frequencies in the world. Major IoT players use different frequency standards. Thus, de-facto, a standard set by a particular industry may dominate the market and users.

In Indonesia, IoT uses frequency options above 3.3 GHz or below 900 MHz. The frequency used within ASEAN countries can be set as a reference.

Another dilemma faced by the government is whether the frequency of IoT will be licensed or left unlicensed. Unlicensed frequencies are generally used for indoor devices. There are two parts to unlicensed frequencies, namely short-range frequencies and long-range frequencies. Short-range frequencies are commonly used for devices connected to Bluetooth, including household devices, home security, and factory automation needs.
An unlicensed frequency can be used as an enabler of innovation. However, a trial frequency can only be used for a limited time and may not be made commercial.

For device standardisation, there are two options for the government. First is adopting globally agreed standards and then conducting a post-marketing survey. The post-marketing survey is carried out to see the conformity of the certified device, which is still circulating in the market, concerning the technical requirements. The second is letting the market mechanism determine the standard of the device that best meets user expectations.

Like 4G phones in Indonesia, IoT devices should also meet the TKDN requirements. This policy is needed to prevent Indonesia from merely becoming a market for advanced technology. The government should anticipate the IoT wave by preparing regulations regarding TKDN.

IoT security standards are important to regulate. However, it is more advisable to refer to the standards developed by well-known world organisations or consortiums, such as the Global System for Mobile Communications Association, Embedded Microprocessor Benchmark Consortium, International Electrotechnical Commission, IoT Security Foundation, and the National Institute of Standards and Technology.

IoT security standard regulations are recommended to be service-layer based. Amongst the issues that need to be addressed are personal data protection, data security, data access management, data governance, interoperability, data transmission security, data encryption, network security, connectivity security, and security in IoT applications.

6.4. ANTICIPATING AI AND BIG DATA REGULATORY NEEDS

AI, big data analytics, and augmented and virtual reality are at the application layer of Industry 4.0. The regulations need to take into account relevant and important matters, including the issues described below.

A clear contract is needed on the protection of personal data and data privacy used by AI technology and its derivatives. The right for data owners that their data can only be used based on mutual consent must be guaranteed. Data owners have the right to prevent their data from being used for promotional and marketing purposes. There is also the threat of biased decisions caused by the algorithms, which might include discrimination and stereotyping.

7. CONCLUSION

Through the provision of broadband internet access, the readiness of adequate digital talent, and the application of cutting-edge technologies like fintech, blockchain, and AI, Indonesia's digital transformation targets digital accessibility, financial inclusion, productivity, and growth. The digital economy will make a substantial contribution to a sustainable and circular economy. All citizens will benefit from this in turn, regardless of their age, race, or social background.

We can create a better living environment with Industry 4.0 that includes more meaningful work, upskilled labour forces, better healthcare and education, as well as smarter and greener cities. The role of governments and all stakeholders is to introduce new technology, prepare competent human resources, and transform business processes as critical tools in Indonesia's digital economy.

Policy and regulations related to digital transformation need to be framed carefully, taking into account the regulations of other countries as benchmark models, and the state of social change which might follow these developments. More significantly, Indonesia should make sure that people come first in the process of digital transformation and that the technology serve the people rather than the other way around. A successful digital transformation could boost economic growth and business performance whilst making a significant contribution to the increasingly competitive global business ecosystem.

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