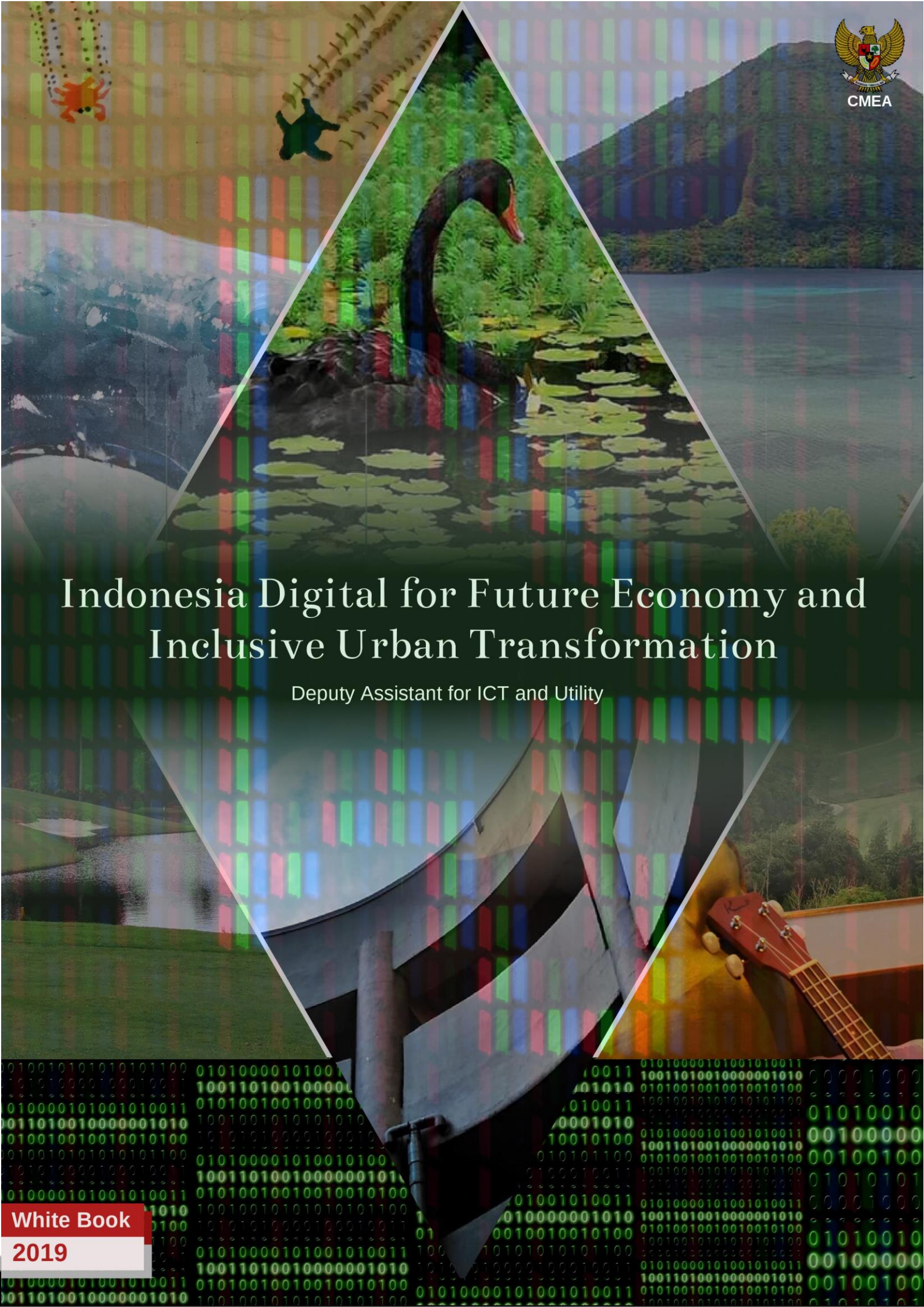

CMEA

Indonesia Digital for Future Economy and Inclusive Urban Transformation

Deputy Assistant for ICT and Utility

White Book

2019

INDONESIA DIGITAL FOR FUTURE ECONOMY AND INCLUSIVE URBAN TRANSFORMATION

INDONESIA DIGITAL FOR FUTURE ECONOMY AND INCLUSIVE URBAN TRANSFORMATION

Deputy Assistant for ICT and Utility
Deputy Ministry for Coordination of Infrastructure and Regional Development Acceleration

Indonesia Digital for Future Economy and Inclusive Urban Transformation

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To my late father and mother,
Muchlis Idris Datuak Mangkuto Rajo and Emma Heaven.

To my beloved family, Siti Mariah and our three children Eiko, Putty, and Haniyfa.

Also, to my superiors, Mr. Heru Handoko, Mr. PP Simatupang, Mr. Widjojo,
Mr. Imron Bulkin, Mr. Gumilang Hardjakoesoema, Mr. Suyono Dikun,
Mr. Bambang Susantono, Mr. Luky Eko Wuryanto and Mr. Wahyu Utomo,
from whom I have learnt a lot, both in working space and daily life.

REMARKS

Infrastructure plays a strategic role in national development, regardless of the development stage. As the economy progresses, the focus shifts to capacity and reliability improvement which boosts competitiveness and, eventually to attain inclusive and sustainable development.

The advancement of Information and Communication Technology (ICT) has had unprecedented impacts on many aspects of human life, particularly in infrastructure. We are witnessing the positive and disruptive effects of the Internet of Things (IoT) in transportation, logistics, tourism, public relations, and other sectors. In fact, the utilization of ICT is in line with the Five Main Directives of President Joko Widodo's Achievement of Vision 2045. The use of ICT can also increase productivity and efficiency of economic capacity, as well as improving the quality of human resources to enhance their competitiveness.

Nowadays, it is inevitable that all elements of society (including the Government) must also utilize technology for development activities that provide higher added value. Utilization of previous communication technology such as 2G, 3G, 4G, and the upcoming development of 5G will ease the connectivity among machines, systems, and people. For example, implementing an effective disaster early warning system which will prevent material losses and lives. Additionally, increasing technological support for logistics activities will accelerate the flow of goods and reduce dwelling time. Finally, the use of financial technology (fintech) will boost digital transactions while providing banking services for all.

I strongly support the drafting process and launch of this White Book "Indonesia Digital for Future Economy & Inclusive Urban Transformation". I hope it would provide alternative perspectives on the use and optimization of digitalization in Indonesia.

Finally, I express my gratitude to all relevant parties who have participated in preparing this white book. Hopefully, it would also provide new ways of thinking about the opportunities and challenges to our national development going forward.

Jakarta, December 2019

Wahyu Utomo
Deputy Minister for Coordination of Infrastructure and Regional Development Acceleration

FOREWORD

All Praises to Allah SWT, God The Almighty, for the gracious mercy and tremendous blessing that enables us to accomplish this white book entitled: Indonesia Digital for Economy and Inclusive Urban Transformation.

This white book is presented to raise awareness of the importance of Information and Communication Technology (ICT) to the Nation and the need for a consolidated and integrated National Digital Strategy Framework. Also to create a discussion around a National Digital Vision and Blueprint and how this Blueprint can be delivered.

I would like to address my appreciation to all government stakeholders, ICT Industry players, associations, contributors, friends, and colleagues who have shared the valuable input, to strengthen the contents more relevant to Indonesia Digital transformation strategy plan. Finally, a million thanks to everyone on my team who has worked so hard in finishing this book.

I do hope that this white book would also provide the most valuable Indonesia digital insights, lightning the digital vision for further development on establishing Indonesia's Future Economy and Inclusive Urban Transformation roadmap supporting the National Mid and Long-term Development Plan.

Jakarta, December 2019

Eddy Satriya
Deputy Assistant for ICT and Utility
Lead Author

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EXECUTIVE SUMMARY

Since the early 2000s, a new fast-growing phenomenon is changing our societies: digitalization. We have now entered a digital age, commonly referred to as the Fourth Industrial revolution. This revolution has the potential to transform every aspect of our daily lives, reshape the decision-making process, disrupt industries and create new industry business models, and generally bring a massive productivity boom. All of this revolution is driven by digital technologies that are better, cheaper e.g. cost of 1 gigabyte of hard drive storage capacity is now around $0.02 compared with more than $400,000 in 1980, faster, more scalable and easier to use than ever before. They converge and recombine through digital platforms to accelerate change across multiple sectors.

Digital technologies are an equalizer; distance will no longer be a factor as we all become highly connected, and limitations on small businesses will be lifted as cloud enables them to operate as if they were a large enterprise. In short, the Fourth Industry revolution is set to transform economies, create new social interactions, and change how our cities and civil society operates. Every industry will be impacted, some greater than others, and some nations will drive digitization while others may struggle.

GOVERNMENTS ARE FOCUSED ON THE DIGITAL ECONOMY

Global Connectivity Index report on how ICT innovation drives inclusive growth and sustainable development indicates that a" 1% increase in GDP can be achieved from a 20% increase in ICT investment and Enterprise Digitization will result in a 20% productivity gain by 2025". This may become one key reason why governments are focused on the Digital Economy.

Many Governments around the world have launched various forms of digital visions, strategies and plans to encourage digital innovation and investment. They are also creating digital affairs departments and developing an integrated policy framework for a whole-of-government approach.

Korea is a good example. In 1997 Korea was devastated by a financial crisis. Today Korea is recognized as the 7th most advanced digital economy and is one of the world's top 10 exporters of ICT goods. Korea has developed a solid foundation to enable digital transformation. The ICT sector is a resilient pillar of the country's economy and become a driver of innovation, boosting high shares of value-added and employment as a percentage of total value-added and total employment; high ICT business expenditure on research and development; and more ICT related patents as a percentage of total IP5 patent families than most other countries. The government undertook 2 main initiatives 1) Development of Digital Strategies and Master Plans for the adoption of digital technologies in public services, private sector, and most importantly for the growth in the overall IT industry and 2) Developed Institutional arranges including government restructuring a creation of digital committees to define policies and regulations as well building financial mechanisms.

Many Governments in the emerging markets are highlighting the pivotal role of ICT in their socio-economic development. The main objective of the national ICT policy is to balance the benefits and the risks of expanded ICT use in a way that is consistent with national development goals.

HOW NATIONS ARE MEASURING THEIR DIGITAL SUCCESS

Today there is no clear and agreed measurement for a nation's digitization. However, there are two indicators that are usually considered; ICT as a percentage of GDP and measure of a countries Digital take up.

ICT as a percentage of GDP

Economic development and growth entail a shift in the proportions of national output, away from the primary sector of agriculture, through the secondary and tertiary sectors of industry and services, towards the new information economy. The provision of ICTs and related services form a sizeable sector of many economies. Increasingly, developing countries are introducing high-level ICT strategies that aim to develop this sector of their own economies as well as using ICT as a tool in other sectors. Based on the International Monetary Fund (IMF) this includes;

- ICT equipment and Software,
- Telecommunications,
- Data Processing and Services,
- Online Platforms (e-Commerce),
- Platform Services (SaaS).

For Developed Markets such as the USA, ICT Sector is approximately 8.3% of national GDP. However, in some ASEAN countries, the ICT Business Process Outsourcing (BPO) Industry alone contributed approximately 7.7% in India and 8% in the Philippines against the 2016 GDP. In Indonesia, based on market estimates provided by IDC, we estimate the ICT Sector, excluding e-Commerce, is 2.62% of GDP.

Measuring a Countries Digital Take Up:

This is a measurement of a country's ICT Supply, Demand, and Experience and Potential. It is a measurement of Broadband Penetration and Takes Up, Data Center capability, Cloud Adoption, Big Data, and IoT Adoption, as well as having the foundation in place i.e. regulations, policies, investments, incentives, skills, etc. Indonesia is currently ranked 64 in Huawei's GCI (Global Connectivity Index) which is a measurement of digital take up as shown in Figure 1.

Figure 1 **Global Connectivity Index 2018**

FRONTRUNNERS		SCORE
1	United States	78
2	Singapore	75
3	Sweden	73
4	Switzerland	71
5	United Kingdom	70
6	Finland	68
7	Denmark	68
8	Netherlands	67
9	Norway	65
10	Japan	65
11	South Korea	64
12	Australia	64
13	Germany	63
14	Luxembourg	63
15	Ireland	62
16	New Zealand	62
17	Canada	62
18	Belgium	61
19	France	61
20	Austria	60

ADOPTERS		SCORE
21	Spain	55
22	Estonia	54
23	UAE	53
24	Lithuania	52
25	Portugal	52
26	Slovenia	51
27	China	51
28	Italy	50
29	Czech Republic	50
30	Hungary	49
31	Slovakia	49
32	Malaysia	48
33	Chile	48
34	Croatia	46
35	Greece	46
36	Russia	46
37	Kuwait	45
38	Poland	45
39	Romania	45

ADOPTERS		SCORE
40	Bahrain	45
41	Saudi Arabia	44
42	Belarus	44
43	Bulgaria	44
44	Brazil	43
45	Kazakhstan	42
46	Mexico	42
47	Oman	42
48	South Africa	42
49	Ukraine	41
50	Uruguay	41
51	Thailand	40
52	Turkey	39
53	Serbia	39
54	Colombia	39
55	Argentina	38
56	Peru	37
57	Philippines	35

STARTERS		SCORE
58	Jordan	34
59	Egypt	34
60	Lebanon	34
61	Vietnam	34
62	India	33
63	Venezuela	33
64	Indonesia	33
65	Morocco	33
66	Algeria	32
67	Ecuador	31
68	Ghana	29
69	Kenya	29
70	Nigeria	29
71	Botswana	29
72	Namibia	29
73	Paraguay	26
74	Tanzania	25
75	Uganda	25
76	Bolivia	25
77	Pakistan	25
78	Bangladesh	24
79	Ethiopia	23

Source: (Huawei, Global Connectivity Index, 2018)

Figure 2 Sustainable Development Goal

Source: (https://www.un.org/sustainabledevelopment/development-agenda/, n.d.)

ALL SECTORS ARE TRANSFORMING THROUGH DIGITAL TECHNOLOGIES

The United Nations recognizes that technology must be harnessed to deliver the Sustainable Development Goals adopted in 2015 by member states.

There are many examples of how Sustainable Development Goals can be achieved through digital technologies.

Improved delivery of social services such as health and education will be available for all through technologies such as telemedicine, distance, and e-learning. The unbanked population will have access to financial services through new FinTech approaches.

Industry automation

It will deliver productivity gains such as increased crop yields through access to agricultural information and the ability to monitor crops, soil, weather, etc. With new business models, startup companies will emerge creating new jobs, for example, Go-Jek, Traveloka, Bukalapak, and Tokopedia. The new internet-based commercial model, e-Commerce, will enable local companies to act globally and will drive the need for transportation and logistics operators to streamline their processes, integrate information and automate the tracking of goods and services. The tourism industry is already undergoing change, as tourists turn to the internet to research destinations, book and pay for their next vacation, requiring all tourism operators to have an online presence.

Smart, sustainable and safe city

Through digital technologies, cities will evolve to be smart, sustainable, and safe. Services will be integrated and improved for example; integration of transportation, traffic management, and parking will provide a seamless journey for citizens. Smart electricity grids will enable citizens to better manage their electricity usage. New smart sensors and CCTV devices will provide city management with information so they can better plan and develop the city of the future. Lastly, **governments will become transparent, open, easy-to-do business with and efficient** through digitization of government processes and by providing access to information and applications online.

Digitization through the use of ICT tools is no longer a "nice to have"; it is an integral part of every sector's future mode and a "must-have".

ACHIEVING INDONESIA'S DIGITAL TRANSFORMATION

In order to achieve digital transformation will require investment in the underlying ICT infrastructure, as well as the development of Indonesian ICT ecosystems, ICT related human capital development, and appropriate policies and regulations.

ICT Infrastructure Development

Common to all sectors is the need for access to Broadband Networks, Data Centers, Cloud Computing; and transformational platforms such as the Internet of Things (IoT), Big Data, and in the future Artificial Intelligence

Broadband Access and Connectivity to support Industries and Governments:

Today the Indonesia Broadband Plan (RPI) addresses telecommunications goals, policies, universal service access plans, etc. However, there continue to be gaps in public networks, particular to support broadband data and video services. Investment is required to service towns and villages that are financially unviable to the telecommunications operators. However, it is difficult to ascertain the true problem as any digital sector plans continue to be developed in silos making it very difficult to develop future broadband plans to address the whole of Indonesia and support all sectors as well as local cities, towns, and citizens.

Based on the ITU's "2017 ICT Development Index" Indonesia is currently ranked 111 out of 176 Countries and while Indonesia has been improving there continues to be a large gap between Indonesia and countries like Thailand and Malaysia.

Additionally, the government should consider building a virtual private network, utilizing telecommunications infrastructure, to support social services such as health and education, and connectivity for government departments [Satriya, Gates Addresses 3,000 People in Jakarta, 2008]. This would ensure all essential services are broadband-connected and would provide the government with a standard fee for broadband access, thereby ensuring government investment is managed appropriately. This is standard practice in developed countries and is being instituted in many developing nations.

Figure 3 ICT Development Index 2017

COUNTRY	2017 RANKING	2016 RANKING	CHANGE
Korea	2	1	▼ 1
Hong Kong	6	6	—
Japan	10	11	▲ 1
New Zealand	13	12	▼ 1
Australia	14	16	▲ 2
Singapore	18	20	▲ 2
Brunei	53	54	▲ 1
Malaysia	63	62	▼ 1
Thailand	78	79	▲ 1
China	80	83	▲ 3
Philippines	101	100	▼ 1
Vietnam	108	108	—
Indonesia	111	114	▲ 3
India	134	138	▲ 4

Source: (ITU, ICT Development Index 2018)

Data Centers in which to house Computing Equipment:

A BroadGroup study estimates that on average, 85%–90% of companies in Asian countries have their data center located in-house, Indonesia is currently 95% in-house. These types of data centers often have a high total cost of ownership, including power consumption. By 2020 it is estimated that 2.5% of global power will be attributed to data centers. Additionally, based on Government Regulation No.71/2019 requiring Indonesian-public related data to be contained in data centers within the country, will drive information technology growth and further increase energy requirements. With public data centers, costs can be minimized and more state of art energy-saving equipment is used e.g. power and air conditioning. However, to encourage businesses to use Public Colocation Data Centers, they will need to be offered competitive options and feel confident that their data center provider will deliver on their services promises. This mandates a need to encourage private sector investment in the data center colocation business

as well as a more regulated approach to data center standards and service claims e.g. if a data center operate claims they have a Tier III facility, a regulator needs to test to ensure this is, in fact, correct and they have met all the standards to achieve this accreditation.

The government should prioritize the development of a data center strategy and create a number of mega data centers to support the whole of government needs. This should reduce CAPEX and OPEX costs as well as provide a facility to support all future application and data needs.

Cloud Computing Infrastructure as a Service (IaaS) for affordable and secure Computing Capacity and Storage:

As sectors start to digitize, there will be a need for computing capacity and storage. The most secure and cost-effective approach is through cloud computing. Indonesia's Government needs to encourage the creation of the local cloud industry for Indonesian cloud companies as well as large international cloud providers locating in Indonesia.

Emerging markets continue to lag in the adoption of cloud-friendly policies, hindering their growth. Indonesia continues to update and reform laws and regulations in the information technology (IT) sector, but the result has not been positive for cloud computing with Indonesia falling points over the previous 12 months.

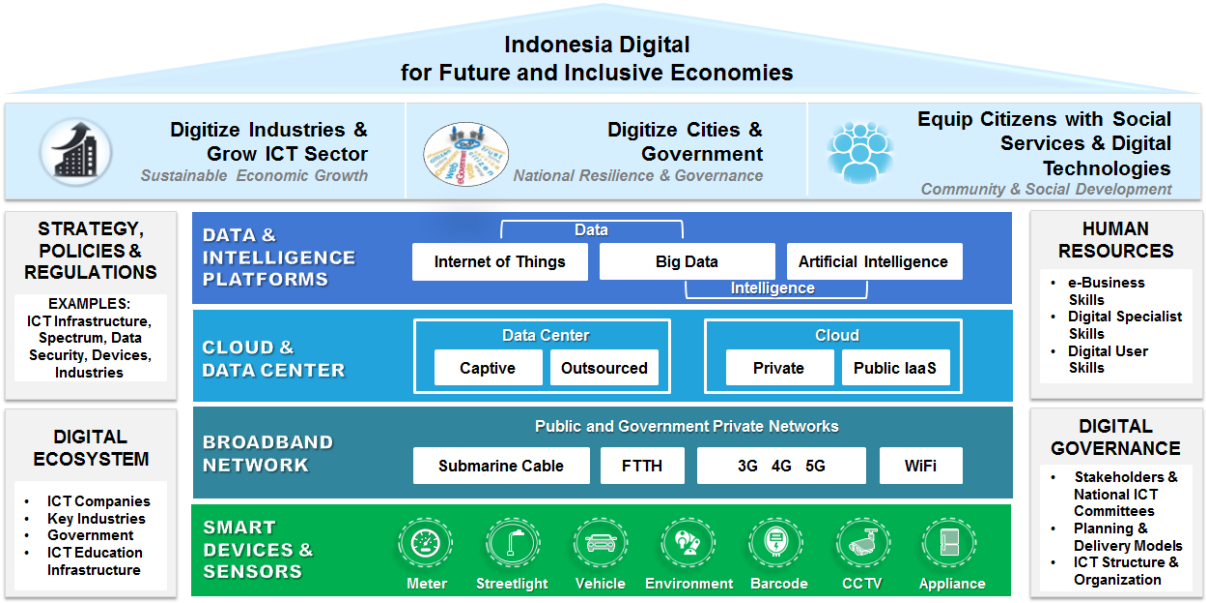
Figure 4 Cloud Readiness Index 2018

Rank, Economy	CRI#01 International Connectivity	CRI#02 Broadband Quality	CRI#03 Power Grid, Green Policy, and Sustainability	CRI#04 Data Centre Risk	CRI#05 Cybersecurity	CRI#06 Privacy	CRI#07 Government Regulatory Environment	CRI#08 Intellectual Property Protection	CRI#09 Business Sophistication	CRI#10 Freedom of Information	TOTAL CRI 2018 SCORE (/100)	Rank Change
#1 Singapore	7.0	9.5	6.0	4.6	9.3	9.0	9.0	8.9	8.5	4.9	76.6	+1
#2 Hong Kong	9.3	7.7	4.4	5.3	8.1	9.0	6.7	8.4	8.3	7.1	74.1	-1
#3 New Zealand	3.9	5.7	7.2	4.8	7.2	8.5	7.7	8.9	8.7	8.6	71.1	-
#4 Japan	3.5	6.5	5.3	4.4	7.9	9.0	7.7	8.3	7.6	7.1	67.1	+1
#5 Taiwan	6.5	6.5	4.5	4.2	8.1	7.0	7.1	7.4	8.0	7.6	66.9	+1
#6 Australia	3.5	5.2	4.1	4.3	8.2	9.0	7.1	8.3	8.0	8.4	66.3	-2
#7 South Korea	2.8	7.4	4.1	4.3	7.8	8.5	8.0	6.3	8.4	7.2	64.8	-
#8 Malaysia	2.5	5.5	4.0	4.1	8.9	7.5	7.9	7.6	7.8	5.3	61.0	-
#9 Philippines	2.5	4.8	4.5	3.9	5.9	8.5	5.7	5.9	5.9	5.9	53.6	-
#10 Thailand	2.7	6.9	2.2	3.8	6.8	4.5	5.4	5.0	7.7	5.5	50.6	-
#11 Indonesia	1.7	5.5	2.9	3.8	4.2	6.5	5.6	6.4	6.7	6.0	49.4	-
#12 India	1.1	4.7	1.5	3.4	6.8	6.0	5.9	6.3	6.1	5.7	47.4	-
#13 China	1.0	4.9	1.6	3.7	6.2	4.0	6.6	6.4	6.5	2.2	43.1	-
#14 Vietnam	3.6	5.3	2.1	3.9	2.5	3.5	5.7	5.1	6.8	2.6	41.0	-

Source: (Asia_Cloud_Computing_Association, 2018)

The government needs to define a Cloud Strategy and Standards for internal use of Cloud Computing for example; what government data and applications should be secured on a private cloud versus public cloud as well as standards around virtualization tools.

Figure 5 Key Aspects of a National Digital Blueprint



Source: (Huawei, 2018)

Common Platforms; Internet of Things IoT, Big Data and in the future Artificial Intelligence

There are literally thousands of applications that could use IoT. In Indonesia, the Internet of Things is increasingly in demand by many companies. Over the course of 2016, the Indonesia IOT Ecosystem started to emerge which included a number of small application developers and Telkomsel and Indosat entering the market. Indonesia Government should consider the development of IoT Policies and Regulations to support the further development of this market for example; regulations on sensor location, location sharing policy, and sensor network connection policy. Pilots and proof of concepts should be developed in conjunction with learning institutions and private enterprises to provide examples of the value of IoT and also to support much needed IoT skills development.

Big Data is used to store and analyze the vast amounts of information that is collected in the IoT Platform. Big data also enables machine learning, a driver of Artificial Intelligence (AI) and is widely used in Virtual (VR) and Augmented Reality (AR). Businesses, governments, and individuals are increasingly able to access unprecedented volumes of data that help inform real-time decision making and provide predictive outcomes by combining a wide range of information from different sources. In Indonesia Pulse Lab Jakarta (PLJ) is needed, a unique joint initiative of the United Nations and the Government of Indonesia, is working to support innovation in the use of big data and human-centered design for inclusive development in Indonesia. For Big Data, Indonesia should consider the formation of a data standard including data ownership so that information can be easily shared with agencies as well as enterprises. The government may need to consider acting as a largely trusted clearinghouse for some of the IoT sensor data.

Recommendation:

These common ICT infrastructure components and platforms need to be in place to enable sector digitization. The government, in collaboration with private enterprises, should develop a National Digital Blueprint for the further development of these common ICT components. This blueprint needs to take into consideration; Policies, Regulations, and Standards, as well as business, financial, and delivery models.

MAKING INDONESIA DIGITAL A NATIONAL PRIORITY

The role of ICT has evolved over the past decades from a supporting, back-office function to become a key enabler and driving force for governments, enterprises, and citizens. Hence, organizations are becoming increasingly dependent on ICT infrastructure, with many of them spending 4% to 7% of the total annual budget on ICT infrastructure investment.

For Indonesia to realize our nation's vision and goals and become a leader in the fourth industrial revolution we must learn to better harness the value from digital technologies and make this a top priority.

Today decisions on digital initiatives and investments are done individually by a specific sector. It is only through an effective governance structure can digital transformation be achieved. Digital governances' structures facilitate appropriate awareness of the strategic importance of ICT among key stakeholders and promote ICT as a strategic tool and enabler for enhancing a nation's effectiveness and efficiency. *To ensure success across complex environments, with multiple stakeholders, and various interests, strong ICT Governance, and Organization Structure are critical.* These key stakeholders need to set an Indonesia Digital Agenda.

The Digital Agenda lays out:

1. The National Digital Vision
2. National Development Priorities
3. Focus Sectors for ICT adoption
4. The Core ICT Enablers to create a Digital Nation
5. Digital Initiatives that support the Focus Sectors and Enablers

Figure 6 Key Aspects of a Digital Agenda

Source: (GSMA, 2018)

WHO SHOULD TAKE THE GOVERNANCE LEAD?

Current approaches to make National ICT and Digital Strategies (NDS) vary across countries. Information from 35 countries provides an overview of the responsibilities allocated for the development, coordination, implementation, and monitoring of NDSs.

The lead on strategy development is often taken by a ministry or body that is not dedicated to digital affairs. However, having a ministry or body that is dedicated to digital affairs is on the rise. Almost all countries engage multiple private stakeholders and public bodies to contribute input to developing their NDS.

Figure 7 Example OECD National Digital Strategy Governance Leads

	LEAD	CONTRIBUTE INPUT	COORDINATE	IMPLEMENT	MONITOR
Government e.g. Prime Minister, President, Ministerial Councils	4	0	5	1	6
Digital Affairs Ministry or body or Ministerial position	8	1	10	3	8
Ministry or body not dedicated to digital affairs	15	2	13	1	11
Several ministries, bodies or institutions	6	14	5	26	7
Multiple public and private stakeholders	1	17	0	3	0

Source: (OECD, Digital Economy Outlook, 2017)

CONCLUSIONS

The Government of Indonesia holds the potential of leveraging digital technologies to achieve national goals and transform into a Digital Indonesia. It is only through cross-sector collaboration and by having a strong government lead governance structure can this be achieved. We have made significant inroads over the past few years but now we need to raise the bar and make digital a national priority. If we do this we will achieve sector growth, and with that job creation and an improved standard of living for our citizens. Additionally, we should also see significant investments being made in the ICT industry in Indonesia by both local and international companies. There is no reason why Indonesia cannot be a leader in this new digital world.

SEVERAL KEY SUCCESS FACTORS ARE NECESSARY TO MAKE THIS A REALITY:

- Committed Stakeholders: Initially key government leaders, but further down the track this should include private sector
- Having "One Vision", agreed with Key Priorities and Outcomes
- Key Sector Engagement and creation of an ICT Ecosystem
- A review of the Core ICT Infrastructure to enable our Vision
- A National Digital Roadmap across all sectors and infrastructure layers
- An Ongoing Governance Structure that will manage cross-sector ICT investment and programs of work ensuring national goals are achieved and duplication is eliminated
- Careful management and alignment of component projects and funding sources to progress in a holistic path
- Digital skills and entrepreneurs to accelerate the digital transformation process
- Access to data and technologies for applied solutions to local challenges
- Availability of critical digital infrastructures

SUMMARY AND RECOMMENDATION

Mobile Broadband (MBB)

5 (Five) five readiness is recommended to improve and popularize MBB connectivity and services, and to build a digital society through digitalization of individual anytime, anywhere.

1. **Spectrum Readiness**: accelerate IMT spectrum release by selecting viable spectrum in total around 450MHz
2. **Site Readiness**: promote the site density by streamlined planning and administrative processes.
3. **Experience Readiness**: enhance the standards and regulation on digital service experience.
4. **User Readiness**: encourage the introduction of entry-level LTE terminals cost below 3% of GNI per capita to improve the digitalization adoption and usage.
5. **Service Readiness:** lead the provision of public services, to support industry to enrich and improve localized services and maximize the value of digital infrastructure

Digital Indoor System (DIS)

Strategy for current indoor digitalization in Indonesia for delivering the services:

- **Lack awareness on building owners**, digital services can generate more value for the building customer's usage.
- **Building permit and infrastructure sharing**, building owner should give easier for telecommunication operators to deliver indoor services
- **Policy Driven for infrastructure permit,** to accelerate indoor coverage deployment rental fee with affordable price.
- **5G Spectrum license**, need to be released to serve better experience for indoor services.
- **Technology transformation**, from DAS (Distributed Antenna Systems) conventional indoor infrastructure to DIS (Digital Indoor Systems) for better capacity and quality.

Wireless Broadband (WBB)

Wireless Broadband technology is initiated and become popular to maximize utilization of Mobile Broadband capacity.

Establish WTTX (Wireless to The Home), to penetrate broadband connectivity easier, while there is no fiber connectivity to the home due to difficulty of geographical and could be as first broadband penetration to the home before fiber deployment.

Speed experience would be defined based on mobile technology being used, 4G and 5G can help better speed experience to the users.

Fixed Broadband (FBB)

Aggressive and sustainable strategy approach to accelerate the fixed broadband deployment, adoption and penetration are follow:

- **Sharing of infrastructure such poles and highway road construction** for quick fiber deployments.
- **Ease of deployment permit, licensing and Rights of Ways (ROW**) from Government
- **Formulation, establishment of steering committee** comprising of all stakeholders such as government, operators, properties players, association and academicians for unified policy and quick agreements
- **Improve fixed broadband product portfolio and affordable attractive package** offerings by bundling new services such as triple or quad play packages (Video, voice, data, smart home) to attract more users.

Disaster Management

Between 2005 to 2015, Indonesia has experienced more than 15,000 natural disasters, whereby the total economic losses exceeded Rp235,26 Trillion, as well as a huge impact in terms of number of victims.

To continue to build up on the good work done by the respective departments, some of the following mitigation measures are recommended:

Non-technological:

- Increase of pervasiveness of the **socialisation and building code application** for key infrastructure;
- Prepare detailed and practical **business continuity plans**;
- Improve the **Disaster Funding Mechanism**;
- **Accelerate post-disaster economic recovery** through the implementation of the business continuity plan;

Technological:

- Ensure **connectivity infrastructure readiness**;
- **Upgrade the digital infrastructure** and building of common digital and data platforms;
- Put in place **more sensors** in the high-risk areas;
- Develop a **disaster management system** that focus on the operational readiness capability, as well as intelligence to enable smart prediction and analysis of disasters.

Smart City

The Indonesian government understands the need for digital transformation and has been pushing for smart city initiatives. Moving forward, the Indonesian government can consider:

- Develop a **national level smart city master plan** and accompanying policies that lay down a strong foundation and allows the individual cities to flourish with their local smart city agenda;
- **Ensure better connectivity** to the remote and rural parts of the country, through the use of new ICT technologies such as 5G and NB-IoT, so as to narrow the digital divide;
- Build a **national level common digital and data platform** that will allow the various government agencies to share data and collaborate together;
- Through citizenry **e-Participation**, involve more citizens and businesses in the smart city initiatives, allowing them to contribute data, as well as make use of open data provided by the government;
- Push for the **digital transformation of the individual domains** (such as transport, security etc.) so as to transform these domains to reap the benefits of digital economy for the country.

E-Government

Referring on Presidential Regulation No. 95 of 2018 concerning Electronic Based Service Systems (SPBE) was made to realize clean, effective, transparent and accountable governance and quality, and reliable public services, all delivered by an electronically based national government system. The strategy approach will be as

- Display **strong leadership** in pushing the eGovernment agenda and maintain the reform process;
- Enable **better participation of local governments and communities**, thereby synchronising the collaboration effort between people and government;
- Support with an **investment strategy** that is sustainable.

From the technological perspective, are needed that will maximise the application of e-Government:

- Connect the country with **optical fiber + satellite**;Better **cellular services**;
- Provision of **Wifi**, especially in the area of government offices and business districts;
- The **best policies** about OTT, cloud services, the Internet and Service Providers, RFID, and Blockchain;
- **Reliable electricity** source;
- **Guaranteed** infrastructure and networks.

.

Multi-sectors Digitalization

E-Agriculture, E-Education, E-Logistic, E-Finance, E- Health are sectors that currently and, in the future, keep moving forward on digital transformation. Integrated all stakeholder contribution are required to establish proper policy, planning, and implementation.

- **Broadband connectivity** to reach the public enterprise, government and others institutions is basic requirement.
- **Policy, regulation for protecting strategic data, data users**, is important to manage security and maximize the benefit to the people.
- **Integrated Planning and Implementation,** for all stakeholders to penetrate and accelerate digital transformation.

Local Content

To **improve technology transfer** from global players to local Indonesia, also to **keep domestic industry contribute** to the Industry ecosystems.

Local Content (KDN) is defined the use of telematics and supporting material/ devices, design and engineering that contains elements of domestic manufacturing, fabrication, assembly, finishing and services performed by local experts and involving local software.

Local Content Requirement or TKDN is the proportion of Local Contents in goods, services, and combination of goods and services. TKDN is not limited to hardware but also includes software. TKDN applies to both subscriber station (SS) or handheld device, and to base subscriber sub-system (BSS) or hardware.

The Government has implemented various key policies to encourage local ICT industry in the development of telecommunication products. One of these policies is the regulation of the Local Content Requirement (TKDN) which stipulates minimum local content requirement for telecommunication devices for use in Indonesia

CHAPTER 1

Digital Economy Outlook

Due to the rapid pace of technological advancement, countries that harness digital technologies stand to gain significant economic and social benefits. Countries are embracing the Digital Economy and have released ICT Policies and Master Plans to create supply, by ensuring National ICT infrastructure is in place, and to drive demand through sustainable sector digitization.

The industry generally believes that a 20% increase in ICT investment will deliver a 1% increase in GDP and through digitization enterprises can expect to achieve a 15 to 25% productivity gain.

This section provides an insight into the role and value of Information and Communications Technology (ICT) is driving National development and examples of how nations around the world are embracing ICT.

- **Digital Economy definition**
- **The Value of ICT in Powering Economies and Sustainable Development**
- **How are Nations Investing to drive Digital Transformation**

DIGITAL ECONOMY DEFINITION

The Digital Economy is the digitization of economic activities that results from billions of everyday online transactions, interactions and activities among people, businesses, devices, data, and processes through the use of digital technologies.

The 'digital economy' has been defined by the Australian Government as *"the global network of economic and social activities that are enabled by information and communications technologies, such as the internet, mobile and sensor networks'. This includes conducting communications, financial transactions, education, entertainment and business using computer phones and devices"*

DIGITAL ECONOMY AT WORK

"The aggressive use of data is transforming business models, facilitating new products and services, creating new processes, generating greater utility, and ushering in a new culture of management." Professor Walter Brenner, University of St. Gallen Switzerland

Sharing Economy

The sharing economy is on the rise and is operated online through digital technologies. It enables collaborative consumption of a service where owners rent out something they are not using, such as a car, house or bicycle. Recently, TechCrunch, a digital economy news site, noted, "Uber, the world's largest taxi company, owns no vehicles, Airbnb, the world's largest accommodation provider, owns no real estate…Something interesting is happening."

E-Money and Cryptocurrencies

E-Money includes mobile money, widely-accepted pre-paid cards, web-based products, and new cryptocurrencies such as Bitcoin. Mobile money is widely used in many developing economies. For example, in 2015 the number of mobile money accounts exceeded the number of bank accounts in 21 African countries. IMF estimates place the Indonesia mobile money share of accounts at 16.48% of the total population.

Enterprise and Government

Enterprises, Industries, and Governments are digitizing to automate processes providing improved services and driving down costs. Examples include; Manufacturing 4.0 Automation, Online Banking, Online Schools, Remote Health, automation of Supply Chain and Logistics, and Smart City Applications for example Safety, Transportation and Traffic, Environmental, and Energy and Water Usage.

E-Commerce

Online retailers are replacing street stores for goods that can be easily shipped. For example, in 2017, the United Kingdom made more than 16% of its sales online. The European Union in 2016, show that 66% of household Internet users made online purchases, and for businesses with 10 or more employees, sales over the Internet to consumers were 2.7% of turnover, and all other e-commerce sales were 15.6% of turnover. In 2015 e-Commerce sales hit $25 Trillion USD, however, 90% of that was B2B with 10% B2C.

THE VALUE OF ICT IN POWERING ECONOMIES

At a time of slowed growth and continued **instability**, many countries are looking for policies that will stimulate growth and create new jobs. Information and communications technology (ICT) is not only one of the fastest-growing industries – directly creating millions of jobs – but it is also an important enabler of innovation and development.

Here are five common economic effects of ICT as provided by the World Economic Forum. Elena Kvochko: Manager Information Technology Industry at the World Economic Forum.

Direct Job Creation

The ICT sector is and will remain, one of the largest employers. In the US alone, computer and information technology jobs are expected to grow by 22% up to 2020, creating 758,800 new jobs. In Australia, building and running the super-fast National Broadband Network will support 25,000 jobs annually. In the US, for each job in the high-tech industry, five additional jobs, on average, are created in other sectors. The global tech market will grow by 8%, creating jobs, salaries and a widening range of services and products. In Indonesia, in the latest economic outlook, the ICT sector will contribute around 10% of GDP.

Contribution to GDP growth

Various countries confirm the positive effect of ICT on growth. For example, a 10% increase in broadband penetration is associated with a 1.4% increase in GDP growth in emerging markets. The double of mobile data use caused by the increase in 3G/4G connections boosts GDP per capita growth rate by 0.5% globally. The Internet accounts for 3.4% of overall GDP in some economies. Most of this effect is driven by e-commerce – people advertising and selling goods online.

The Emergence of New Services and Industries

Numerous public services have become available online and through mobile phones. The transition to cloud computing is one of the key trends for modernization. Many governments are now shifting their ICT infrastructure into the cloud and launching mobile and e-services for citizens and businesses. ICT has enabled the emergence of a completely new sector: the app industry. Research shows that Facebook apps alone created over 182,000 jobs in 2011 and that the aggregate value of the Facebook app economy exceeds $12 billion.

Workforce transformation

New "microwork" platforms, developed by companies like oDesk, Amazon, and Samasource, help to divide tasks into small components that can then be outsourced to contract workers. Microwork platforms allow entrepreneurs to significantly cut costs and get access to qualified workers. In 2012, oDesk alone had over 3 million registered contractors who performed 1.5 million tasks. This trend had spillover effects on other industries, such as online payment systems. ICT has also contributed to the rise of entrepreneurship, making it much easier for self-starters to access best practices, legal and regulatory information, and marketing and investment resources.

Business Innovation

In OECD countries, more than 95% of businesses have an online presence. The Internet provides them with new ways of reaching out to customers and competing for market share. Over the past few years, social media has established itself as a powerful marketing tool. ICT tools employed within companies help to streamline business processes and improve efficiency. The unprecedented explosion of connected devices throughout the world has created new ways for businesses to serve their customers.

ICT ENABLING SUSTAINABLE DEVELOPMENT GOALS

Figure 1. 1 Sustainable Development Goal

Source: (https://www.un.org/sustainabledevelopment/development-agenda/, n.d.)

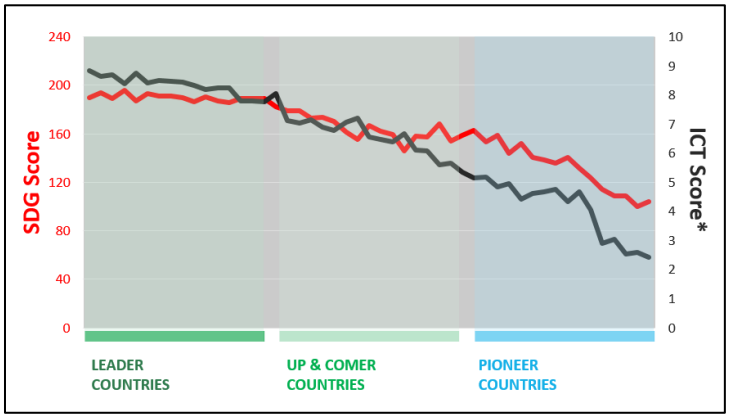
The 17 Sustainable Development Goals (SDGs) adopted by the United Nations in September 2015 map out global targets to guide our progress in sustainable development up to the year 2030.

From the 2017 ICT Sustainable Development Goals Benchmark, the analysis identified ICT is highly correlated with country-level SDG performance (89%), suggesting that countries that perform well on ICT also perform well on the SDGs, and countries that underperform on ICT are also lagging on SDG achievement.

ICT can accelerate and scale sustainable development through three enablers:

1. **Access to information and services -** Through ICT infrastructure and the use of mobile phones, cellular telecom networks (e.g., 3G and LTE) utilization, the Internet and broadband, ICT can improve access to information and services for individuals globally, rural and urban living.
2. **Connectivity between individuals and organizations -** Increased connectivity between individuals, organizations, and networks at an instantaneous or near-instantaneous level, can increase productivity and innovation across multiple sectors and communities, and provide the real-time communications needed for the rapid scaling of critical services.
3. **Efficiency from improved productivity and resource efficiency -** ICT can unlock and leverage productivity gains from increased access to information and communication between individuals (e.g., reduce resources wasted on travel, manual collection of data), as well as provide the infrastructure for collecting and analyzing large sets of data (e.g., big data). Big data analysis can help reveal opportunities for efficiencies, scale customized solutions, and support agile development by collecting real-time information (through smartphones and devices connected to the Internet of Things).

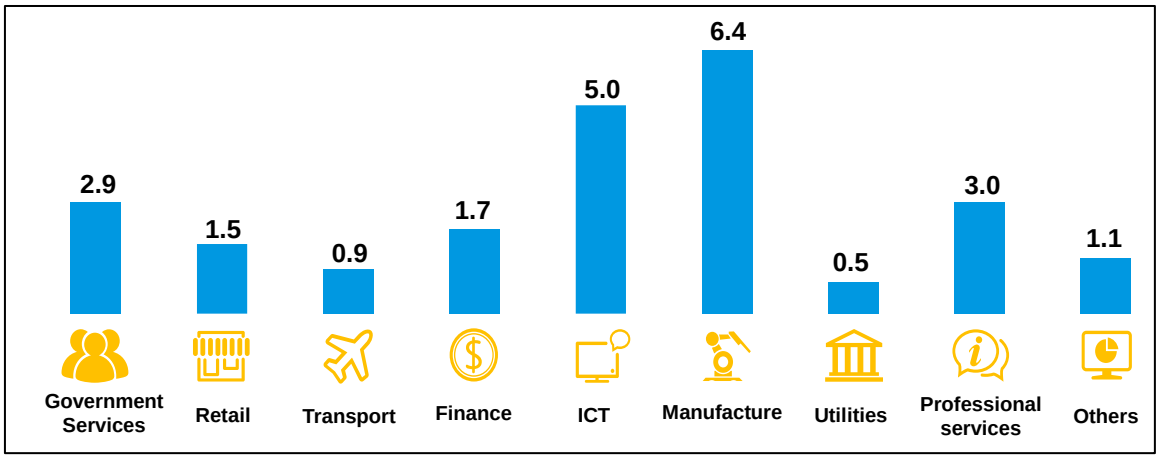
Figure 1. 2 Link between ICT and SDG progress



Source: (Huawei, ICT SDG Benchmark, 2017)

This diagram depicts Indonesia's SDG Goal achievement is in-line with Indonesia's ICT development.

Figure 1. 3 Digital Economy Projection 2025



Source: (Huawei, Global Industry Vision 2025)

Digital innovation and applications transform not only products, business models and markets, but also jobs and trade. In some sectors, ICT investment has led to job losses while in others it has led to job creation. For example, in most countries, labor demand decreases as a result of ICT investment in manufacturing, business services, and trade, transport, and accommodation, while it increases in culture, recreation and other services, construction and, to a lesser extent, in government, health and personal care, energy, and agriculture. Further, the use of digital technologies affects the nature of work in some areas. For example, services traded over online platforms, including accommodation and transport, are increasingly provided by individuals that tend to carry out flexible, temporary and part-time work in such jobs.

THE DIGITAL ECONOMY IS PROJECTED TO REACH USD 23 TRILLION IN 2025

The digital economy is creating new opportunities for trade and development. It is helping smaller businesses and entrepreneurs in developing countries to connecting with global markets more easily and is opening up new ways of generating income. Information and communication technologies (ICTs), e-commerce and other digital applications are being leveraged to promote entrepreneurship and innovation, and to support productive activities, and job creation. Mobile and digital solutions are contributing to facilitating greater financial inclusion.

Governments around the world are promoting the opportunities and challenges brought by this digital transformation. With its potential to innovate, stimulate and grow economies and create new jobs, digital transformation is now high on the global agenda. Figure 1.3 shows that sector contribution to the global economy in 2025 will reach 23 Trillion USD.

HOW ARE THE NATIONS INVESTING TO DRIVE THE DIGITAL TRANSFORMATION

The ICT sector is a key driver of innovation globally. For example, in OECD countries it accounts for the largest share of business expenditure on research and development and is one-third of total patent applications worldwide.

Based on the United Nations Digital Economy Report 2017, ICT is experiencing significant growth, by 2019 Internet Traffic will have grown 66 times from 2015 and by 2025 there will be more than 100 billion connected devices. In 2014 ICT accounted for 6.4% of global GDP. By 2019, Statistica estimates that the global ICT market will be worth a total of more than 5.1 trillion USD.

As concluded in Global Connectivity Index 2015: ICT innovation drives inclusive growth and sustainable development.

- 1% increase in GDP can be achieved from a 20% increase in ICT investment
- Enterprise Digitization will result in a 20% productivity gain by 2025

A study conducted by the World Bank stated that an additional 10 percent of broadband penetration could trigger economic growth in developing countries and a developed country by 1.38 and 1.12 percent. Research by Booz Allen Hamilton also stated that the increase of 10 percent broadband access in a year correlates with increasing 1.5 percent of labor productivity in five years.

In the Indonesian context, research by Katz in 2012 showed that for every 1 percent increase in household broadband penetration would reduce unemployment growth by 8.6 percent. BCG also estimates that any construction of mobile access broadband in the 700 MHz band would increase productivity by 0.4 percent in the service industry and 0.2 percent in manufacturing.

These studies further strengthen the role of telecommunications and information technology in a country.

To maximize the benefits of digital transformation, Governments around the world are focusing on defining their digital vision and strategy, creating a digital affairs department, and developing an integrated policy framework for a whole-of-government approach. There are 156 countries which set strategies and policies to encourage ICT Investment and have released National ICT Development Master Plan, such as Singapore Smart Nation, Digital Canada 150, Smart Digital Malaysia, Germany Industry 4.0, Advanced Manufacturing 2.0, RRC Internet Plus, Nigeria National Broadband Strategy, Colombia Live Digital, Connected Argentina.

Figure 1. 4 Countries are Setting Strategies and Policies to Encourage ICT Investment

Source: (ITU, 2017), (Indonesia's Ministry of Industry, 2018)

GOVERNMENTS ARE NURTURING THE DIGITAL ECONOMY THROUGH INVESTMENTS IN SMART CITIES

Those futuristic urban centers which use ICTs to improve public services such as transportation, health care, electricity, and water provision.

- In China, the Ministry of Housing and Urban and Rural Development had selected 193 cities and

economic development zones by 2013 to be official smart city pilot sites.

- In Sri Lanka, some 800 telecenters were set up across the country in the middle of 2015 to connect communities of farmers, students and small entrepreneurs to information, learning and trading opportunities.

Korea Digital Development Approach

Korea has developed a solid foundation to enable digital transformation. The ICT sector is a resilient pillar of the country's economy. It is a driver of innovation, boosting high shares of value-added and employment; high ICT business expenditure on research and development; and more ICT related patents as a percentage of total IP5 patent families than most other countries.

Key Initiatives

Strategies and Master Plans

Since the mid-1990s, the Korean government has established three master plans for the development of the information society:

- The Informatization Promotion Act and Master Plan
- CYBER KOREA 21
- e-KOREA VISION 2007

In particular, CYBER KOREA 21 was one of the most important policies to cope with the changing environment as a result of the Asian financial crisis. Through these plans, Korea came one step closer to a knowledge-based society with the construction of advanced information infrastructure, the introduction of various information systems in public services and in the private sector, as well as growth in the overall IT industry.

Institutional arrangements and Financing mechanisms

Korea has restructured government organizations responsible for the informatization strategy: the Informatization Promotion Committee chaired by the Prime Minister, and the Informatization Strategy Meeting chaired by the President. This allowed different agencies and ministries to coordinate their respective informatization policies. The establishment of the Ministry of Communication and Information Technology (MCIT) and strengthening of the National Computerization Agency under the MIC's umbrella has a huge implication institution building, as both have played a pivotal role in designing, implementing and coordinating national ICT policies and e-government initiatives.

It is also notable that the Informatization Promotion Fund created the system of letting the profits from ICT fields be reallocated into the ICT sector and enabled focused investment in ICT. Also, new financing methods –'invest first, settle later', and matching deposits – attracted private sector investments, utilizing government resources as seed money. This can be interpreted as a PPP-based funding mechanism. In summary, Korea was able to be equipped with the necessary laws, funds, organizations, and programs for a jump-start in ICT.

India ICT Industry Development

India's information and communication technology (ICT) sector is seen as epitomizing the opportunity that globalization offers a low-income developing country. The success of Indian techno-entrepreneurs in the US and the rapid growth of the Indian software and IT-enabled services industries, especially it's export segment, have shown expectations of the potential for growth and human development that ICT holds out.

The Government of India has pursued liberalization policies to enable the ICT Industry to develop. These include income tax exemptions for profits on software exports and reduction on import duty on computer software from 114% to 0%.

MICT facilitates and coordinates various initiatives of the central and state government and private sector. Priority has been given to; e-Governance, software development in Indian languages, IT for the masses, Distance Education, e-Commerce, Cyber Security, Postgraduate education and research in IT, and emerging areas for Research and Development initiatives. Additionally, foreign investment in the sector has been high encourage resulting in many of the world-leading ICT companies having a significant presence in India and generating significant exports particularly through ICT Outsourcing and Software Development.

Australia Government National Digital Economy Strategy

The Australian Government launched the National Digital Economy Strategy in 2018, to answer these strategic questions: "What are the key new growth industries that Australia should be tapping into? In what technologies and sectors should Australian businesses take the lead, and where should we be a 'fast follower' of international trends?" This strategy was developed in consultation with industry, thought-leaders, small and medium-sized businesses, government, community as well as the broader private sector. It will set out a roadmap for the government, the private sector, and the community to work together for Australia to succeed in a digital economy. Becoming a world leader in **digital innovation could boost the Australian economy by AU$140 billion to AU$250 billion over the next eight years.**

France

France announced its Industry of the Future project in April 2015. The project rewards companies that modernize with tax cuts and advantageous loans. It focuses on nine priority markets: new resources; sustainable cities; ecological mobility; future transportation; future medicine; the data economy; intelligent objects; digital confidence; and intelligent food. The first call for project proposals focused on future-oriented fields such as 3D printing, augmented reality and connected objects.

Kenya National ICT Master Plan

Key outcomes from Kenya's National ICT Master Plan:

- Creating Konza Technology City - Regional Hub for many of the large ICT companies, which the government has branded the 'Silicon Savannah'. The government is providing basic infrastructure and supporting policy and regulatory frameworks, leaving it to private investors to build and operate the industrial development.
- Developing the BPO Industry which today employs 3,000 Youths and generate $20M in Revenue
- Providing incentives and investments to create the explosion of local ICT Development Clusters (ilab, ihub, Nailab, etc.). These clusters are creating mobile applications for multiple sectors.
- Driving the program around Government automation for e.g. e-Customs, Citizen Portal, e-ID system, etc.

Chile Leading in Latin American Digital Economy

Chilecon Valley is emerging as a Latin America Tech Hub. *"We used to be isolated geographically, with the sea, the Andes, the desert and Antarctica as natural borders. With Start-Up Chile, we wanted to break those barriers. Now, Chileans still live isolated, but they think global" Sebastian Vidal, Start-Up Chile Executive Director*

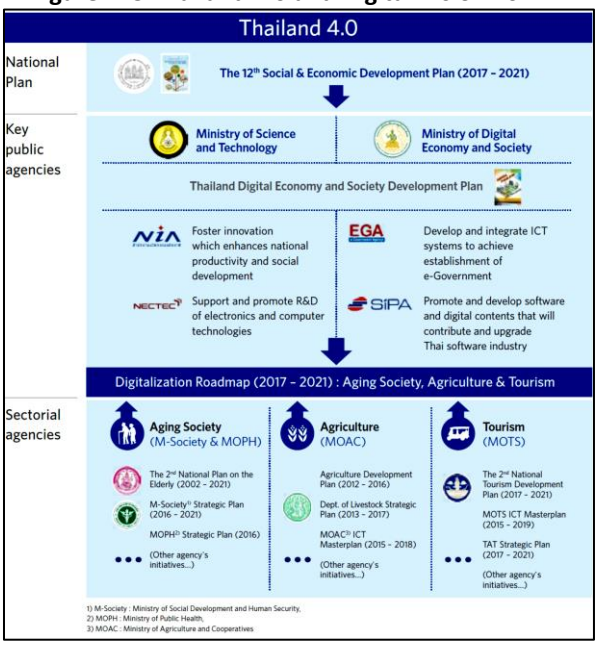
The Tech Hub has created new jobs and developed the local ICT Industry

- Over 23% of Chileans age 18-64 have started their own businesses, highest % in OECD (3X OECD AVG.)
- "Start-Up Chile" hosts 100 start-ups every year, totaling 800+ start-ups from 60+ countries.

Thailand 4.0 and Digital Vision 2021

Thailand 4.0 is the national development model defining the direction for Thailand to become a high-income economy through the use of technology and innovation.

Figure 1. 5 Thailand 4.0 and Digital Vision 2021



Source: (Thailand, Insights on Digitalization of Thailand Industry: Digital Roadmap for Aging Society, Agriculture and Tourism, 2017)

Thailand's Digital Vision 2021 sets out national digital priorities for the next 5 years.

"Digitalization transforms Thailand towards a connected society where everyone has enhanced accessibility to relevant information and services and leverages innovations effectively to drive That is to become more self-reliant, reduce socio-economic inequality and boost competitiveness"

The holistic Digital Framework includes the digital solutions relevant to the three focus sectors as well as key enablers.

- Holistic views of digitalization of the 3 sectors
- 4 key enablers identified including broadband, cloud infrastructure development, human capital readiness, and innovation capabilities
- 39 initiatives detailed and organized across 4 distinct digital solutions per sector. Including the role of government and relevant organizations along with recommendations for policies and incentives detailed in each initiative

Progress has been made on implementing the digital vision. This includes the implementation of smart city pilots, development of digital master plans and ICT infrastructure improvements. These are the first stepping stones of a long digital journey. Going forward, Thailand should focus on the digitalization of key sectors in the economy and improvement of key enablers like innovation, human capital and broadband infrastructure.

CONCLUSION

Unlocking the benefits of digital transformation requires addressing the challenges created by this transformation, in particular for jobs, skill, and trust.

The government of Indonesia should be proactive and adopt a fully integrated policy-making approach whereby all stakeholder is invited to the table to develop and implement a clear way forward to shape the digital transformation.

The approach should also measure the breadth of digital transformation and the effectiveness and success of the related policy.

MEASURING THE DIGITAL ECONOMY

MEASURING THE DIGITAL SECTOR

Today there is no clear and agreed measurement for the digital economy. However, measuring the digital sector provides a good indication of the impact of digitization on GDP.

For example, it was estimated, by the IMF (International Monetary Fund) in their 2018 report on "Measuring the Digital Economy", that the U.S. Digital Sector contributed 8.3% of GDP in 2015. This was attributed to Information and Communications Technology (ICT) Technologies, Platforms and Services. An additional 1% was estimated in areas of Advertising and apportioning the worldwide output of U.S. multinational enterprises (MNEs)

Examples of Developing Nations who have ICT BPO (Business Process Outsourcing) Industries

- ▲ 2016 India BPO Industry 7.7% of GDP
- ▲ 2016 Philippines BPO Industry 8% of GDP

Table 1. 1 ICT as A Percentage Of GDP

Product group	Percent of GDP
Included in GDP (on a value-added basis):	
ICT equipment, semiconductors and software	2.8
Telecommunication and Internet access services	3.3
Data processing, and other information services	0.7
Online platforms, including e-commerce platforms	1.3
Platform-enabled services, (e.g., the "sharing economy")	0.2
Total (with incomplete adjustment for double counting of output)	**8.3**
Conceptually not included in GDP, or missed for procedural reasons:	
Wikipedia and open source software	0.2
Free media from online platforms funded by advertising	0.1
"Do-it-yourself" fixed capital formation of online platforms	0.3
Output of MNEs attributed to tax havens	0.4
Total (with incomplete adjustment for double counting of output)	**1.0**

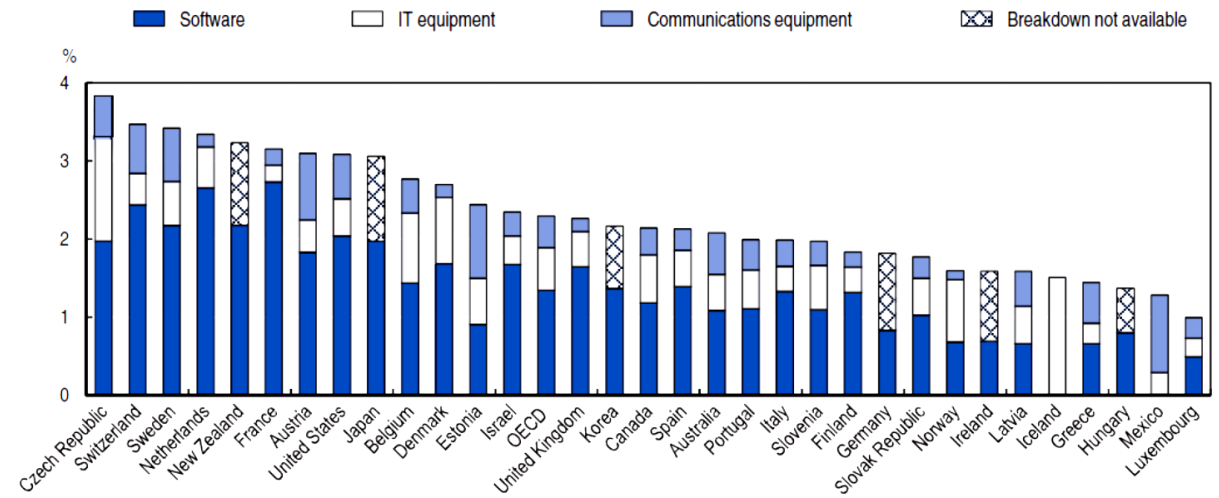
Source: **(IMF, 2018)**

Note: Software is generally over 50% of ICT investment, followed by Telecommunications and IT Equipment.

Digital Sector Spend in Indonesia:

IDC estimated that ICT Spending in Indonesia will reach IDR 465 Trillion in 2019. IDC revealed the key trends and technologies for 2019 and beyond that business leaders need to look and consider in the decision-making process and the digital ecosystem.
#1 Digitalized Economy: By 2022, more than 61% of Indonesia GDP will be digitalized, with growth in every industry driven by digitally enhanced offerings,

Figure 1. 6 ICT Investment by Capital Asset



Source: (OECD, Digital Economy Outlook, 2017)

operations, and relationship, driving US$ 78 billion in IT-related spending from 2019 through 2022

#2 Digital-Native IT: By 2022, 50% of all IT spending will be on 3rd Platform technologies, as over 50% of Indonesian enterprises build “digital-native” IT environments to thrive in the digital economy.

#3 Expand to the Edge: By 2022, over 15% of Indonesian organization’s cloud deployments in Indonesia will include edge computing, and 10% of endpoint devices and the system will execute AI algorithms.

#4 AppDev Revolution: By 2022, 40% of all new apps will be feature microservices architectures that improve the ability to design, debug, update, and leverage third-party code; 15% of all production apps will be cloud-native.

#5 New Developer Class: By 2024, a new class of professional developers producing code without custom scripting will expand the developer population by 15%, accelerating digital transformation.

#6 Digital Innovation Explosion: From 2018 to 2023 — with new tools/platforms, more developers, agile methods, and lots of code reuse — 5 million new logical apps will be created.

#7 Growth Through Specialization: By 2022, 20% of public cloud computing will be based on non-x86 processors (including quantum); by 2022, organizations will spend more on vertical SaaS apps than horizontal apps.

#8 AI Is the New UI: By 2024, AI-enabled user interfaces and process automation will replace one-tenth of today's screen-based apps; by 2022, 10% of Indonesian enterprises will use conversational speech tech for customer engagement.

#9 Expanding/Scaling Trust: By 2022, 10% of servers will encrypt data at rest and in motion, over 10% of security alerts will be handled by AI-powered automation, and about 2 million people will have blockchain-based digital identities.

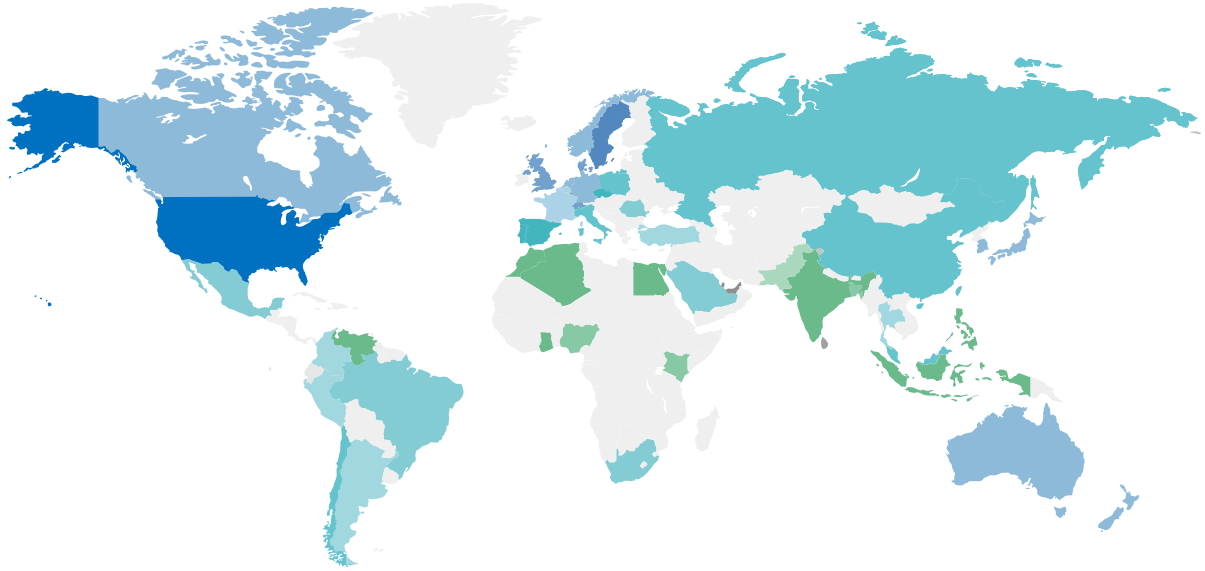
#10 Consolidation vs. Multi-cloud: By 2022, the top 4 clouds "mega-platforms" will host 60% of IaaS/PaaS deployments, but by 2024, 40% of Indonesian organizations will mitigate lock-in through multi-cloud or hybrid technologies and tools.

Measuring a Nations Digital Take Up through GCI Key Indicators

GCI is another measure of a Nations's success in its Digital Transformation. Huawei has created the GCI (Global Connectivity Index) which measures key indications of digitization. This type of approach is used by planning departments and policymakers to better understand where to invest.

As shown in Figure 1.7, The GCI plots 79 nations progress in Digital Transformation, grouping them into three clusters based on their GCI scores: Starters, Adopters, and Frontrunners. A nation's GCI score is derived from benchmarking those nations' digital capabilities against 40 plus Key Performance Indicators KPIs.

Figure 1. 7 Digital Economy Heat Map



FRONTRUNNERS	SCORE
1 United States	78
2 Singapore	75
3 Sweden	73
4 Switzerland	71
5 United Kingdom	70
6 Finland	68
7 Denmark	68
8 Netherlands	67
9 Norway	65
10 Japan	65
11 South Korea	64
12 Australia	64
13 Germany	63
14 Luxembourg	63
15 Ireland	62
16 New Zealand	62
17 Canada	62
18 Belgium	61
19 France	61
20 Austria	60

ADOPTERS	SCORE
21 Spain	55
22 Estonia	54
23 UAE	53
24 Lithuania	52
25 Portugal	52
26 Slovenia	51
27 China	51
28 Italy	50
29 Czech Republic	50
30 Hungary	49
31 Slovakia	49
32 Malaysia	48
33 Chile	48
34 Croatia	46
35 Greece	46
36 Russia	46
37 Kuwait	45
38 Poland	45
39 Romania	45

ADOPTERS	SCORE
40 Bahrain	45
41 Saudi Arabia	44
42 Belarus	44
43 Bulgaria	44
44 Brazil	43
45 Kazakhstan	42
46 Mexico	42
47 Oman	42
48 South Africa	42
49 Ukraine	41
50 Uruguay	41
51 Thailand	40
52 Turkey	39
53 Serbia	39
54 Colombia	39
55 Argentina	38
56 Peru	37
57 Philippines	35

STARTERS	SCORE
58 Jordan	34
59 Egypt	34
60 Lebanon	34
61 Vietnam	34
62 India	33
63 Venezuela	33
64 Indonesia	33
65 Morocco	33
66 Algeria	32
67 Ecuador	31
68 Ghana	29
69 Kenya	29
70 Nigeria	29
71 Botswana	29
72 Namibia	29
73 Paraguay	26
74 Tanzania	25
75 Uganda	25
76 Bolivia	25
77 Pakistan	25
78 Bangladesh	24
79 Ethiopia	23

Source: (Huawei, Global Connectivity Index, 2018)

STARTERS

Average GDP Per Capita: US$3,700
GCI score: 20-34

These countries are in the early stage of ICT infrastructure. Their focus is on increasing ICT supply to give more people access to the Digital Economy. Indonesia is in the Starters Cluster, ranked 64th.

ADOPTERS

Average GDP Per Capita: US$16,300
GCI score: 35-55

Nations in this cluster experience the biggest GDP growth from ICT Infrastructure. Their focus is on increasing ICT demand to facilitate industry digitization and high-quality economic growth.

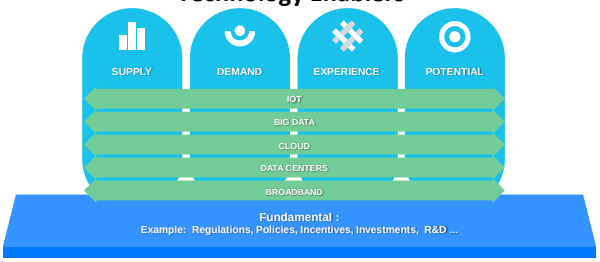
FRONTRUNNERS

Average GDP Per Capita: US$54,100
GCI score: 56-85

These nations are mainly developed economies. They continually boost user experience and use Big Data and IoT to develop a smarter and more efficient society.
KPIs have been defined across 4 Economic Pillars and 5 Technology Enablers

- Economic Pillars being; Supply of ICT Infrastructure and Resources, Demand for ICT solutions, End User Experience, and ICT Potential
- Technology Enablers being; IoT, Big Data, Cloud, Data Center, and Broadband

Figure 1. 8 KPIs From 4 Economic Pillars and 5 Technology Enablers

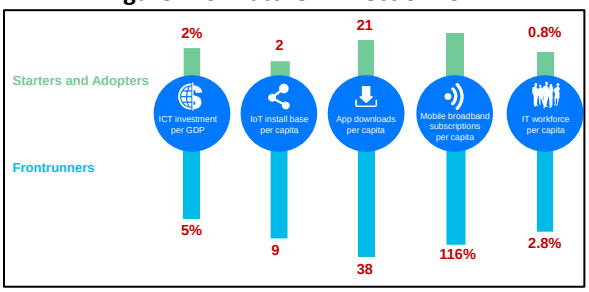


Source: (Huawei, Global Connectivity Index, 2018)

A three-year observation of the GCI data reveals a widening gap, indicating deepening inequality. The numbers tell the story: In GCI 2017, Frontrunners pulled far ahead, improving their GCI scores by 4.7 points, and Adopters by 4.5 points. But the Starters lagged farther behind, improving their GCI score on average by only 2.4 points.

We are witnessing an ICT version of sociology's "Matthew Effect," where the "rich get richer and the poor get poorer" based on accumulated advantage over time. Policymakers in the Adopters, cluster and especially in the Starters, must consider the growing inequality as it will have continued consequences on their ability to compete and sustain economic growth.

Figure 1. 9 Matthew Effect on ICT



Source: (Huawei, Global Connectivity Index, 2018)

INDONESIA DIGITAL STATUS

Indonesia is the most important internet market in Southeast Asia as a result of its sheer size, emerging middle class, and digitally savvy population. Annual Indonesian Internet Service Providers Association Survey (APJII) says that Indonesia has 171.7 million internet users, which points to a penetration rate of 64.8% of the population [APJII, Buletin APJII Agustus 2019, 2019]. 79% of Internet users log on to the web at least once a day. The majority of web traffic in Indonesia comes from mobile phones, facilitated by the availability of cheap smartphones to the Indonesian population coming online for the first time; sidestepping desktops and PCs directly.

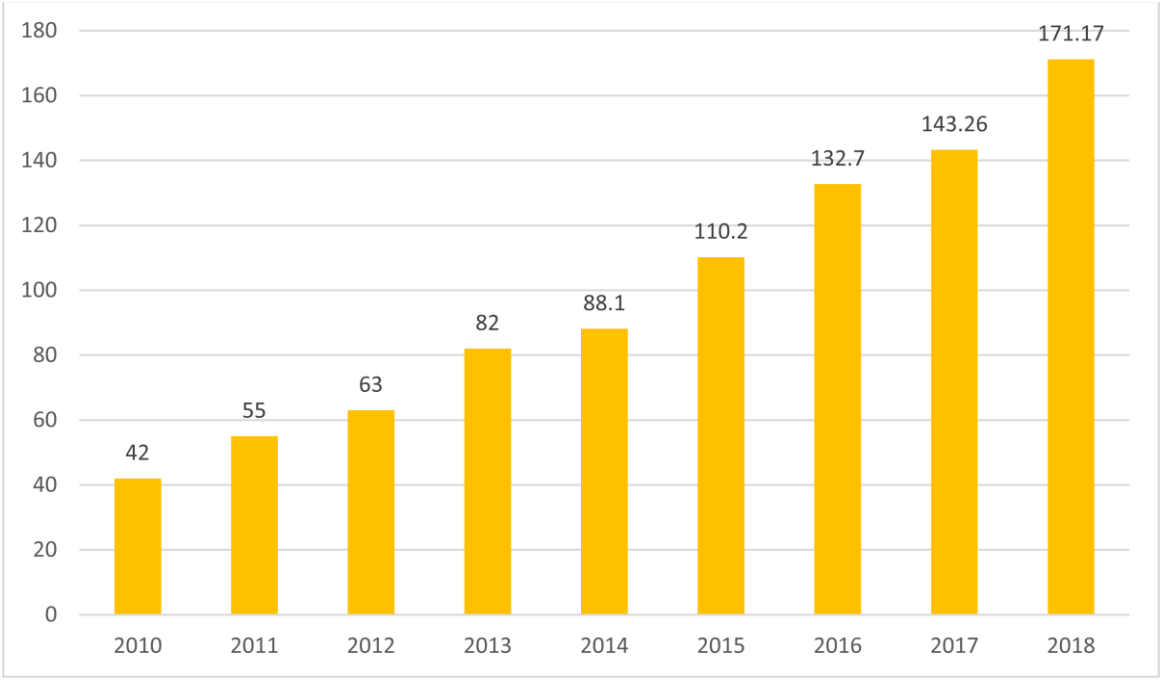
However, Enterprises and governments lag in their take up of ICT technologies and their remains gaps in National ICT Infrastructure e.g. Broadband Networks, Data Centers and Cloud, with newer technologies such as Big Data and IoT having limited success.

ITU Indonesia 2017 Report – Measuring the Information Society

Mobile services: Indonesia has 7 operators with 85% coverage being provided by the top three. 2G networks are extensive and based on the *National Socio-Economic Survey* found that 88% of households had a mobile phone in 2015 (93% in urban areas and 83% in rural areas). Mobile broadband has been available for over a decade following the deployment of 3G networks in 2006. All of the leading operators launched LTE in 2014. Smartphone penetration has been growing. Now evolution becomes to be the theme, and 4G and 5G constitute the future target network. During 2020 and 202 it will enter a period of rapid growth forward to 80% of all connections, becoming a mainstream technology to provide users with high-speed mobile broadband connectivity. 5G will develop a 10% connection share and deep integration with the vertical industry.

Fixed Services: PT Telkom is the leading player (85%) in the fixed broadband market through ADSL and optical fiber (up to 100 Mbps). It competes with cable television and new optical fiber-based market

Figure 1. 10 The Number of Internet Users in Indonesia (in Millions)

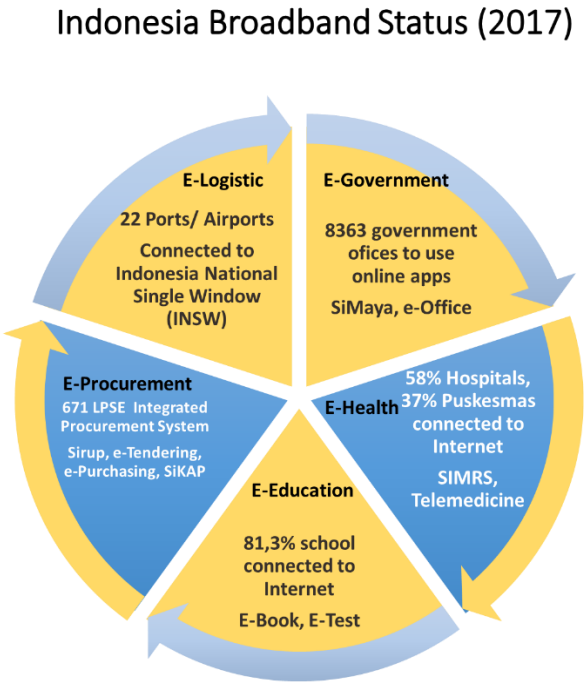


Source: (APJII, Buletin APJII Agustus 2019, 2019)

entrants. A number of fixed wireless operators have already deployed. There is an extensive domestic backbone of over 80,000 kilometers connecting major islands. Indonesia also has launched several satellites for domestic connectivity and remote village connectivity. The country is connected to over a dozen regional and intercontinental submarine cables.

Government Policy: In 2014, in line with MP3EI (Master Plan for Acceleration and Expansion of Indonesia Economic Development), the Government launched Indonesia Broadband Plan (IBP) for 2014 to 2019, through Presidential Decree No. No. 96/2014 on which aims by 2019 to provide fixed broadband access to all government offices, hospitals, and schools at speeds of at least 2 Mbps [Satriya, Jokowi, Zuckerberg and Broadband, 2014]. This number is likely to be revised for today's requirements.

Figure 1. 11 Indonesia Broadband Status on 5 Sectors based on IBP



Item	Connected to Internet	Not Connected	Total
Schools	172,213	39,495	211,708
Hospitals	1,599	1,159	2,758
Puskesmas	3,636	6,118	9,754

Source: (Deputy Assistant for ICT and Utility), MCIT, processed

Conclusion: Competition results in the growing up-take of mobile and broadband services. One consequence is the duplication of key facilities affecting affordability. The broadband plan calls for infrastructure sharing and open access to bottleneck facilities.

Figure 1. 12 Indonesia Key Indications 2017

Key indicators for Indonesia (2017)		Asia & Pacific	World
Fixed-telephone sub. per 100 inhab.	4.2	9.5	13.0
Mobile-cellular sub. per 100 inhab.	173.8	104.0	103.6
Active mobile-broadband sub. per 100 inhab.	95.7	60.3	61.9
3G coverage (% of population)	93.8	91.3	87.9
LTE/WiMAX coverage (% of population)	90.4	86.9	76.3
Individuals using the Internet (%)	32.3	44.3	48.6
Households with a computer (%)	19.1	38.9	47.1
Households with Internet access (%)	57.3	49.0	54.7
International bandwidth per Internet user (kbit/s)	21.2	61.7	76.6
Fixed-broadband sub. per 100 inhab.	2.3	13.0	13.6
Fixed-broadband sub. by speed tiers, % distribution			
-256 kbit/s to 2 Mbit/s	43.6	2.4	4.2
-2 to 10 Mbit/s	12.7	7.6	13.2
-equal to or above 10 Mbit/s	43.7	90.0	82.6

Source: (ITU, ICT Development Index 2018)
Note: Data in Italics are ITU estimation

Indonesia Key Recommendations

ICT Infrastructure Priorities

- Expand public-private partnerships for ICT infrastructure
- Expand high-speed broadband coverage: FTTH networks to reach over 20% of households, 4G coverage for 40% of end-users.
- Invest in data centers to provide cloud services.
- Booth access to affordable computing devices and smartphones to over 60% of the population.
- Promote businesses to take up ICT and digitization.

Industry and Company Priorities

- Promote businesses to take up ICT and digitize through the use of cloud as the platform.
- Promote new innovations in the selected sector e.g. focus on IoT in agriculture.
- Promote the adoption of e-commerce and online marketing.

ICT Industry and workforce priorities

- Foster growth of ICT Industry
- Develop education programs to ensure the workforce has digital skills.
- Build education programs to upgrade the develop ICT workforce.

SECTOR DIGITIZATION

The Digital Age, commonly referred to as the Fourth Industrial Revolution, is transforming industry sectors, social services, and governments. This transformation is driven by a suite of core technologies; broadband networks, cloud-based data centers, internet of things, big data, and artificial intelligence. Every sector requires digitization requires.

Connectivity

Means Broadband and Narrowband connections as well as Smart Access Devices. Some of the Smart IoT Devices enable specific applications e.g. city water levels, and some are common and should be shared such at CCTV cameras.

Information Access

Means Cloud-based Data Centers in which to economically store and analyze vast amounts of the sector and application-specific information, IoT Platforms to collect information provided from IoT Sensors, and Big Data Platforms to manage the storage and analytic functions.

Application and Process Automation

Means sector-specific applications that will be hosted in Cloud-based Data Centers. There are some applications that could also be shared across sectors for example e-Commerce Marketplace Applications could be used by most sectors, other applications such as Collaboration systems are also common.

These common ICT infrastructure components and platforms need to be in place to enable sector digitization. The government, in collaboration with the private sector, should develop a National Digital Blueprint for the further development of these common ICT components. This blueprint needs to take into consideration; Policies, Regulations, and Standards, as well as business, financial, and delivery models.

Figure 1. 13 Example of Commonality Across Industry Development Sectors

SECTOR	SECTOR SERVICES	CONNECTED *Broadband, IoT*	INFORMATION ACCESS *Big Data, IoT, Cloud, Data Center*	APPS/PROCESS AUTOMATION *IoT, Cloud, Data Center*
AGRICULTURE	Access to Agriculture, Forestry & Fisheries Information & Apps	Broadband *Farmers*	Agricultural Information	Farm Apps
	Agriculture e-Commerce	Broadband *Sellers/Buyers*	Crop & Market Information	Marketplace Apps
	Precision Farming e.g. Monitoring Soil, High Tech Machinery	Narrowband *Sensors*	Sensor Information	Sensor Related Apps
TOURISM	Destination Awareness	Broadband *Tourism Operators & Local Government*	Destination Information	Marketing Apps
	Tour Planning	Broadband *Tourists*	Booking Information	Tourism Exchange
	Destination Commute	Broadband *Tourists*	Transport Information	Visa & Planning Apps
	Destination Experience "Smart Tourist Destination"	Broadband *Tourists, CCTV, City Management* Narrowband *Sensors*	Destination & Sensor Information	Destination Service Apps
TRANSPORT & LOGISTICS	Integrated Logistic	Broadband *Logistics Operators* Narrowband *Sensors*	Logistics & Sensor Information *Transport, Fleet, Cargo*	Logistics Apps *Inventory Mgmt, Distribution Mgmt, Transport Mgmt, Goods Tracking, Planning*
	Port Management	Broadband *Port Employees, CCTV* Narrowband *Sensors*	Port & Sensor Information	Port Management Apps *Command & Control, Security, ERP, Sensor Apps*
	Online Customs	Broadband *Logistics Firms, Banks, Transport Cos*	Customs Information	Customs Apps *Clearance, Tariff, Bonded Warehouse, Anti-Smuggling*
	e-commerce for Online Buyers/Sellers	Broadband *Buyers & Sellers*	Sellers Information	Commerce Marketplace Apps

Source: (Deputy Assistant for ICT and Utility)

Figure 1. 14 Example of Commonality Across Socio Development Sectors

SECTOR	SECTOR SERVICES	CONNECTED *Broadband, IoT*	INFORMATION ACCESS *Big Data, IoT, Cloud, Data Center*	APPS/PROCESS AUTOMATION *IoT, Cloud, Data Center*
HEALTH	National Health Information System	**Broadband** *Healthcare Professionals*	**Patient & Hospital Information**	**Hospital Apps** *HIS, LIS, Pharmacy, Disease Surveillance*
	Remote Telemedicine	**Broadband** *Remote Centers & Healthcare Staff* **Narrowband** *Patient Sensors*	**Patient & Sensor Health Information**	**Communications Apps** *Telepresence & Video Conferencing* **Patient Sensor Apps**
EDUCATION	Information Preparation and Management	**Broadband** *Teachers & Courseware Developers*	**Education Information Management**	**Content Apps** *Digitization Tools, Content Mgmt , Digital Libraries, Access Portals*
	Teaching & Learning	**Broadband** *Students, Teachers, Classrooms*	**Courseware & Student Information**	**Learning Apps** *e-Learning, Collaboration & Digital Learning Apps, Distance Learning (Virtual Reality, Video Conferencing)*
	School Administration & Management	**Broadband** *Teachers & CCTV*	**Courseware & CCTV Information**	**Testing, Office & Admin Apps**
FINANCE / FINTECH	Digital Payments Alternative & personal Financing Alternative Lending	**Broadband** *FinTech Customers* **Narrowband** *Wearable Devices*	**Financial Information**	**FinTech Financial Apps** *Blockchain, Augmented Reality, Artificial Intelligence, Finance Platforms*

Source: (Deputy Assistant for ICT and Utility)

Figure 1. 15 Examples of Commonality Across National Resilience and Governance Sector

SECTOR	SECTOR SERVICES	CONNECTED *Broadband, IoT*	INFORMATION ACCESS *Big Data, IoT, Cloud, Data Center*	APPS/PROCESS AUTOMATION *IoT, Cloud, Data Center*
SMART CITY	City Surveillance Monitoring and Planning	**Broadband** *City CCTV* **Narrowband** *City Sensors*	**CCTV & Sensor Information**	**City Apps to support sensors** *Policing, Disaster Management, Traffic Management, Building Management, Parking, Waste etc.*
	City Operations and Management	**Broadband** *City Workers, Police, Emergency Services*	**Collection of all City Information & Analytics**	**City Operations Apps** *Command & Control Apps, Planning, GIS, Asset Mgmt etc.*
E-GOVERNMENT	Online Government	**Broadband** *Government Employees, Citizens & Businesses*	**Whole of Government & Service Information** **Citizen e-ID** **Property Information**	**Online Government Apps** *Access Information Portals, Government Apps Store, Business to Business Interaction i.e. Procurement & Logistics, Communications (Telepresence, Messaging, Collaboration)*
	Smart Government Planning	**Broadband** *Government Departments*	**Whole of Government Information Repository to enable Government Planning & Decisions**	**Data Analytic Tools & Planning Applications to support e.g.** *Health – Disease Surveillance MoH, Education – Trends in Learning MoE, Transportation – Roads, Traffic, Crime – Trends*
	Efficient Government	**Broadband** *Whole of Government Virtual Private Network fro Interagency communications*	**IT Infrastructure Consolidated & Shared Cloud**	**Government Apps To enable process efficiencies** *Finance, HR, Procurement etc.*

Source: (Deputy Assistant for ICT and Utility)

CHAPTER 2

Building Indonesia Digital

Figure 2. 1 Indonesia ICT Milestones

1907	Post, Telegraph dan Telephone
1961	Perusahaan Negara (PN) Pos dan Telekomunikasi
1965	PN Telekomunikasi
1966	Ministry of Post and Telecommunication
1966	Directorate General of Post and Telecommunication in Transportation Department
1974	Public Company for Telecommunication (Perumtel); PT. INTI; Sentral Telepon Digital Indonesia (STDI)
1980	PT. Indosat (GR No.53/1980)
1988	PT. Aplikanusa Lintasarta
1989	Law No.3/1989 on Telecommunication
1990	STDI 2 – Indonesia Digital Telephone Exchange 2
1991	Perumtel changed to PT. Telekomunikasi Indonesia (Telkom)
1993	PT. Satelido was founded
1995	IPO PT. Telkom
1997	Tim Koordinasi Telematika (TKTI) Presidential Decree No.30/1997
1999	Law No.36/1999 on Telecommunication
2000	Indosat and Telkom agreed to transfer of ownership of shares in Satelindo and Telkomsel to end cross-ownership in the two companies and to show goodwill in business competition
2001	Ministry of Communication and Information
2003	Presidential Instruction No. 3/2003 concerning National Policies and Strategies for E-Government
2005	Merge of Ministry of Communication and Information and Directorate General Postel
2006	Dewan TIK Nasional (DETIKNAS)/National Council on ICT
2008	Law No 11/2008 on Information and Electronic Transaction
2014	Dewan TIK Nasional (WANTIKNAS)/New National Council on ICT
2016	National Strategy on Financial Inclusion
2017	National Roadmap on E-Commerce
	Presidential Decree No. 53/ 2017 on National Cyber and Crypto Agency
2018	National Roadmap on E-Government
2019	PT. INTI's financial condition is not good, said to have debt of billions rupiah
	Government Regulation No. 71/ 2019 on Electronic Transaction and System Operation/ Maintenance

Source: (Deputy Assistant for ICT and Utility), 2018

OVERVIEW

Since ancient times humans have tried to create various tools in communicating to obtain information or other purposes. Entering 1990, Indonesian government planned to accelerate the development of telecommunications as infrastructure that push the development of other sectors. As described in Indonesia ICT Sector Milestones (Figure 2.1), The Public Telecommunications Company (Perumtel) is a business entity authorized to conduct public telecommunications in the domestic region and the Indonesia Satellite Corp (Indosat) is designated as a telecommunications business entity for the international dial. Based on Government Regulation No. 25 of 1991, Perumtel was re-establish a Company (Persero) in anticipation of the globalization era, such as the implementation of free trade both internationally and regionally. In 1993, PT. Palapa Indonesia Satellite (Satelindo) was established under the supervision of PT. Indosat and operated in 1994. As a subsidiary of Indosat, Satelindo has become the first GSM operator in Indonesia. In 1995 the name of PT. Telekomunikasi Indonesia (Telkom) is introduced to the public and in the same year carried out an internal restructuring program, operational cooperation with private sectors and Go Public. In 1996, the new operational cooperation was implemented at PT. Telkom, PT. Telkom is one of the State-Owned Enterprises whose shares are owned by the Government of Indonesia. PT. Telkom provides fixed wireline services, fixed wireless services, mobile services, data/internet, and other multimedia services.

There was no significant development in the ICT sector during the monetary crisis in 1997. To induce investment in ICT infrastructure, Law No. 36 of 1999 is introduced concerning the elimination of a telecommunications operation monopoly. Entering the 21st century, the Indonesian Government deregulated the telecommunications sector by opening free-market competition, Telkom no longer monopolizes Indonesian telecommunications. In 2001 Telkom bought 35% of Telkomsel's shares from PT Indosat as part of the implementation of the restructuring of the telecommunications service industry in Indonesia, which was marked by the elimination of joint ownership and cross-ownership

between Telkom and Indosat. To maintain growth in a competitive industry environment Telkom has transformed from an Information and Telecommunication company into a TIME (Telecommunication, Information, Media, Edutainment) company by maintaining the legacy business and developing the new wave business.

The development of telecommunications in Indonesia has entered a new phase after the enactment of Law No. 36/1999 concerning Telecommunications with the rapid development of the information technology industry. Cell phone coverage has reached all provinces in Indonesia and parts of regencies/ cities in Indonesia. More telecommunications providers are increasingly growing types of telecommunications services provided ranging from fixed telephones, mobile telephones, and wireless telephones. Cellular communication is not only voice communication, but it also extends to data communication. It became difficult to separate the activities of telecommunications services with applications. The growth of telecommunications service users and telephone customers, especially for mobile telephones, is also higher with the increasing number of applications attached to telecommunications equipment. The growth of the telecommunications services sector is the highest in the Indonesian economy growth compared to other sectors.

Since cellular telecommunications services began to develop in the mid-1990s in Indonesia, the number of cellular phone users has continued to increase from year to year. In 2001, GPRS (General Packet Radio Service) technology was introduced, with its ability to communicate data packets. This technology is often referred to as the generation of two and a half (2.5G), then refined by EDGE (Enhanced Data Rates for GSM Evolution) in 2002, commonly referred to as the generation of two point seven five (2.75G). In 2004 operators began to emerge with a third technology (3G). With the development of cellular technology which is getting better, from 2007 cellular subscribers have touched as many as 38 million customers.

With the vast geographical area of Indonesia making cellular mobile technology the first choice in communicating by the people of Indonesia. In 2010, cellular communication customers had touched 175.18 million customers and resulted in fixed telephone subscribers declining from 11.67% of Indonesia's population in 2008 to 2017 to only 2.32%. Due to the development of cellular technology, in 2014 fourth-generation cellular technology (4G) was already operating in Indonesia. The technology makes choices in communicating using data packages. Since then, cellular subscribers have increased from time to time to date.

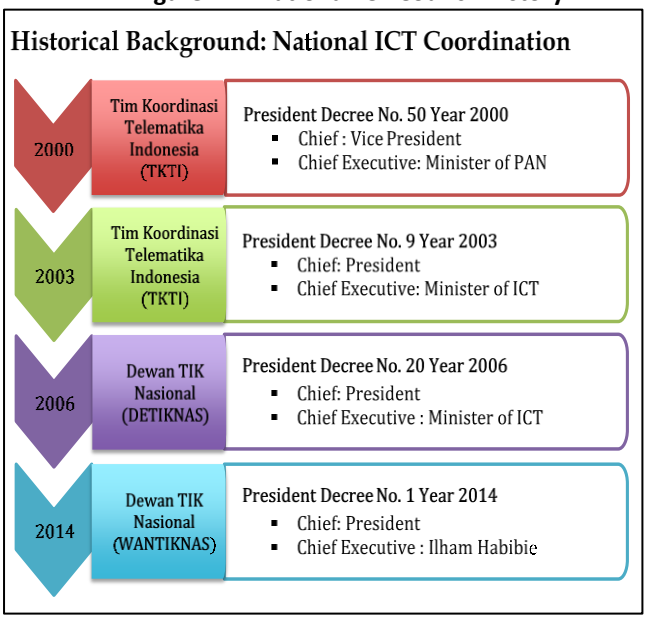
In the 1994s, the first commercial ISP began operation. An initial connection to the Internet is done using dial-up. Initial access used text mode with a shell account, Lynx browser, and pine e-mail client on the AIX server. Beginning in 1995, several Bulletin Board System (BBS) in Indonesia offered Telnet access services abroad by using the Lynx remote browser in the US, so that Internet users in Indonesia could access the Internet using HTTP.

Since 1994 the Internet has entered Indonesia with a primary Top-Level Domain ID (TLD ID), then continued with a second-level domain. The first ISP (Internet Service Provider) in Indonesia that is connected to the Internet with a bandwidth capacity of 64 Kbps. From that moment on, Indonesia's internet access continued to grow with time. With the development of the Internet, in 1996 APJII (Indonesian Internet Service Providers Association) was established. APJII then make annual surveys for estimating internet users. In 2001 only 4.2 million people or 1.9% of the population is connected to the internet. But now in 2018, the number is increasing extensively to 171.17 million users or 64.8% of Indonesia's population.

Going forward, developing wireless technology will be even better with the adoption of Industry 4.0 by the Indonesian government and telecommunications infrastructure to be a necessity and enabler in the industrial revolution [Satriya, Agenda Besar Menanti Depkominfo, 2005].

Besides the MICT, Indonesia also has National ICT Council called WANTIKNAS. As a Multi-stakeholder Institution, WANTIKNAS has a duty to formulate the strategic direction about Information and Communication Technology. In this case, WANTIKNAS which is trusted by the Minister of Political, Law, and Security has a right to give a solution about cyber defense and attack [Satriya, Dewan Teknologi: Harap Cemas Menanti Kemajuan Teknologi Informasi, 2006]. A brief explanation of the National ICT Coordination Agency is described in Figure 2.2.

Figure 2. 2 National ICT Council History



Source: (WANTIKNAS)

ICT SECTOR CONTRIBUTION

Indonesia is today one of the fastest-growing economies in the world. The main focus of its economy is the export of goods such as textiles, automobiles, electrical appliances, and oil and gas. But nowadays, one of the sectors with a great contribution to the GDP growth is the ICT sector as shown in Figure 2.3.

Based on McKinsey's report, Indonesia ranked first as the country that recorded the fastest growth in adopting a digital economy, scored 99 of 100 [McKinsey, 2019]. The digital economic adoption growth index is calculated based on the level of digital applications by individuals, businesses, and governments on three pillars. The three pillars are the digital foundation (availability and download speed), digital reach (data consumption per user), and digital value (use in digital payments or e-commerce).

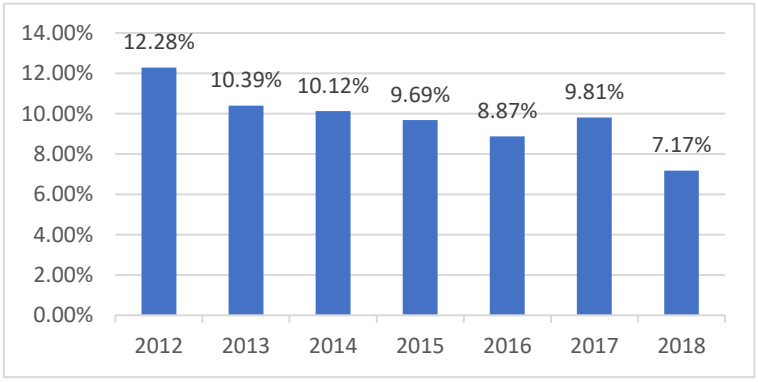
Indonesia's growing digital economy has also contributed significantly to the nation's growth and the republic is digitalizing rapidly. Social media usage in the country is also among the highest in the world. According to a recent McKinsey report, Indonesia's e-commerce sector is comprised of US$5 billion of formal e-tailing and more than US$3 billion of informal commerce [McKinsey, 2018]. E-tailing businesses are the ones that many of us are familiar with and include the likes of eBay and Amazon. In Indonesia, the notable e-tailing websites are JD, Lazada, Shopee, and Tokopedia. Conversely, informal commerce involves the buying and selling of goods through unofficial means such as the use of social media and messaging platforms like WhatsApp and Facebook.

Among the main reasons e-commerce has seen such a rapid rise in Indonesia is the increase of smartphones being used there. As opposed to online users in Europe or the United States, most Indonesians have skipped the digital evolution from personal computers to laptops and tablets, and have gone on straight to smartphones. It is reported that mobile penetration in Indonesia is over 20% against the population, and more than 64.8% of the population are connected to the internet.

Smartphones are also more affordable than desktop computers and laptops which makes them highly accessible to the majority of Indonesians. With more than 40 percent of its population on smartphones, about 70 percent of the country's internet traffic comes from these devices. The McKinsey report highlighted that almost 75 percent of Indonesia's online shoppers use mobile devices – a much higher rate than neighboring Malaysia (62 percent) and the farther United States (39 percent).

Indonesia's flourishing e-commerce sector, however, cannot just be attributed to its growing base of consumers, but also to the creative industries and online sellers too [Satriya, Telekomunikasi, Industri Kreatif, dan Tantangannya, 2009]. The number of online sellers in Indonesia has doubled every year for the past few years. It reached a total of 4.5 million active sellers in 2017. About 99 percent of these are microenterprises and half

Figure 2. 3 Information and Communication Sector Contribution for GDP Growth

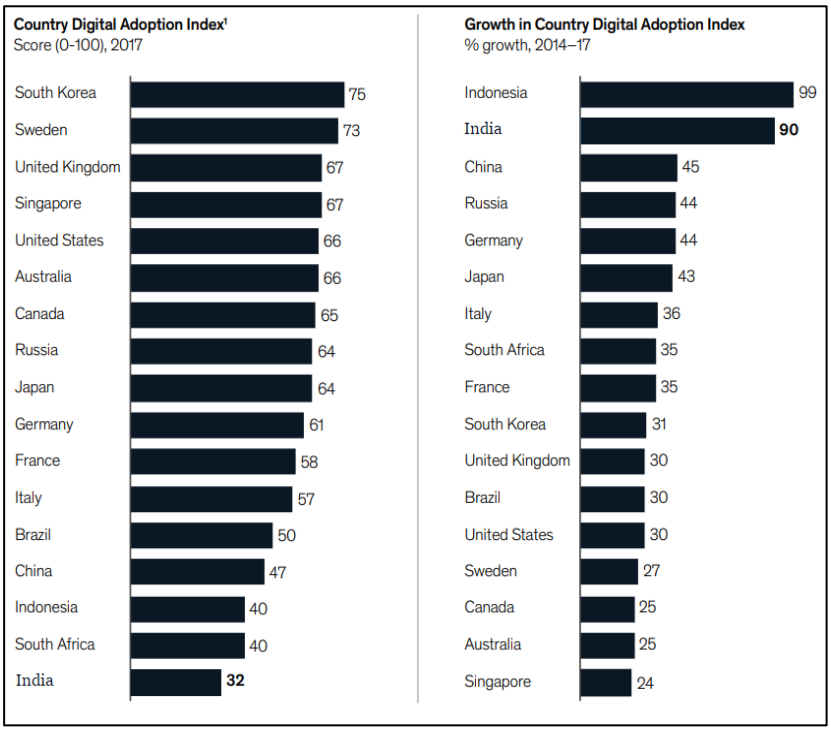


Source: **(Deputy Assistant for ICT and Utility)**

of them are online-only businesses with no physical store presence. This number is relatively small against 59.2 million units of MSMEs with 61.41% contribution to the country's GDP. The Ministry of Industry said the revenue of Small and Medium Industries increased seven times after marketing its products through digital platforms. [Alika, 2019]

The Indonesian e-commerce market is projected to grow eightfold from 2017 to 2022 with e-tail spending growing from US$5 billion to US$425 billion [McKinsey, 2018]. Social commerce spending is expected to grow from US$3 billion to between US$15 billion and US$25 billion. As digitalization occurs, the digital economy could well be one of the main pillars of Indonesia's economy in the future.

Figure 2. 4 Country Digital Adoption Index and Growth



Source: [McKinsey, 2019]

Regulation Number 52/53 the Year 2000

As proposed by MICT, Coordinating Ministry for Economic Affairs together with all stakeholders, especially all telecommunications operators, held coordination meetings on the article/ clause to be stipulated in the revision of Government Regulation Number 52 Year 2000 and Government Regulation Number 53 Year 2000. The principal amendment to the 2 Government Regulations is essentially regulating the problem of backbone network sharing and spectrum of the network between operators. The rules of sharing among operators must be based on the principle of fairness on a clear investment calculation basis. This amendment is needed to utilize broadband infrastructure to support the telecommunications industry ecosystem to achieve efficient telecommunications operations, accelerate the development of national telecommunications infrastructure and services, and implement compliance with rules and coordination between stakeholders. However, the amendments have never been signed yet by President, probably due to lack of article on Telecommunication Law Number 36 Year 1999 to accommodate these issues.

Local Contents for ICT Sectors

Indonesia Government through three ministries, MCIT, Ministry of Trade and Ministry of Industry agreed to issue two schemes of local content calculations for 4G LTE cellphones with 30 percent minimum percentage of local content starts in January 2017. The two schemes include hardware and software calculations.

For the two schemes, there are several components of the calculation. For hardware, it is divided into 70 percent manufacturing, 20 percent development, and 10 percent application. While for software the composition is 70 percent application, 20 percent development, and 10 percent manufacturing. These schemes have been stipulated in the form of Ministerial Regulation No. 29 of 2017 titled Provisions and Procedures for Calculating Local Content Composition for Cellular Phones, Handheld Computers, and Tablet Computers. The government is encouraging the usage of local content products on strategic projects funded by the state and manufacturing production in Indonesia. This effort is to increase the productivity and competitiveness of national industries.

Other regulations related to the implementation of local content, including Government Regulation No. 29 of 2018 concerning Industrial Empowerment, Presidential Decree No. 24 of 2018 concerning the National Team for Increasing Use of Domestic Production, and Regulation of the Minister of Industry No. 29 of 2017 concerning

Provisions and Procedures for Calculating the Value of TKDN for Products Cellular Phones, Handheld Computers, and Tablet Computers.

Broadband Infrastructure: Palapa Ring and Satellite

The development of ICT infrastructures in Indonesia, such as the Palapa Ring and Multifunctional Satellite Projects has been deemed successful in implementing universal service obligation (USO) policies [MCIT, 2019]. Although faced with a number of challenges as an archipelago, strategic projects in ICT sectors are developed optimally. The number of countries in the ASEAN region make Indonesia an example for developing ICT infrastructure.

The Palapa Ring project, which has been 100% completed. The Palapa Ring will provide high-speed broadband access to the most remote areas in Eastern Indonesia, providing connectivity and internet penetration to all 514 cities on all major islands in Indonesia, such as Java, Sumatra, Kalimantan, Sulawesi, Maluku, and Papua. The broadband project developed by the Government through the PPP scheme has a high speed and coverage of more than 12,000 km of submarine and terrestrial fiber optic cables, 49 Microwave Hops, and covers mountainous areas with limited electricity resources. In providing terrestrial and VSAT technology in remote areas to integrate the Indonesian network, a number of funds originating from PPP are allocated to meet all the needs of the community in the most efficient and effective way, including in the distribution of telecommunications infrastructure [MCIT, 2019].

Universal Service Obligation (USO)

Implementation of USO is based on Law of the Republic Indonesia No. 36 of 1999 regarding telecommunications leaving monopoly to full competition [MCIT, 2015],

• With the agreement of all Network Operators in 2005, All Operators will contribute 1.25% of their gross revenue for implementing the USO program. This was endorsed by Government Regulation No 7 of the year 2009, and the Government takes responsibility for implementing the USO programmers.

• The government established Public Service Agency (BLU)-BPPPTI (now BAKTI) under the Ministry of MCIT and report to both Minister of MCIT and MoF,

• BAKTI tasks are not only building ICT in villages, but also other ICT facilities to provide a cheaper cost of the Internet and broadband. Further, BAKTI plays a role to set up the eco-system and build up broadband in the country.

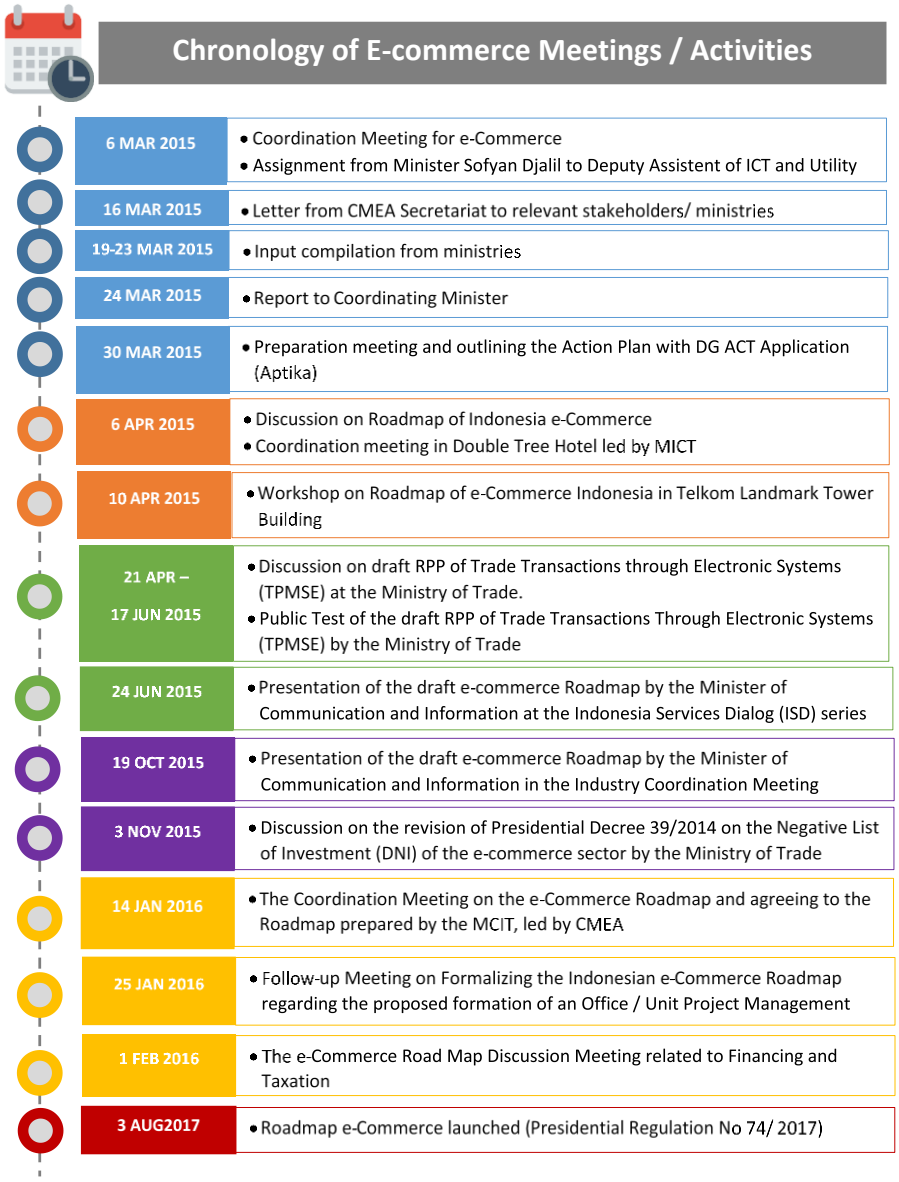
Roadmap E-Commerce

The development of online business in Indonesia which is very fast requires a sound development policy, and regulated legal certainty, for the protection of the industry, community, and consumers as well. Anticipating this, in the Coordination Meeting on March 6, 2015, Coordinating Minister for the Economic Affairs (Mr. Sofyan Djalil) has made the preparation of an E-Commerce Roadmap. As shown in Figure 2.5, Deputy Assistant for ICT and Utility together with Minister Rudiantara lead several meetings in order to get input from the related ministries and elaborate those ideas and inputs into E-Commerce Roadmap. The meetings and activities are summarized in Figure 2.6.

Figure 2. 5 Stakeholder Meeting on E-Commerce Road Map Preparation

Source: Deputy Assistant for ICT and Utility

Figure 2. 6 Chronology of E-Commerce Meetings/Activates



Source: (Deputy Assistant for ICT and Utility), 2018

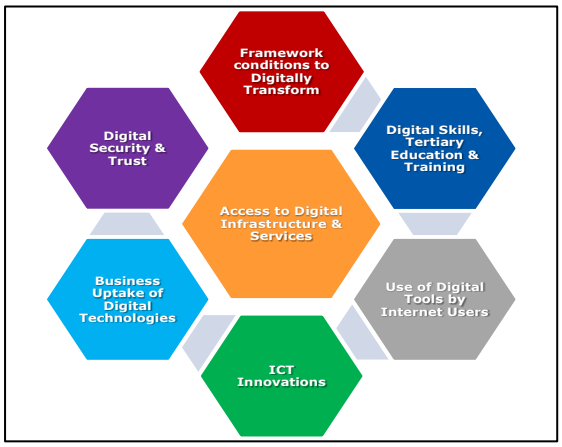
BUILDING THE FOUNDATION FOR DIGITAL ECONOMY

FRAMEWORK CONDITIONS TO DIGITALLY TRANSFORM

Digital transformation does not occur in isolation; it is shaped by and contributes to shaping, the broader economy, and society as a whole.

Framework policies play an important role by ensuring that the conditions exist for the digital transformation to flourish. This includes Regulations, Policies, and Investment Guide in ICT.

Figure 2. 7 Access to Digital Infrastructure and Services



Source: **(DEPUTY ASSISTANT FOR ICT AND UTILITY)**

DIGITAL SKILLS, TERTIARY EDUCATION, AND TRAINING

Without an adequate ICT Industry and skilled resources, digital transformation would be limited.

These areas look at businesses that offer positions for ICT specialists, businesses that offer ICT training and ICT graduates.

USE OF DIGITAL TOOLS BY INTERNET USERS

Internet users using common digital technologies or engaged in selected online activities: cloud computing, online courses, health information and searches, e-banking, online purchases, social networks, content creation, and e-government.

ICT INNOVATIONS

ICT research and development expenditures, ICT shares of total value-added and employment, as well as the proportion of ICT specialists, are significantly higher in digital economies.

The focus should be on research and development, Patents, ICT e-Government, e-Commerce, Mobile Banking, and Social Media.

BUSINESS UPTAKE OF DIGITAL TECHNOLOGIES

Policies must be enabled to help the effective use of digital technologies by workers, firms, and governments; policies that foster innovation and help address challenges in specific sectors of the economy; and policies that promote the use of digital technologies to improve the functions of governments and public service delivery.

Focus is on Industry Digitization and ICT Spend.

DIGITAL SECURITY AND TRUST

Indicators of digital security and trust in performing digital economies include a focus on privacy and security concerns as well as cybersecurity.

ACCESS TO DIGITAL INFRASTRUCTURES AND SERVICES

Digital infrastructures, including efficient, reliable and widely accessible broadband.

Communication networks and services, data, software, and hardware, are the foundations of the digital economy is based. It is essential that governments promote investment in digital infrastructures and innovation throughout the internet ecosystem

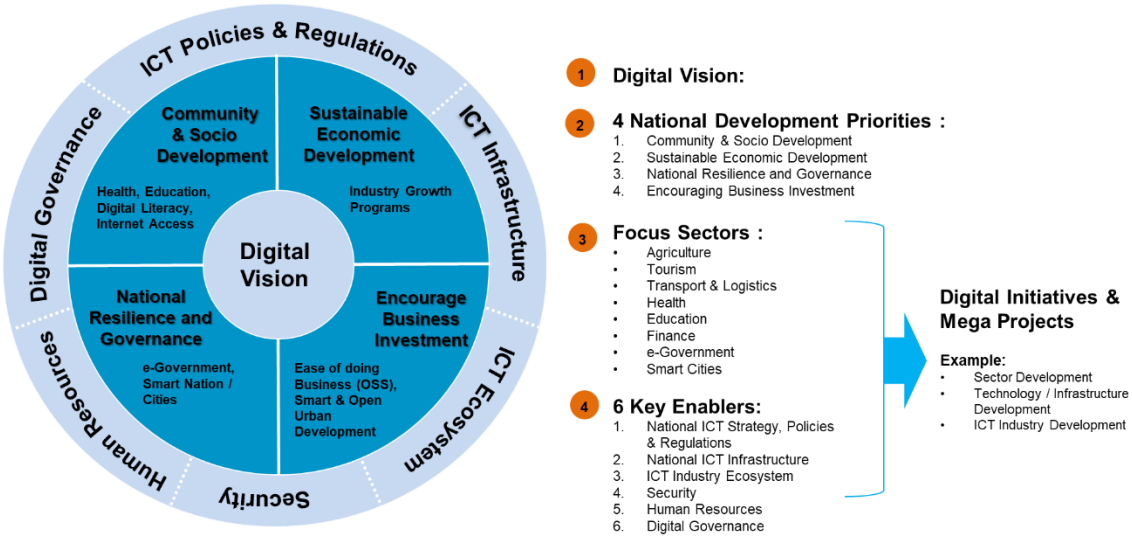
SETTING THE DIGITAL AGENDA

Since the 1990s ICT has made a major contribution to the growth and productivity of many nations around the world. ICT is a driver of innovations in products, processes, and organizations, and in industrial and services sectors. If information can be transmitted electronically, transaction costs will be lowered and enterprises and governments will be able to devote more time to expand business.

Developments such as; global e-commerce supply chains, online mobile banking, personal health remote diagnostic tools, and tourism exchanges, have changed the way industries operate and most importantly have eliminated geographical boundaries. The world of ICT and the Internet is global and unstoppable. That is why most countries around the world are setting their National Digital Agendas to; deliver socio-economic growth, growing cities and nations in a sustainable way, ensure governments operate efficiently and effectively in delivering their services, and generally to compete in the global digital economy and drive GDP.

INDONESIA DIGITAL KEYS AGENDA

Figure 2. 8 ICT Vision in Indonesia



SOURCE: (Deputy Assistant for ICT and Utility)

INDONESIA'S DIGITAL COMPETITIVENESS IS RISING

Indonesia became the country with the second-highest competitiveness ranking upgrade after China in 2019. Indonesia's ranking in the International Institute of Management Development (IMD) World Digital Competitiveness Ranking which measures the capacity and readiness of 63 countries in adopting and exploring digital technology to drive business transformation, government and society – rise from 62nd in 2018 to position 56th in 2019. The main driver for the rise in Indonesia's position is the strengthening of supporting factors for technological development, especially in terms of capital availability. Indonesia rise 6 positions about the availability of capital for technology development of banking and financial services technology. Indonesia ranks 13th globally about the support of venture capital for technology development. Indonesia also ranks 8th in the category of ability to adapt to business trends through the use of big data and analytics. The

availability of capital for companies developing business in technology is very abundant, investor support is not only available for some companies that have achieved unicorn valuation, but also for start-up companies that are just starting a business. The success of large technology companies such as Gojek, Bukalapak, and Tokopedia helped to drive the digitalization of the MSME business.

INDONESIA COMPETITIVENESS RANKING

Minister of Communication and Information said that increasing digital competitiveness was one of the factors supporting the surge in the competitiveness of the national economy. It is in line with the ranking released by IMD, shows that Indonesia's competitiveness in the World Competitiveness Ranking in 2019 has jumped 11 ranks from position 43 to 32. The success of Indonesia gets three unicorns and one decacorn, making capital flow for technology business more vigorous. These companies are also aggressively developing business through the use of big data and machine learning. The Minister also said that Indonesian ICT spending is far behind that of neighboring countries. ICT spending for corporate and government is only 0.1% of GDP compared to Thailand at 0.3% of GDP and Malaysia at 0.6% of GDP. In fact, based on per capita technology expenditure, the portion of Thailand's expenditure reaches 20 times that of Indonesia. The government has tried to start massive construction through the high capacity Palapa Ring and Satellite project. This success can be used to optimize and expand digitalization in the Education sector, such as maximizing the digitalization of the learning process or the issuance of certificates electronically. This step is needed to equalize education and the benefits to society in the digital sector to rural areas.

CHAPTER 3

CONNECTIVITY, ICT INFRASTRUCTURE, AND BIG DATA

National ICT infrastructure Transformation

Broadband connectivity is the pedestal of the digital economy. It is a nationwide infrastructure like road and canal, bringing digital to persons, families, and organizations, and making a platform for digitalization of governance, healthcare, education, trade, finance, energy, and transport.

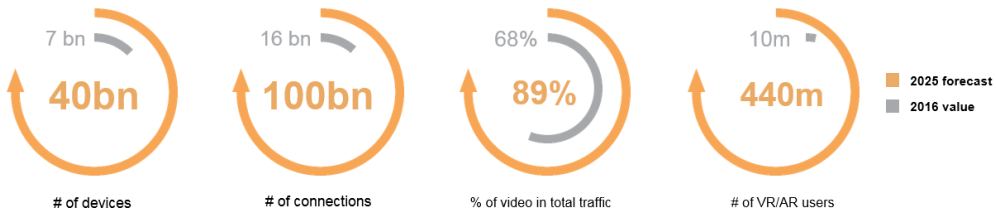
In the digital economy development strategy of emerging countries, building broadband connectivity is the first step and the focus of the public investment. On a high-quality infrastructure, digital applications can be developed and prosper, then, digital usage can be deepened and promoted. Finally, as described in Figure 3.1, the value of digitization was eventually multiplied nationwide through demographic dividends. For Indonesia, "the launch of the Indonesia Broadband Plan (IBP) as stated in Presidential Decree No. 96 of 2014 marks an important milestone" [Satriya, Jokowi, Zuckerberg and Broadband, 2014]

GLOBAL OVERVIEW

Across the world, broadband development is accelerating and is expected to fulfill multiple sustainable goals set for the future. According to Global Industry Vision report, 2025 Global Broadband Network estimates:

- Connections will reach 100 billion
- In developing economies, individual connections will increase by 48%
- Broadband will be used in 75% of homes bridging the spatial distance on economic activities
- Smart Phones will increase by 250%.

Figure 3. 1 Sustainable Development Goal



Source: (Huawei, 2019)

In more detail, as shown by Cisco Visual Networking Index in Table 3.1, broadband continues to grow to meet greater data transmission needs.

Table 3. 1 Cisco Visual Networking Index

Wired/Wi-Fi/Mobile Traffic:

- Globally, fixed/wired IP traffic will reach 116.8 EB per month by 2022, up from 58.3 EB per month in 2017.
- Global fixed/wired IP traffic grew by 21% in 2017.
- Globally, fixed/wired IP traffic will grow 2-fold from 2017 to 2022, a compound annual growth rate of 15%.
- Global fixed/wired was 48% of total IP traffic in 2017 and will be 29% of total IP traffic by 2022.
- Global fixed/wired was 35% of total Internet traffic in 2017 and will be 21% of total Internet traffic by 2022.
- Globally, fixed/Wi-Fi IP traffic will reach 201.8 EB per month by 2022, up from 52.5 EB per month in 2017.
- Global fixed/Wi-Fi IP traffic grew by 34% in 2017.
- Globally, fixed/Wi-Fi IP traffic will grow 4-fold from 2017 to 2022, a compound annual growth rate of 31%.
- Global fixed/Wi-Fi was 43% of total IP traffic in 2017 and will be 51% of total IP traffic by 2022.
- Global fixed/Wi-Fi IP traffic will be 1.7X Fixed/Wired IP traffic by 2022.
- Global fixed/Wi-Fi was 53.0% of total Internet traffic in 2017 and will be 56.8% of total Internet traffic by 2022.
- Global fixed/Wi-Fi Internet traffic will be 2.7X Fixed/Wired Internet traffic by 2022.
- Globally, mobile IP traffic will reach 77.5 EB per month by 2022, up from 11.5 EB per month in 2017.

Network Speeds:

- Globally, the average fixed broadband speed will grow 1.9-fold from 2017 to 2022, from 39.0 Mbps to 75.4 Mbps.
- Globally, the average fixed broadband speed grew 42% from 2016 to 2017, from 27.5 Mbps to 39.0 Mbps.
- Globally, 98% of fixed broadband connections will be faster than 5 Mbps by 2022, up from 84% today.
- Globally, 95% of fixed broadband connections will be faster than 10 Mbps by 2022, up from 69% today.
- Globally, 79.0% of fixed broadband connections will be faster than 25 Mbps by 2022, up from 42.4% today.
- Globally, 62.9% of fixed broadband connections will be faster than 50 Mbps by 2022, up from 29.2% today.
- Globally, the average mobile connection speed was 8.7 Mbps in 2017.
- Globally, the average mobile connection speed will grow 3-fold from 2017 to 2022, reaching 29 Mbps by 2022.

INDONESIA OVERVIEW

In the first two decades of this century, Indonesia has ushered in the rapid development of ICT infrastructure. With the rapid spread of Fixed Broadband and 2G and 3G mobile technologies, typical services represented by voice, text (Email), pictures (web browsing) and video have changed the way people communicate and access information.

Compared with the economic volume ranking, Indonesia's broadband infrastructure has a lot of room to improve. Figure 3.2 shows Indonesia Ranking on Broadband. GDP means Gross Domestic Product, IDI means ICT Development Index, and FBB stands for Fixed Broadband.

Figure 3. 2 Indonesia Broadband Ranking

Index	GDP	GDP per Capita	IDI	Speedtest Global Index	
				FBB	Mobile
Ranking	16th	110th	111st	104th	125th
Total	222	222	176	176	145

Source: (ITU), (World Bank), (Ookla speedtest)

Indonesia is the 16th largest economy all over the world by the GDP ranking. Although the GDP per capita is more than 100th in the ranking, not as high as GDP, it implies the huge potential to concentrate resources (policy and investment) and to build an ICT infrastructure that is regionally leading and serves the entire society through concentrating resources (policy and investment).

In stark contrast to the ranking of GDP, Indonesia is currently ranked 111th out of 176 countries in the ITU's IDI rankings, one of the starters of ICT development. According to Ookla's speedtest ranking in September 2019, FBB and MBB are located at 104th and 125th respectively. In the momentum of rapid growth and development in Indonesia, ICT and GDP show a contrast of 100 and 10.

That is the significant challenge Indonesia faces if it is to successfully continue the building of the telecommunications infrastructure required to support a large population spread over the sprawling archipelago nation.

IDI implies more details to identify the direction to improve the ICT infrastructure.

Table 3. 2 ICT Development Index

COUNTRY	2017 RANKING	2016 RANKING	CHANGE
Korea	2	1	▼ 1
Hong Kong	6	6	—
Japan	10	11	▲ 1
New Zealand	13	12	▼ 1
Australia	14	16	▲ 2
Singapore	18	20	▲ 2
Brunei	53	54	▲ 1
Malaysia	63	62	▼ 1
Thailand	78	79	▲ 1
China	80	83	▲ 3
Philippines	101	100	▼ 1
Vietnam	108	108	—
Indonesia	111	114	▲ 3
India	134	138	▲ 4

Source: (ITU, ICT Development Index, 2017)

This ranking is based on a combination of; Mobile and Fixed Subscriber base, Broadband Subscriber base, Internet Subscriber base, International and Local Bandwidth to support Internet, access to PCs and Smart Devices, and ICT Skills and Digital Literacy

In terms of household penetration, Indonesia is still at a low level of 11% as shown in Table 3.3. Although the per capita GDP of Indonesia is higher than that of the Philippines and Vietnam, its penetration is far from the latter.

Regarding Average Fixed Broadband (FBB) speed, Indonesia just reaches 19 Mbps while the Philippines and Malaysia already upgrade to 27Mbps and

85Mbps respectively. In fact, more than 80% FBB package in Indonesia is lower than 10Mbps.

Compared with other developing countries in South-Eastern Asia, Indonesia's communication infrastructure level does not match its level of economic development.

Table 3. 3 Penetration and FBB Speed in Eastern and South-Eastern Asia in 2018

Country	Household Penetration	Average FBB Speed(Mbps)
Singapore	117.3%	130
South Korea	112.0%	165
China	88.6%	100
Vietnam	63.0%	47
Thailand	44.5%	100
Malaysia	36.5%	85
Philippines	22.4%	27
Indonesia	11.0%	19

Source: (OVUM WBIS Subscription Forecast 2018 & Speedtest)

GNI per capita values of 2 to 5 per capita are the standard and normally practiced benchmarks for the affordability of ICT services. In Asia Pacific region, few countries already achieved this target, while other countries in which Indonesia still have 7.4 GNI per capita as per the last 2 years and need to struggle fast and becomes aggressive in lowering down **the GNI per capita to 3.5% as a good acceptable standard for year 2023 to 2024.**

Table 3.4 shows the rankings of different Asia Pacific countries in terms of fixed broadband basket GNI per capita. as taken from ITU publication (statistical report) "Measuring the Information Society Report Volume 1", 2018.

As a conclusion drawn from ITU publication report, it is much cleared that Indonesia needs to be more aggressive for fixed broadband penetration and plays aggressively in building fixed broadband infrastructure readiness in the coming 4 to 5 years.

Table 3. 4 2017 Fixed-broadband basket of Asia Pacific Region – data source

RANK	Country Name	As %of GNI per capita	USD
11	Brunei Darussalam	0.73	18.10
13	Singapore	0.80	36.14
35	Malaysia	1.16	9.37
53	Vietnam	1.51	2.74
94	Thailand	3.80	18.88
118	Philippines	6.50	19.82
123	Indonesia	7.94	23.43

Table 3. 5 Indonesia Key Indications 2017

Key indicators for Indonesia (2017)		Asia & Pacific	World
Fixed-telephone sub. per 100 inhab.	4.2	9.5	13.0
Mobile-cellular sub. per 100 inhab.	173.8	104.0	103.6
Active mobile-broadband sub. per 100 inhab.	95.7	60.3	61.9
3G coverage (% of population)	93.8	91.3	87.9
LTE/WiMAX coverage (% of population)	90.4	86.9	76.3
Individuals using the Internet (%)	32.3	44.3	48.6
Households with a computer (%)	19.1	38.9	47.1
Households with Internet access (%)	57.3	49.0	54.7
International bandwidth per Internet user (kbit/s)	21.2	61.7	76.6
Fixed-broadband sub. per 100 inhab.	2.3	13.0	13.6
Fixed-broadband sub. by speed tiers, % distribution			
-256 kbit/s to 2 Mbit/s	43.6	2.4	4.2
-2 to 10 Mbit/s	12.7	7.6	13.2
-equal to or above 10 Mbit/s	43.7	90.0	82.6

Source: (ITU, ICT Development Index 2018)
Note: Data in Italics are ITU estimation

The World Economic Forum analysis provides a good indication that improvements are needed across the board. While Indonesia is improving, continued progress in the development of the telecom sector and services is needed.

VISION AND GOALS

It has become a consensus that broadband connectivity is the infrastructure of the digital economy, just like roads and canal in countrywide providing an entrance to the digital world, and like the electricity to improve the productivity for persons, households, organizations, and things.

In the first two decades of this century, Indonesia has committed to the rapid development of digital communication. With the rapid spread of cellular mobile coverage and remarkable improvement of fixed broadband quality, digital penetration in Indonesia has been improved significantly.

With the growth of the market, the evolution of technology, and the richness of services, the next five years, for broadband connectivity, will be a new stage of accelerated development and deep integration with other industries for more innovation.

Based on the development trend of future digitalization and broadband connectivity, Broadband Vision 2024 is proposed: "**A smart society and digital market enabled by broadband**".

This vision is to promote, facilitate and foster affordable and universal access to telecommunication/information and communication technology networks, services and applications and their use for social, economic and environmentally sustainable growth and development. It will also help build a leading infrastructure for Indonesia and take a favorable position in the global digital transformation wave.

In order to turn the vision into reality, 3 key tasks for broadband development are proposed:

- **Bridge the digital divide**
  - Ubiquitous connectivity and all connected
  - Popularize high-quality experiences
  - Narrow the digital divide with developed markets
  - Bridge the domestic digital divide for rural areas
- **Establish regional leadership**
  - Create a group of dual gigabit cities
  - 4G+5G mobile target network
  - Establish regional leading benchmarks
- **Unlock digital innovation**
  - improve digital vitality by enhancing competition

Prioritize building a forward-thinking broadband infrastructure in value areas that encourages digital innovation.

DEFINITION OF BROADBAND

Definition of broadband is the specific measure for the 3 key tasks to reach a consensus and concentrate resources on broadband construction and investment.

Three aspects have been considered before the definition.

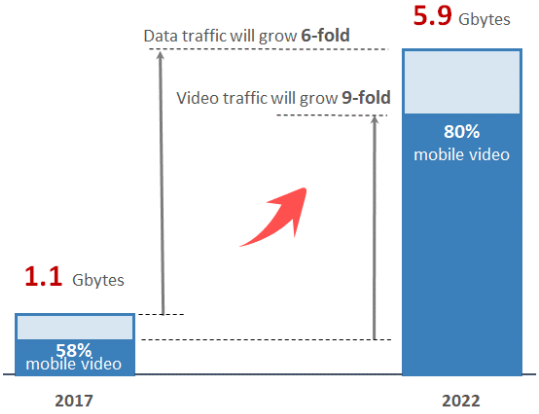
- To meet demands and stimulate the supply
- To follow and surpass the global broadband development
- To encourage the evolution and unlock the innovation

To meet demands and stimulate the supply

The connection standard needs to meet the basic requirements of MBB full service, and video is the benchmark business of current and future. Tracing according to the video standard to meet MBB full-service requirements.

Among the contents carried by mobile networks, video services account for about 58% of mobile traffic in Indonesia (globally 60.1% of traffic), and it is expected that the proportion of this service will reach 80% in 2022, with CAGR (2017-2022) of 36%. Video service has become the benchmark service for broadband network bearers, providing users with an immersive experience for communication. In other words, the video network becomes to be the basic attribute of digital infrastructure. Connectivity is first shocked and becomes the premise of the digital evolution of the social economy, considering that the network that cannot deliver video are difficult to be classified as high-quality broadband. In addition, the broadband infrastructure which is able to deliver the video is also able to deliver the universal service in an efficient way.

Figure 3. 3 Comparison of mobile data traffic per connection per month in Indonesia (2017 vs 2022)



Source: (Cisco VNI, 2017)

YouTube, a giant of the video platform, provides a reference for the connection speeds required by different video sources. This is one of the input items for broadband definition. The speed of 10 Mbps or higher can provide users with high-definition video experience on mobile screens; while on 4D video content on large screens, such as smart TVs, the download rate requirements increase to 20 to 60 Mbps.

Table 3. 6 Live encoder settings, bitrates, and resolutions of video service

Video Format	Resolution	Video Bitrate Range
4K @ 60 fps	3840 * 2160 p	20,000 - 51,000 kbps
4K @ 30 fps	3840 * 2160 p	13,000 - 34,000 kbps
1440p @ 60 fps	2560 * 1440 p	9,000 - 18,000 kbps
1440p	2560 * 1440 p	6,000 - 13,000 kbps
1080p @ 60 fps	1920 * 1080 p	4,500 - 9,000 kbps
1080p	1920 * 1080 p	3,000 - 6,000 kbps
720p @ 60 fps	1920 * 720 p	2,250 - 6,000 kbps
720p	1920 * 720 p	1,500 - 4,000 kbps
480p	1920 * 480 p	500 - 2,000 kbps

Source: (YouTube)

Note: "fps" means frames per second; "video bitrate" is smaller than the speed of air-interface, and the latter is more than 1.3 times of the former.

FCC (Federal Communications Commission) in United States provides a broadband Speed guide to describe why they select 25 Mbps as the downlink speed standard for universal service. For household with multi-family members, the standard should be higher.

Table 3. 7 Broadband Speed Guide from FCC

Activity	Minimum Download Speed (Mbps)
General Usage	
General Browsing and Email	1
Streaming Online Radio	Less than 0.5
VoIP Calls	Less than 0.5
Social Media	1
Student	5 - 25
Telecommuting	5 - 25
File Downloading	10
Watching Video	
Streaming Standard Definition Video	3 - 4
Streaming High Definition (HD) Video	5 - 8
Streaming Ultra HD 4K Video	25
Video Conferencing	
Standard Personal Video Call (e.g., Skype)	1
HD Personal Video Call (e.g., Skype)	1.5
HD Video Teleconferencing	6

Source: (FCC, 2019)

To follow and surpass the global broadband development

Building a high-quality national universal service is a key part of building a nationally unified digital platform and market. The definition of broadband universal service has gradually become a global consensus.

ITU Strategy 2020-2023 proposes a global goal of achieving 96% broadband coverage by 2023 and 10Mbps connectivity has become the common standard for universal service of broadband. The detail of the ITU Strategy is described in Table 3.8.

From the typical nation's definition of universal service, the speed above 10 Mbps is considered to be the speed that enables full participation in a digital society as shown in Table 3.9.

Table 3. 8 ITU Strategy 2020-2023 Target

Goal 1: Growth	Goal 2: Inclusiveness	Goal 3: Sustainability
1.1: by 2023, 65% of households worldwide with access to the Internet 1.2: by 2023, 70% of individuals worldwide will be using the Internet 1.3: by 2023, Internet access should be 25% more affordable (baseline year 2017) 1.4: by 2023, all countries adopt a digital agenda/strategy 1.5: by 2023, increase the number of broadband subscriptions by 50% 1.6: by 2023, 40% of countries to have more than half of the broadband subscriptions more than 10 Mbit/s 1.7: by 2023, 40% of the population should be interacting with government services online	2.1: by 2023, in the developing world, 60% of households should have access to the Internet 2.2: by 2023, in the least developed countries, 30% of households should have access to the Internet 2.3: by 2023, in the developing world, 60% of individuals will be using the Internet 2.4: by 2023, in the least developed countries, 30% of individuals will be using the Internet 2.5: by 2023, the affordability gap between developed and developing countries should be reduced by 25% (baseline year 2017) 2.6: by 2023, broadband services should cost no more than 3% of average monthly income in developing countries 2.7: by 2023, 96% of world population covered by broadband services 2.8: by 2023, gender equality in Internet usage and mobile phone ownership should be achieved 2.9: by 2023, enabling environments ensuring accessible telecommunications/ICTs for persons with disabilities should be established in all countries 2.10: by 2023, improve by 40% the proportion of youth/adults with telecommunication/ICT skills	3.1: by 2023, improve cybersecurity preparedness of countries, with key capabilities: the presence of strategy, national computer incident/emergency response teams, and legislation 3.2: by 2023, increase the global e-waste recycling rate to 30% 3.3: by 2023, raise the percentage of countries with e-waste legislation to 50% 3.4: by 2023, net telecom-munication/ ICT-enabled Greenhouse Gas abatement should have increased by 30% compared to the 2015 baseline 3.5: by 2023, all countries should have a National Emergency Telecommunication Plan as part of their national and local disaster risk reduction strategies **Goal 4: Innovation** 4.1: by 2023, all countries should have policies/strategies fostering telecommunication/ICT-centric innovation **Goal 5: Partnership** 5.1: by 2023, increased effective partnerships with stakeholders and cooperation with other organization and entities in the telecommunication/ICT environment

Source: (ITU, Strategy 2020-2023, 2018)

Table 3. 9 Typical nation's definition of universal service

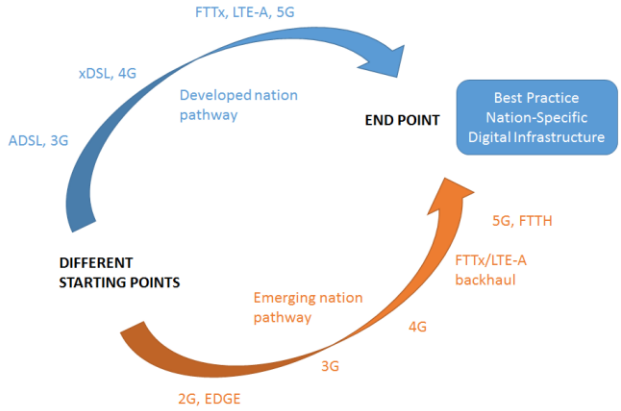
Nation	Definition of universal service	Source
U.K	⩾ 10Mbps (downstream) ⩾ 1Mbps (upstream)	Ofcom, Achieving decent broadband connectivity for everyone. 2016
U.S	⩾ 25Mbps (downstream) ⩾ 3Mbps (upstream)	FCC, Review and reset this target every 4 years. 2018
Austria	⩾ 12 Mbps (downstream)	FCC, Universal Service, 2018
Norway	⩾ 10/20 Mbps (downstream) ⩾ 2 Mbps (upstream)	OVUM, 2019

In addition to universal service, building a leading demonstration area is also a key step in digital transformation, and is promoted nationwide by stimulating innovation in areas with high digital vibrancy.

To encourage the evolution and unlock the innovation

Besides meeting the quality of existing services is a basic requirement, the definition also needs to consider the development of future technologies and services. In the next five years, evolution is the theme due to the requirement of higher efficient data delivery. The optic fiber infrastructure and 4G+5G cellular network will be the mainstay of digital information infrastructure.

Figure 3. 4 Developed and emerging national pathways to best practice digital infrastructure



Source: (Windsor Place Consulting, 2019)

Developed Nations:

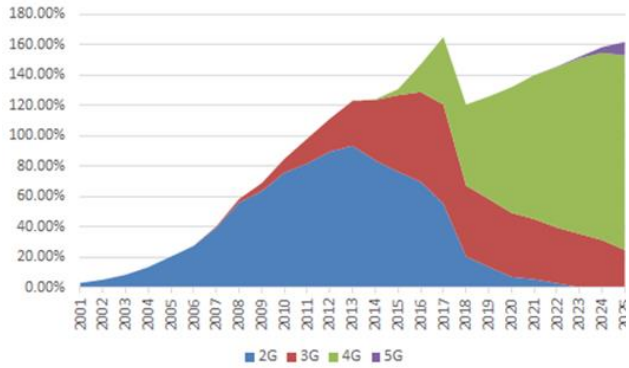
- extensive pre-existing passive infrastructure
- High fixed-line penetration
- High levels of smartphone adoption
- High GDP per capita and ARPU
- Well-developed regulatory structures

Emerging Nations:

- Less passive infrastructure
- Low fixed-line penetration
- Rapid smartphone adoption flow base
- Relatively low GDP per capita and ARPU
- Less well-developed regulatory structures

From the forecast of GSMA shown in Figure 3.5, the mobile connections in Indonesia in the next 5 years will be mainly 4G, around 128%. 5G will be emerging sharply, while 2G and 3G connections will reduce quickly to below 25%. 4G spreading and 5G development will form a ubiquitous high-speed digital infrastructure with improved efficiency. This infrastructure connects the whole country into a unified digital society, bringing innovative applications such as cloud service to more people in real-time, giving them more productive digital capabilities to meet diverse demands.

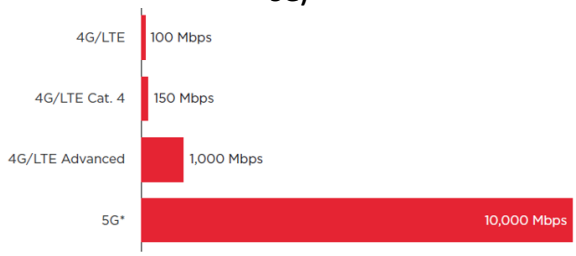
Figure 3. 5 Indonesia Mobile Connection as a % of Population



Source: (GSMA Intelligence, 2019)

Technological evolution has also made it possible to build a dual Gigabit city. FTTH provides 10 Gbps connectivity, mobile networks can provide more than 1Gpbs connectivity, and future information delivery upgrades will bring more possibilities for digital services as shown in Figure 3.6. Table 3.10 shows the performance requirements for several scenarios from 3GPP.

Figure 3. 6 Maximum theoretical downlink speed by technology generation, Mbps (10 Gbps is the minimum theoretical upper limit speed specified by 5G)



Source: GSMA Intelligence

Table 3. 10 Performance requirements for high data rate and traffic density scenarios

	Scenario	Experienced data rate (DL)	Experienced data rate (UL)	Area traffic capacity (DL)	Area traffic capacity (UL)	Overall user density	UE speed	Coverage
1	Urban macro	50 Mbps	25 Mbps	100 Gbps/km^2	50 Gbps/km^2	10 000/km^2	Pedestrians and users in vehicles (up to 120 km/h	Full network
2	Rural macro	50 Mbps	25 Mbps	1 Gbps/km^2	500 Mbps/km^2	100/km^2	Pedestrians and users in vehicles (up to 120 km/h	Full network
3	Indoor hotspot	1 Gbps	500 Mbps	15 Tbps/km^2	2 Tbps/km^2	250 000/km^2	Pedestrians	Office and residential
4	Broadband access in a crowd	25 Mbps	50 Mbps	[3,75] Tbps/km^2	[7,5] Tbps/km^2	[500 000]/km^2	Pedestrians	Confined area
5	Dense urban	300 Mbps	50 Mbps	750 Gbps/km^2	125 Gbps/km^2	25 000/km^2	Pedestrians and users in vehicles (up to 60 km/h)	Downtown
6	Broadcast-like services	Maximum 200 Mbps (per TV channel)	N/A or modest (e.g., 500 kbps per user)	N/A	N/A	[15] TV channels of [20 Mbps] on one carrier	Stationary users, pedestrians, and users in vehicles (up to 500 km/h)	Full network
7	High-speed train	50 Mbps	25 Mbps	15 Gbps/train	7,5 Gbps/train	1 000/train	Users in trains (up to 500 km/h)	Along railways
8	High-speed vehicle	50 Mbps	25 Mbps	[100] Gbps/km^2	[50] Gbps/km^2	4 000/km^2	Users in vehicles (up to 250 km/h)	Along roads
9	Airplanes connectivity	15 Mbps	7,5 Mbps	1,2 Gbps/plane	600 Mbps/plane	400/plane	Users in airplanes (up to 1 000 km/h)	

Source: (3GPP)

3GPP's definition of standards and capacities of 5G for different scenarios is another reference.

Based on the above analysis, a multi-class broadband definition (Table 3.11) is proposed to drive stakeholders to create more and more high-quality broadband connection services.

Table 3. 11 Multi-class broadband definition

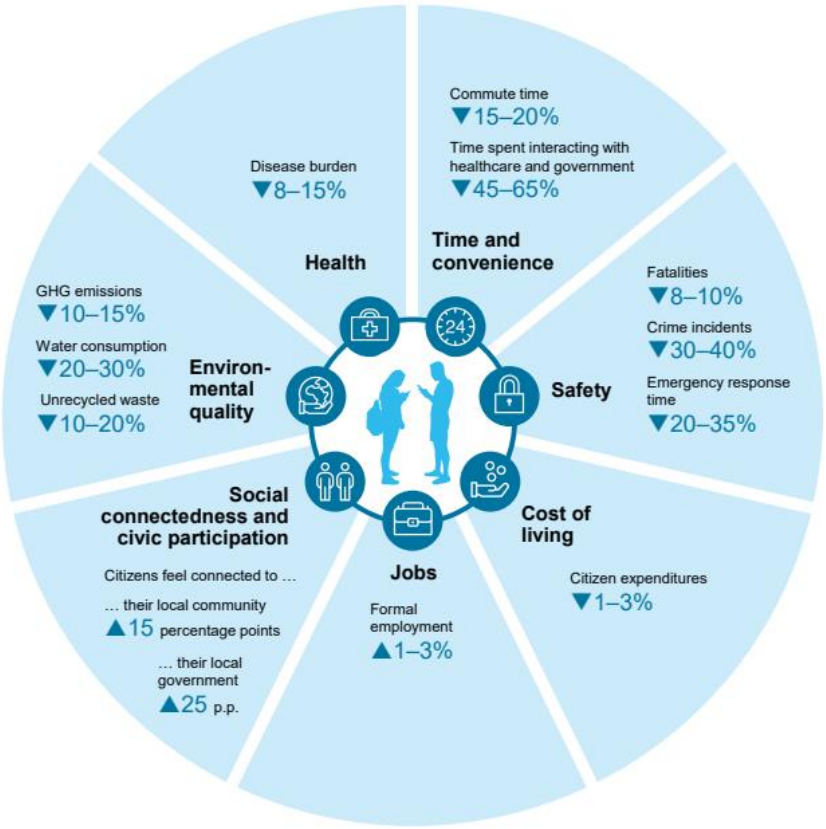
Class	Downstream Speed	Target Area	Purpose
Class 1	≥ 10 Mbps	Countrywide Rural	• Universal service for mobile connectivity reaching benchmark of HD mobile video • target of ITU strategy 2023
Class 2	≥ 25 Mbps	Countrywide Urban and Rural	• Universal service for (fixed / wireless) Home Broadband, reaching benchmark of 4K Ultra HD
Class 3	≥ 100 Mbps	Countrywide Urban	• Cloud AR/VR • Home Broadband reaching benchmark of 8K Ultra HD
Class 4	≥ 500 Mbps	Countrywide Dense Urban	• 5G universal application • 360° 8K VR
Class 5	≥ 1 Gbps	4+1 cities Dense Urban	• inGiga-bit Cities

Source: (3GPP)

DIGITAL CAPITAL ENABLED BY DUAL-GIGABIT BROADBAND

New Capital Indonesia has been announced in the Kalimantan Island. This is not only the expectation of development achievements but also the imagination of people's future urban life. A more efficient, responsive, and sustainable city is the future of the new capital [Satriya, Memindahkan Ibu Kota, Membangun Indonesia, 2007]. It should be a model of urban development at the national and even regional level, with a constant source of momentum for regional development.

Figure 3. 7 Digital city application improves quality of life



Source: (McKinsey & Company, 2018)

Among the many functions that the capital has, digitalization and intelligence are among the keys. The digital function connects the new capital with all the inhabitants of Indonesia's "Thousand Islands" and achieves a zero-distance interaction of digital connections across the ocean and the strait. On the one hand, it will accelerate the convergence of politics, economy, and culture, foster a new development model, and develop the wealth buried in the data treasure; on the other hand, the new capital will become the high land of digitalization and will

radiate rapidly, driving the development of the country and the region.

In the process of playing the above roles, there are three types of capabilities in the digital capital:

- **Data production capacity**: diversified user terminals (PC, Laptop, and Smartphone) and Internet of Things terminals that convert city activities into data.

- **Data transmission capacity**: super-fast broadband infrastructure connects ubiquitous data sources and backbone networks, data centers.

- **Data usage ability**: digital applications such as big data, cloud, AI, etc., sublimate data into new diversified services.

The establishment of these capabilities requires three layers of targeted digital planning needs.

The first layer is digital sensory nodes: the mass of smartphones and sensors take constant readings of variables such as traffic flow, energy consumption, air quality, and many other aspects of daily life and put information at the fingertips of those who need it. Behind this is companies in all industries offering innovative solutions based on market demand.

The second layer is an ultra-fast infrastructure that provides high-quality digital connectivity and open data portals. Quickly pass data from the generated nodes to the objects of the application and give people the ability to instantly access global information and act.

The third layer is a series of digital usage, including big data, cloud, and AI, leading to better decisions and behavior change. Translating raw data into alerts, insight, and action requires the right tools, and this is where technology providers and service providers come in. Tools are available in multiple domains: security, mobility, health, energy, water, waste, economic development, and housing, and engagement and community.

Among these three layers, the digital infrastructure is of great value, which can better support cloud services, 4K/8K IPTV and other business scenarios. It can also help enterprises to work more efficiently, help industries improve efficiency, and build a platform for smart cities, driving the development of the other two layers. However, the challenges facing construction are also the biggest, such as large investment, difficult to entry, and hesitation in private sector investment. This year, Singapore, China, and other countries have introduced industrial policies in an effort to gain an advantage in the digital connectivity field. Indonesia is a pole in the ASEAN region. The digital planning and policies of the new capital can inject great confidence in the industry and even the region, and it is imperative to make the new capital a dual-gigabit city.

The dual-gigabit connotation is a future-oriented infrastructure: based on the all-optical Gigabit network and the wireless Gigabit network, it provides gigabit-level ultra-high-speed, millisecond-level low-latency connections for users of various scenarios. With this digital exchange capability, the new capital will be built into a leading digital innovation port in the region, fostering localized digital applications, accelerating the digital transformation of the country and the region, giving enterprises the ability to transform their wisdom and provide a better new life for the family. Providing individuals with a new digital experience, giving new and efficient ways for urban operations, and unlocking the potential of national development from a digital dimension.

GOALS OF BROADBAND DEVELOPMENT

In order to achieve the above vision, a series of goals need to be proposed:

1) Mobile Broadband (MBB)
Speed experience

i) Urban Area :

(1) In 2020, 90% of basic service users reach 5Mbps, and 50% of the area reach 10Mbps (HD Mobile Video)

(2) In 2022, 90% of basic service users reach 10Mbps (HD Mobile Video), and 50% of the area reach 25Mbps (4K Ultra HD)

(3) In 2024, 90% of basic users reach 25Mbps (4K Ultra HD), 50% of ordinary users reach 100Mbps (AR/VR), 20% of high-end users reach 500Mbps (360o 8K VR), and 4+1 City Giga is 1 Gigabit speed.

ii) Rural Area

(1) In 2020, 60% of rural areas have signal coverage (55% in 2019, an increase of

4,000 rural/years), while 60% of users reach 3Mbps.

(2) In 2020, 72% of rural areas have signal coverage (increasing 10,000 rural areas in 2 years), while 70% of users reach 3Mbps and 50% reach 5Mbps.

(3) In 2024, 85% of rural areas have signal coverage (12,000 rural areas increased in 2 years), while 85% of users reach 5 Mbps and 50% reach 10 Mbps.

2) Wireless Broadband (WBB)

(1) WBB refers to FBB and calculates growth based on experience value of 3:7. The target is to increase users by 3M/year by 2024 (FBM users increase by 7M/year)

(2) The current WBB user 350K (50 XL users, 300K FM users), the goal is to develop to 650K users (300K / year) by 2020, 5G Fixed Wireless Access began to accelerate in 2022, 8 Million users by 2024

3) Fixed Broadband (FBB) for Household

According to predicted network forecasts and estimations, currently, 7 million home users are expected to reach 7.5 to 8 million by the end of 2019 (about 65 million households nationwide), and household broadband coverage is only 12%.

(All speeds forecast mentioned in the below table is also depending on the scale deployments of 10G PON and maturity and readiness of 50G PON standards and availability)

(1) After year 2019, the household user's target will increase by 2 million. Therefore by 2020 will be reached 10 Million subscribers, it is 15% of fixed broadband household penetration.

(2) After that, the annual user growth rate will increase by 5 million/year, in 2022 year will be 20 million, and the household broadband coverage rate will be 30%. Which is equal to current Malaysia 30% fiber-optic penetration.

(3) When fiber connectivity in big cities are available, it is estimated to be 30 million in 2024, and home broadband coverage is nearly 45%

4) Fixed Broadband for Public Facilities users:

(1) Adjust the target value of the base bandwidth from 100 Mbps to 300 Mbps (reflecting the differentiated competition of FBB relative to MBB and the scale deployment of 10G PON and 50G PON technology)

(2) All capitals will achieve 100% fiberization in 2020, to 2021 10% Giga will be available, and 10% will reach 10 Gbps by 2024;

(3) Rural area achieves 30% fiber coverage in 2020 and 80% fiber coverage by 2024

5) Fixed Broadband for Enterprise:

(1) Considering that it is mainly distributed in non-Rural areas, 100% fiberization in 2020, 5% of users reach 10Gbps, and 70% in 2024

Below proposed predicted broadband speeds or bandwidth roadmap based on the pace of current network development, penetration, market dynamics, technological advancements, and users/enterprises' high-speed requirements. However, in the actual development and penetration level need to evaluate on a yearly basis and see the deviations from the set benchmarks.

Table 3. 12 Broadband Standard Recommendation

Percentage		2020	2022	2024
Mobile Broadband (MBB)	Urban	90% at 5Mbps 50% at 10Mbps (Speed)	90% at 10Mbps 50% at 25Mbps 20% at 100Mbps (Speed)	90% at 25 Mbps 50% at 100 Mbps 20% at 500Mbps 1% at 1 Gbps (Speed)
	Rural	60% Villages (Coverage) 60% at 3Mbps (Speed)	70% Villages (Coverage) 70% at 3Mbps 50% at 5Mbps (Speed)	80% Villages (Coverage) 80% at 5Mbps 50% at 10Mbps (Speed)
Wireless Broadband (WBB)	Overall	90% at 10Mbps 50% at 25Mbps (Speed)	90% at 25Mbps 50% at 100Mbps (Speed)	90% at 50 Mbps 50% at 300 Mbps 20% at 500Mbps 5% at 1Gbps (Speed)
Fixed Broadband (FBB) Household	Overall	Connections：10 Mil (15% Household) 100% at 100Mbps (Speed)	Connections：20 Mil (30% Household) 100% at 100Mbps 60% at 300Mbps 20% at 1Gbps (Speed)	Connections：30 Mil (45% Household) 100% at 300Mbps 40% at 1 Gbps 20% at 10 Gbps (Speed)
Fixed Broadband (FBB) Public Facilities		100% at 300Mbps 40% at 500Mbps 10% at 1Gbps (Speed)	100% at 300Mbps 70% at 500Mbps 20% at 1Gbps (Speed)	100% at 500Mbps 50% at 1Gbps 30% at 10Gbps (Speed)
Fixed Broadband (FBB) Enterprises	Urban	100% at 300Mbps 50% at 500Mbps 10% at 1Gbps (Speed)	100% at 500Mbps 60% at 1Gbps 20% at 10Gbps (Speed)	100% at 500Mbps 90% at 1Gbps 70% at 10Gbps (Speed)

CHALLENGES FOR ACHIEVING THE GOALS

FBB DEVELOPMENT

While broadband users have grown on the back of a surge in mobile broadband subscriptions and smartphone sales, fixed broadband connections remain relatively low, despite broadband development has accelerated.

PT Telkom as shown in Figure 3.8 remains the dominant operator and provides services over traditional copper lines but has a long-term plan to transition these to fiber-optic cable with triple play (Voice, Internet, and TV). Other operators provide fixed telephone services using a wireless local loop or as part of a bundled service with cable television or fiber subscriptions. There is an extensive domestic backbone of over 80,000 kilometers connecting major islands with smaller Islands using Satellite connectivity.

FBB Subscribers

The total number of subscribers in the FBB market in Indonesia is 8.3 million. The growth rate remains slow and is dependent on PT Telkom deployments.

FBB Target

The current FBB target is mid-range and high-end users (SES: A1, A2, and B, accounting for 26% of the population) Obtaining high-quality users is the top priority of carriers. Strong Wireless competition causes some restrictions on the development of FBB.

FBB Video Services

Pay-TV and OTT Video Services – The penetration rate of paid TV services is only 7%, which is the lowest in the South Pacific region as shown in Figure 3.9. This is due partly to low broadband installation rates. By 2017 there were approximately 4.5 million Pay TV and OTT Video subscribers and it is projected that by 2020 this will reach 10 million.

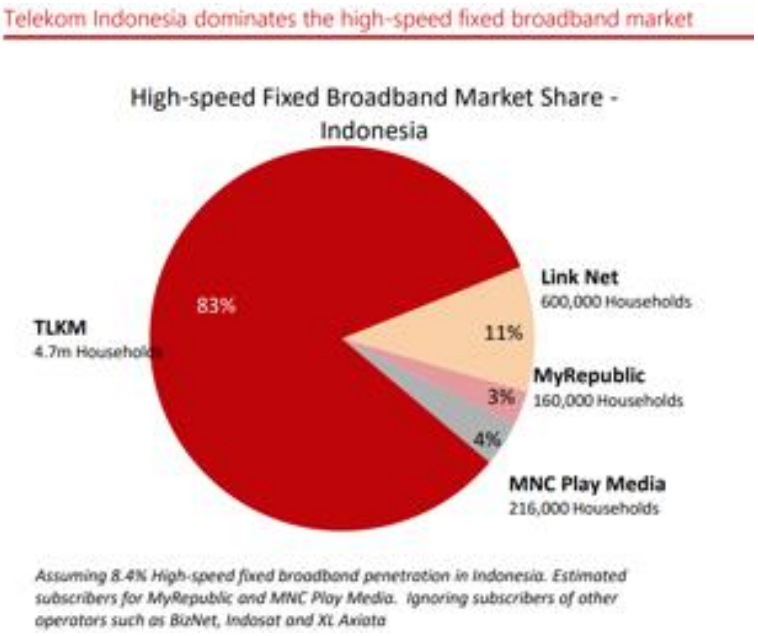
Big Video/4K UHD becomes popular aligning the user experience demand, device ecosystems are already in the market. Other facilities such as UHD Contents and infrastructure to support high-speed need to be accelerated. Fiber Optic to the home as the main infrastructure is still low, the enhancement on construction permits and technology can accommodate user demand requirements.

Video Surveillance - Industries such as city, police, finance, government, and office building, healthcare, production, and retail are the main users of the digital surveillance system. Currently, the video surveillance platform built by enterprises occupies an absolute dominant position. However, the emergence of cloud video technologies will change the market landscape

FBB Barriers

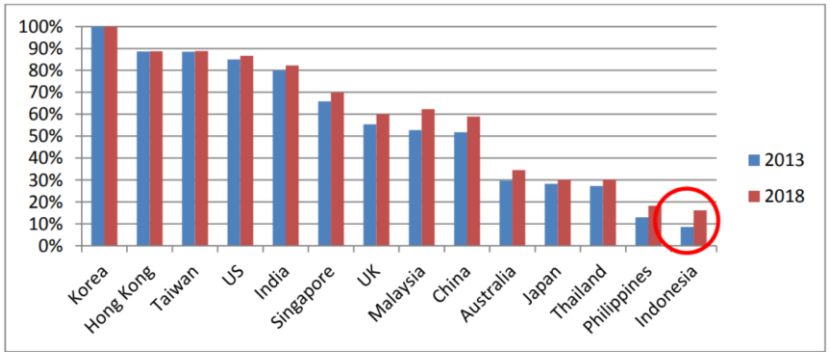
Monopoly of mid-range and high-end community conglomerates makes it difficult to lay cables.

Figure 3. 8 Indonesia Fixed Broadband Status



Source: (SingStat, DBS Bank 2018)

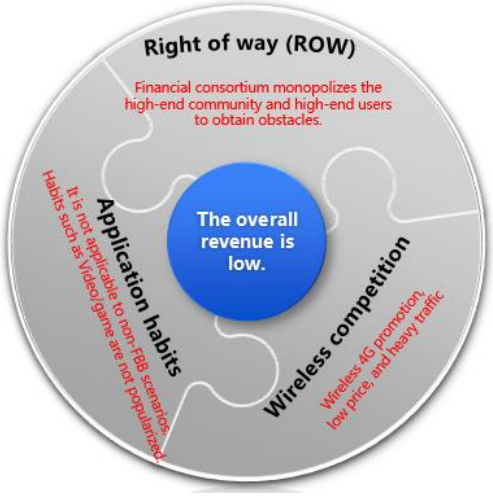
Figure 3. 9 Pay TV Market Penetration



Source: (MPA, 2018)

Policies and regulations need to be created around right ways as well as pole sharing to welcome investment, ensure cost effective approaches for users and network providers, and prevent lengthy restrictions on deployment. Central Government must take a firm stand facilitating deployment of fiber optic cables, in order to realize infrastructure development targets in all region an area.

Figure 3. 10 FBB ecological barriers and analysis



Source: (Huawei, 2018)**/** (Deputy Assistant for ICT and Utility)

Submarine Cable

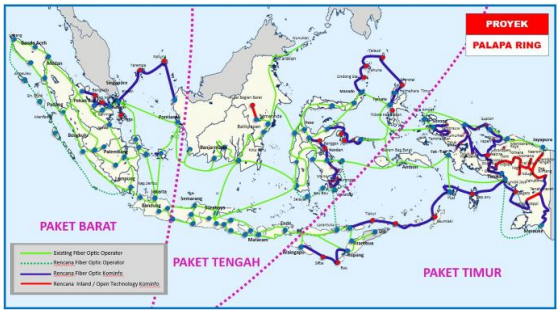
There is an extensive domestic backbone of over 80,000 kilometers connecting major islands through underwater fiber-optic cables in a ring configuration to enable redundancy as shown in Figure 3.11.

The Palapa Ring, which involves an undersea fiber-optic cable network and onshore network that stretches across 36,000 kilometers, will provide fast broadband Internet to Indonesians in both the urban and rural areas across the country. As the inauguration of the Palapa Ring held on October 14th, all Indonesian districts (Kabupaten) are connected through fiber-optic communication. The Palapa Ring project is divided into three sections: West, Central, and East. Each section is developed by a different consortium. The consortia are Palapa Ring Barat (West section), LEN Telekomunikasi Indonesia (Central section), and Palapa Timur Telematika (East section). The project is known as Indonesia's first government-to-business cooperation scheme (PPP Scheme) with availability payment method.

West Section has been commercially operated since March 2nd, 2018 with 2,147 kilometers of cable network. Central Section has been operated in the same year on December 21nd with 3,102 kilometers of cable network. Finally, the last section, East Section with the longest cable network of 6,878 kilometers has been operated since August 29th, 2019.

Indonesia also has launched several satellites for domestic connectivity, and remote villages are connected by VSAT. Domestic submarine cable is gradually being deployed however issues relating to the take-up of existing network capacity have led to a slowing of deployment. International submarine cable needs to be developed to promote national economic development

Figure 3. 11 Submarine Cable Connectivity in the Region



Source: (BAKTI, 2018)

CHALLENGES IN MBB DEVELOPMENT

In the first two decades of this century, Indonesia has ushered in the rapid development of digital mobile communication. With the rapid spread of 2G and 3G mobile information communication technologies, typical services represented by voice, text (Email), and pictures (web browsing) have changed the way people communicate and access information.

In the next five years, evolution is the theme due to the requirement of higher efficient data delivery. Indonesia's mobile industry will continue to develop into a new stage. To efficiently carry the digital content, the replacement of old technologies and infrastructure upgrade are required. 4G spreading and 5G development will form a ubiquitous high-speed digital infrastructure with improved efficiency. This infrastructure connects the whole country into a unified digital society, bringing innovative applications such as cloud service to more people in real-time, giving them more productive digital capabilities to meet diverse demands.

To find out the obstacles to the future of digital connectivity, GSMA Mobile Connectivity Index (MCI) is suggested to be a reference as shown in Table 3.12. It describes the progress of the Indonesian mobile business in the last three years, identifying the highlights and defects. From the MCI, the network performance, spectrum, and handset price turn up to be the current shortboard.

From the perspective of the target network, five major challenges exist in the development of MBB in Indonesia:

1. Network Performance
2. Digital Divide
3. Spectrum
4. Site Density
5. Affordability

Table 3. 13 Indonesia's Mobile Connectivity Index of Past 3 Years

Category	*Index*	*2016*	*2017*	*2018*
Infrastructure	Network Coverage	75.2	88.4	90.5
	Network Performance	32.9	41.5	43.5
	Other enabling Infrastructure	62.4	66.5	66.3
	Spectrum	17.9	19.6	19.6
Affordability	Mobile tariffs	49.3	54.7	61.6
	Handset price	18.1	48.4	41.9
	Taxation	85.6	86.8	86.3
	Inequality	77.6	77.6	63.8
Consumer readiness	Mobile ownership	62.1	62.7	64.4
	Basic Skills	57.6	58.5	59.1
	Gender Equality	72.6	73.4	74.0
Content and service	Local Relevance	43.4	48.8	53.0
	Availability	74.5	72.7	66.0
	Online security	44.0	42.4	77.6

Source: (GSMA, Mobile Connectivity Index, 2019)

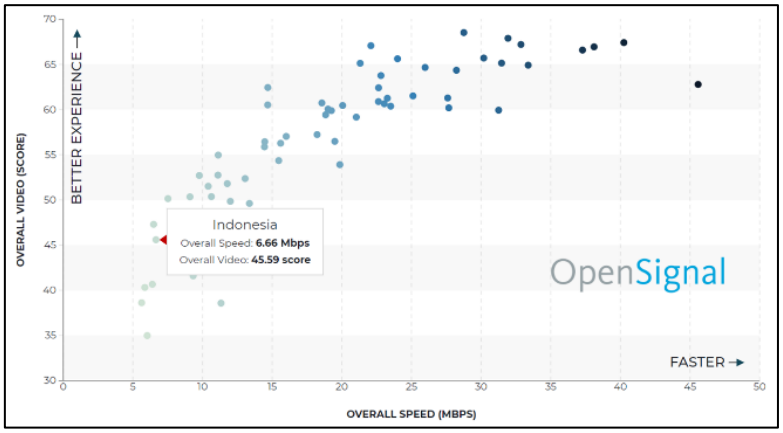
1. Network Performance

Network performance, or the quality of connectivity, is directly perceived by the subscribers, due to the impact on user experience. The higher the performance the network works in, the more data it transmits in a shorter latency, and the more inclusiveness the digital service could be.

The continuous integration of digital society and physical society drives the emergence and development of new digital content. Nowadays, the video becomes a mainstream digital service all over the world, providing an immersive experience in the digital society. The traffic of mobile video in Indonesia will grow 9-fold in 2022 from 2017.

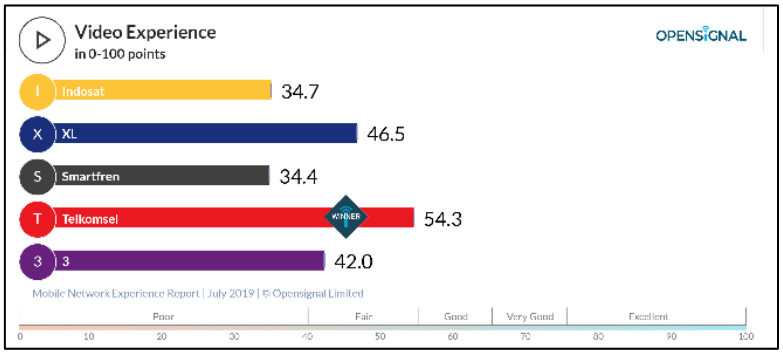
OPENSIGNAL, an independent mobile analytics company, provides an analysis of the current situation among markets. On a certain level, this reveals the law of improving the video experience that the speed is one of the key factors as shown in Figure 3.12. However, as described in Figure 3.13, the video experience provided by each operator is not the same. This kind of difference also exists in different cities as shown in Open Signal Results in Figure 3.14.

Figure 3. 12 Comparing Overall Video Experience and Download Speed



Source: (OPENSIGNAL, Comparing Overall Video Experience and Download Speed, 2018)

Figure 3. 13 Different Video Experience from Operators



Source: (OPENSIGNAL, Download Speed Experience in Indonesian Cities, 2019)

2. Digital Divide

In rural areas, due to lack of coverage, network connectivity can only provide much lower performance than that in cities, and connections are absent in many places outside of java. The lack of broadband infrastructure has led to a trend of widening the digital divide [Satriya, Telematika Perlu Kajian Bermutu, 2006].

In Presidential Decree No.96 of 2014 on Indonesia Broadband Plan 2014-2019, the definition of broadband is 2 Mbps (fixed) and 1 Mbps (mobile). In the next five years, this definition needs to evolve simultaneously and should be constantly revised for regional differences and new services.

As a reference, both the organizations and countries are proposing their own definition.

In the next five years, network performance is one of the key challenges to meet the digital demands, including the overall performance level, regional imbalance and the gap between demands and supply.

3. Spectrum

Table 3. 14 Spectrum identified by ITU for IMT services in region 3

Band	MHz
450 - 470 MHz	20
470 - 608/610 MHz	140
610/614 - 698 MHz	88
694/8 - 790 MHz	96
790 - 960 MHz	170
1427 - 1452 MHz	25
1452 - 1492 MHz	40
1492 - 1518 MHz	26
1710 - 1885 MHz	175
1885 - 2025 MHz	140
2110 - 2200 MHz	90
2300 - 2400 MHz	100
2500 - 2690 MHz	190
3300 - 3400 MHz	100
3400 - 3500 MHz	100
3500 - 3600 MHz	100
4800 - 4990 MHz	190
TOTAL	1072 - 1500 MHz

Source: (LS telcom UK Ltd, Analysis of the World-Wide Licensing and Usage of IMT Spectrum, 2019)

Table 3.14 shows International Mobile Telecommunications (IMT) Spectrum, the amount of spectrum which is identified by ITU in region 3 where Indonesia is.

Table 3. 15 Current Situation of Indonesia's Mobile Spectrum

Bands	Range (MHz)	Existing / Planned services	Status
8 (900 MHz)	880-890 / 925-960	GSM / UMTS / LTE	Fully assigned
3 (1800 MHz)	1710-1785 / 1805-1880	GSM / LTE	Fully assigned
1 (2100 MHz)	1920-1980 / 2110-2170	UMTS / LTE	Fully assigned
40 (2300 MHz)	2300-2400	Satellite / LTE / 5G	Partially assigned
28 (700 MHz)	703-748 / 758-803	Analog Broadcast / LTE / 5G	Pending assignment
7&38 or 41 (2600 MHz)	2500-2690	Satellite / LTE / 5G	Pending assignment
C-Band	3300-3600	Satellite / 5G	Pending assignment

Source: (Huawei International, Current Situation of Mobile Spectrum, 2019)

Indonesia has made available spectrum in bands of 850MHz, 900MHz, 1800MHz, 2100MHz, and 2300MHz for mobile services. Figure 3.15, Figure 3.16, Figure 3.17 shows Indonesia's current and planned mobile spectrum allocation and the comparison to other countries.

The amount of spectrum identified by ITU for IMT in Indonesia amounts to a total of 915 MHz forming harmonized mobile bands (excluding new spectrum identified for 5G). From the perspective of the entire spectrum resource space, Indonesia has a spectrum gap of more than 450MHz, in terms of spectrum availability for MNOs, lagging behind many Asian markets including four ASEAN members: Singapore, Philippines, Malaysia, and Thailand.

A lack of available frequency continues to hinder the nationwide development of mobile broadband infrastructure. The challenge of the spectrum can be concluded as 3 points:

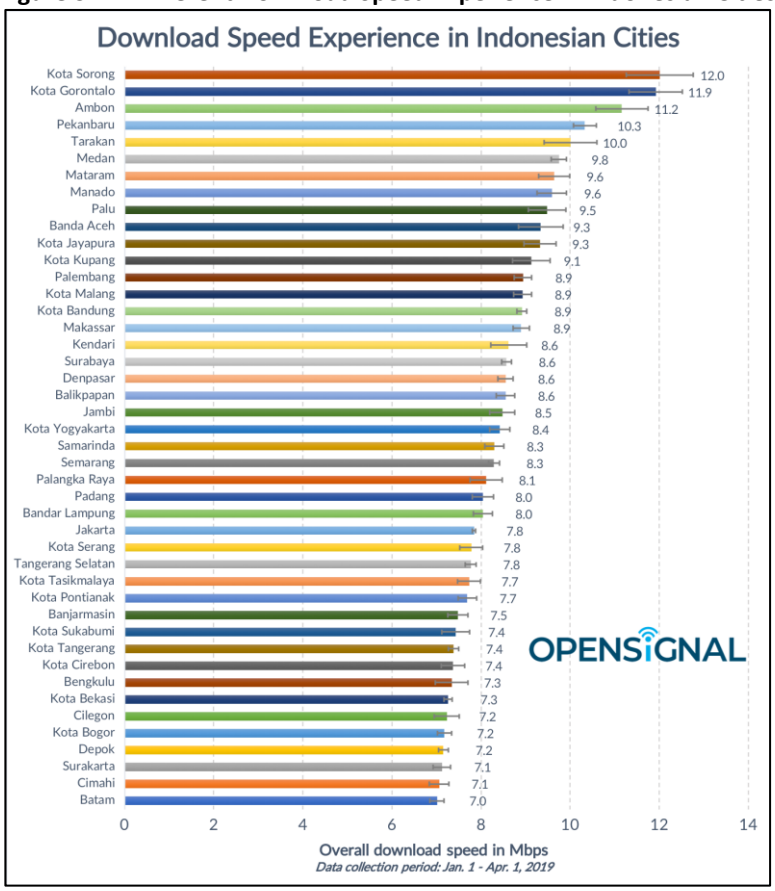
▲ **Digital dividend spectrum shortage**

The digital dividend spectrum represents the bandwidth of the spectrum in the 600, 700 and 800 MHz bands.

Among three of them, the 700MHz band is a gold band that provides nationwide 4G/5G universal service and is the enabler to accomplishing national connectivity goals. According to the GSMA's analysis, assigning 700 MHz to mobile broadband would deliver economic benefits of $11 billion (IDR161 trillion) to the Indonesian economy over the period 2020–2030, equivalent to an incremental 1% of GDP. However, **GSMA MCI scores 0 for the digital dividend spectrum for Indonesia** due to the absence of this band for mobile broadband.

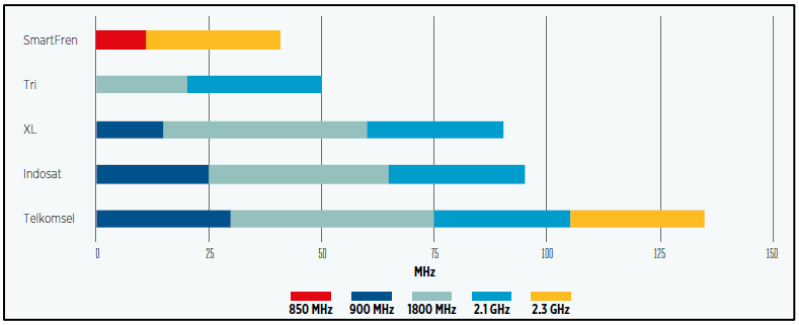
Now 700MHz band is currently occupied by analog TV. On 1 August 2018, the MCIT issued a consultation on digital TV broadcasting but made no announcements of timelines for when the band

Figure 3. 14 Different Download Speed Experience in Indonesian Cities



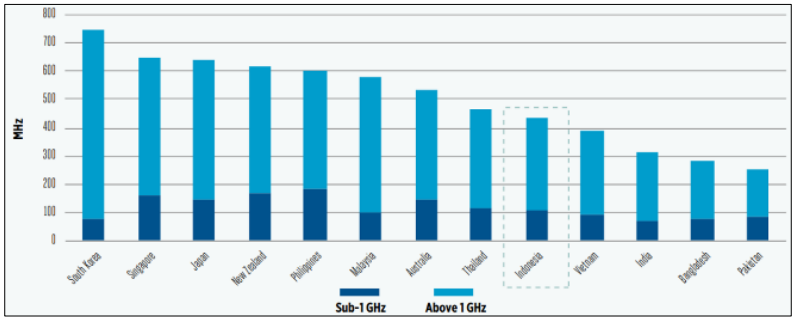
Source: (OPENSIGNAL, Download Speed Experience in Indonesian Cities, 2019)

Figure 3. 15 Spectrum Holdings of Indonesian Mobile Operators



Source: (Huawei International, Current Situation of Mobile Spectrum, 2019)

Figure 3. 16 Comparison of MBB Spectrum



Source: (GSMA, Accelerating Indonesia's digital economy: Assigning the 700 MHz band to mobile broadband, 2018)

is to be released to operators. As this band is key to bringing affordable 4G mobile broadband services to all parts of Indonesia, from dense urban areas to communities living more rurally, and realizing numerous socioeconomic benefits, it is critical that planning for the release of the band moves forward.

As many of the people who will become connected during the next few years live in rural areas, this band's technical characteristics support better coverage with less infrastructure compared to higher bands, which are typically used for boosting capacity in hotspot areas. This efficiency helps reduces capital and network costs, benefiting consumers through faster rollouts and lower retail prices. With millions of Indonesian citizens unserved by any type of broadband, the 700 MHz band, and spectrum below 1 GHz in general, will continue to be important to connect everyone. By the digital dividend from the 700 MHz spectrum, the prevailing coverage gap can be tackled, resulting in higher mobile penetration and improved access to services, such as education and healthcare, in rural areas. Mobile operators, other ecosystem companies, governments and regulators all have a role to play in ensuring that Indonesia reaps the benefits as soon as possible.

▲ Capacity spectrum shortage

In order to cope with the growing 4G connections and traffic in the next five years, it is wise to deploy more spectrum.

The main sources of the new spectrum are 2300MHz and 2600MHz. These bands have a total bandwidth of 290MHz. Currently, 2300MHz has been partially distributed, and the rest is occupied by broadcast and satellite.

Besides MBB deployment, these bands are also the resources for Fixed Wireless Access which is able to accelerate the home connection in the last mile for the areas without fiber.

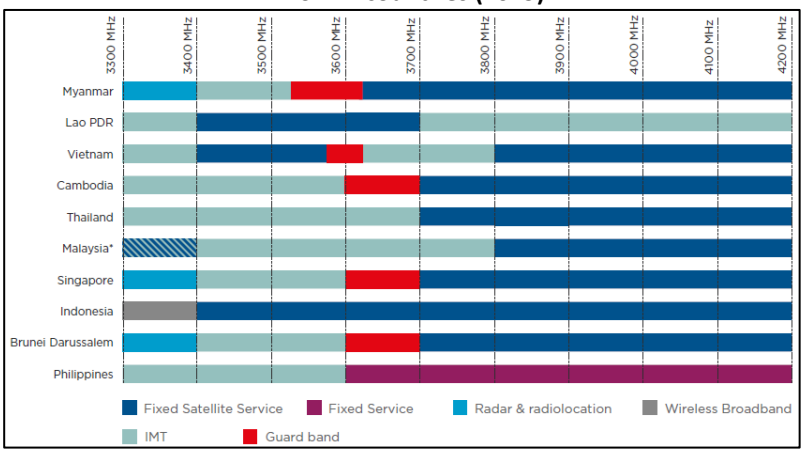
In order to cope with the growth of the 4G / 5G connections and data traffic consumption and traffic in the next five years, it is wise to deploy more spectrum.

▲ 5G spectrum shortage

Unlike previous generations of mobile networks, the fifth-generation (5G) technology is expected to fundamentally transform the role that telecommunications technology plays in society. 5G is also expected to enable further economic growth and pervasive digitalization of a hyper-connected society, where not only are all people connected to the network whenever needed, but also many other devices/things virtually creating the society with everything connected (i.e. Internet of Everything). 5G will, therefore, enable much more new use cases than the previous mobile networks.

The variety of requirements creates a variety of spectrum needs. Hence, different spectrum bands will be needed to support all use cases.

Figure 3. 17 Current or planned 3.3-4.2 GHz spectrum allocations for 5G in ASEAN countries (2019)



Source: GSMA, 2019

There are a variety of spectrum bands available for deployment of 5G, which can be sub-divided into three macro-categories: sub-1GHz, 1-6GHz and above 6GHz.

Sub-1GHz spectrum is needed to extend high speed 5G mobile broadband coverage across urban, suburban and rural areas and to help support IoT services: 5G services will struggle to reach beyond urban centers and deep inside buildings without this spectrum. A portion of the UHF television spectrum should be made available for this purpose through the second digital dividend.7 The European Commission supports the use of the 700 MHz band for 5G services and in the United States the 600 MHz band has been assigned and T-Mobile has announced plans to use it for 5G.

Spectrum from 1-6 GHz offers a good mixture of coverage and capacity for 5G services: It is vital that regulators assign as much contiguous spectrum as possible in the 3.3-3.8 GHz range and also consider the 4.5-5 GHz and 3.8-4.2 GHz ranges for mobile use. Existing mobile licenses should also be technology-neutral to allow their evolution to 5G services.

Spectrum above 6 GHz is needed for 5G services such as ultra-high-speed mobile broadband: 5G will not be able to deliver the fastest data speeds without these bands. It is vital that governments support the mobile spectrum above 24 GHz at WRC-19 (e.g. 26 GHz) and additionally make the 28 GHz band available where possible. The 26 GHz and 28 GHz bands have especially strong momentum and as they are adjacent they support spectrum harmonization and therefore lower handset complexity, economies of scale and early equipment availability.

Currently, the extended C-band (3400-3700 MHz) and standard C-band (3700- 4200 MHz) are heavily used by satellite services in Indonesia, and there is the same situation for 2300 MHz and 2600 MHz.

Given the heavy satellite usage, with an estimated total of more than 100,000 VSAT services in operation, a considerable amount of time and effort will be needed to optimize the use of the 3.5 GHz band for 5G, particularly in major cities and industrial complexes.

4. Site Density

If the spectrum is likened to the "land" resource of wireless telecommunications and broadband infrastructure, the site acts as the "road" connecting users to the digital society. Site density is a direct factor in determining the range and quality of wireless digital connections.

As shown in Table 3.16, TowerXchange and We Are Social showed that user-per-cell site density in Indonesia is now about 1,446, based on estimates of 91,700 total cell sites against internet users of around 132.7 million internet users as of first quarter of 2018, and the pop-per-site density is 2951, based on estimates of the total cell sites against population of 271,088,351. Compared with the main neighboring countries like India, China, and Vietnam, there is a stark difference in the site density in Indonesia.

Table 3. 16 Site Density Comparison

Country	*No. of Cell Sites*	*No. of Internet Users*	*User-Per-Site Ratio*	*No. of Pop*	*Pop-Per-Site Ratio*
China	1.9M	751M	384	1.43Bn	755
India	1.4M	462M	316	1.37Bn	976
Indonesia	91.7K	133M	1446	271M	2951
Philippines	16.6K	67M	4036	108M	6757
Vietnam	70K	64M	914	96M	1378

Source: (TowerXchange and We Are Social, 2018)

The significance of the site is to transform the "land" of the spectrum into a "road" to achieve ubiquitous and convenient digital connectivity. More users share the limited site resource, in lower efficiency digital data transmits. Site density just illustrates the early warning of this issue.

Indonesia's huge population and growth trends show great potential for digital development and unprecedented pressure on wireless broadband infrastructure. How to provide first-class digital connectivity for everyone to be unimpeded in the digital society is one of the key challenges of today's digital infrastructure.

5. Affordability

Affordability determines the adoption of 4G and 5G, the user evolution. Better affordability encourages consumers to choose new technologies and digital usage, while worse affordability has the opposite effect.

Table 3. 17 Comparison of Consumer Affordability

Country	*Average Income Annually*	*Smartphone Penetration*	*1GB price as a % of GNI per capita*
China	9,470 $	55.3%	1.36%
India	2,020 $	27.7%	0.48%
Indonesia	3,840 $	27.4%	0.78%
Philippines	3,830 $	44.9%	1.84%
Vietnam	2,400 $	37.7%	1.19%

Source: (Worlddata.info, Newzoo, A4AI, 2018)

In Table 3.17, compared with neighboring countries, Indonesia has the advantage of affordability in terms of mobile tariffs. However, in terms of terminal prices, it is too high in all the above countries (Table 3.18).

Table 3. 18 Comparison of Terminal Device Price

Country	*3G Terminal Device Price*	*4G Terminal Device Price*	*4G Device Price as a % of GNI per capita*
China	$94.49	$330.85	4.01%
India	$64.52	$178.51	10.69%
Indonesia	$65.08	$204.89	6.03%
Philippines	$58.98	$246.36	6.88%
Vietnam	$91.28	$287.63	13.96%

Source: (IDC, 2018)

From the statistics of 85 markets as shown in Figure 3.18, it can be found that in countries with 4G penetration rate above 50%, the ratio of 4G terminal price to GNI per capita is less than 3%, which is also the target level recommended by the ITU in Strategy 2020-2023.

The current average proportion of Indonesia is 6%, and this ratio could be much higher for low-income people. If this ratio is still that high in the future, or even higher, potential users will be kept out of the future digital society, and stakeholders will reduce investment and upgrades to MBB infrastructure connecting low-income people because of low market value. In the end, the affordability problem has become a hindrance to universal digitalization and network evolution.

Strengthening cooperation with the industry chain can effectively reduce the price of 4G or even 5G terminals in the market. Providing terminals with a price of less than $100 will significantly accelerate the migration of 2G and 3G connections to 4G connections.

Others

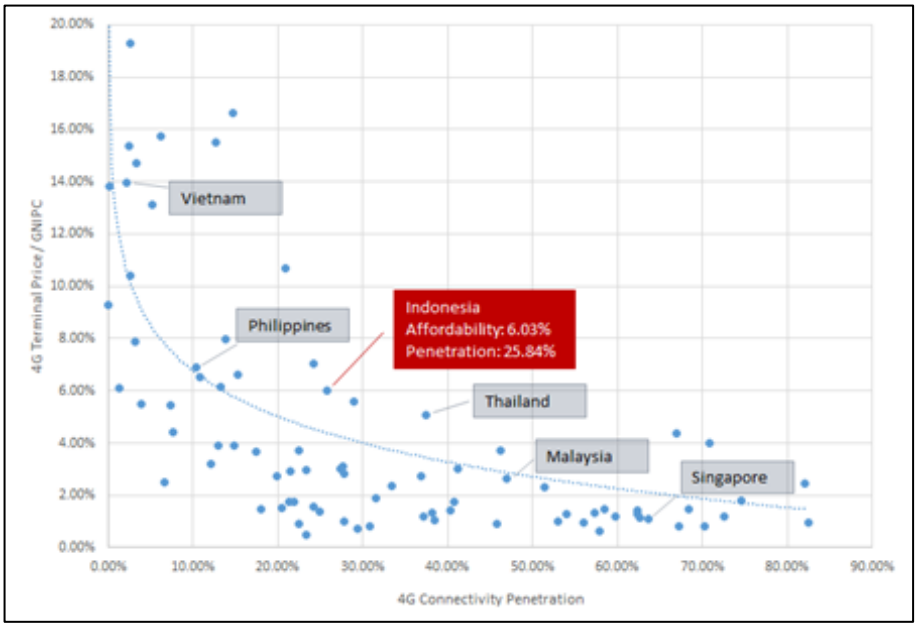
- Microwaves Transmission

  The access network in Indonesia is mainly microwave, and the transport network architecture and technology need to upgrade in order to support future broadband demands and services. Referring to Indonesia's geographical, high quality and speed microwave is the key requirement for high-quality broadband connectivity. A low price spectrum license is a potential way to encourage more investment in the microwave network.
- Network Subsidies

  Although there are mobile coverage standards in remote areas, they cannot be strictly implemented. 10% of the population has no access and in outer-lying islands, this is more than 30%. Subsidies are insufficient. Operators may not be interested due to a lack of incentives. There is a lack of controls to enable the government to manage and enforce regulations.
- Infrastructure Sharing

  The broadband plan calls for infrastructure sharing and open access to bottleneck facilities to enable economical and rapid network deployment. Right of Way (ROW) is still the largest obstacle in front of network infrastructure deployment. On the one hand, it is necessary to open more public facilities to deploy network infrastructure, encourage private ROW to open up and provide norms;

Figure 3. 18 Relationship between 4G Device Affordability and 4G Adoption



Source: (IDC, 2018)

second, try to share the network itself, establish a unified broadband infrastructure in remote areas, and Share to reduce the burden on all parties.

- Energy Saving

  Power consumption mobile broadband network is high, which equipment BTS electricity contributes to high operational cost. It is necessary to enhance the technology to single RAN BTS standards to optimize energy saving.

CHALLENGES IN INDOOR DIGITALIZATION

One of the key challenges in broadband development is the coverage in the indoor environment. Good digital reach in an indoor environment is key to ensuring better broadband experience delivery for both people and Industrial connectivity.

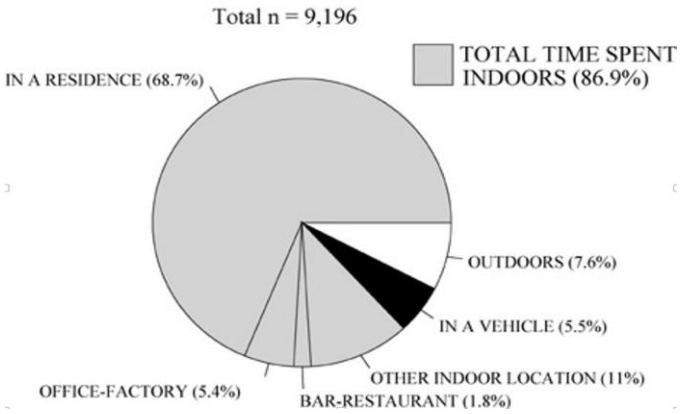
According to the *Tele Management Forum, Indoor 5G network, 2018, m*ore than 80% of digital services on 4G mobile networks occur indoors. A greater number of digital services will take place indoors as 5G spurs digital service diversity and extends digital business boundaries.

Further, according to the National Human Activity Pattern Survey (NHAPS)'s report as shown in Figure 3.19, Humans spend an average of 86.9% of their time indoors. This ratio will continue to increase with the development of urban digitalization.

Development in indoor connectivity to best suit a variety of use cases is key as the majority of IoT devices will also be typically in indoor environments.

In addition to the above description, hospitals, schools, airports, railway stations, subways, etc. are all important areas of urban digitalization.

Figure 3. 19 NHAPS-Nation, Percentage Time Spent



Source: (NHAPS-Nation, Percentage Time Spent, 2001)

CONCLUSION

1. Low Connectivity Performance
   Current service standards are already behind service requirements. It is one of the key challenges to meet the digital demands in connectivity performance and user experience in the next five years.
2. Spectrum shortage
   A lack of available frequency continues to hinder mobile network operators' (MNOs) nationwide development. The increase of MNOs' frequency allocations will not only accelerate the evolution but also improve coverage and connectivity outside Java.
3. Low Site Density
   Indonesia's lower site density compared with the main neighboring countries. The huge population and growth trends show great potential for digital development and unprecedented pressure on wireless broadband infrastructure. How to provide first-class digital connectivity for everyone to be unimpeded in the digital society is one of the key challenges of today's digital infrastructure.
4. Lack of Affordability on Terminal Devices
   The current average proportion of Indonesia is 6%, and this ratio could be much higher for low-income people. If this ratio is still that high in the future, or even higher, potential users will be kept out of the future digital society, and stakeholders will reduce investment and upgrades to MBB infrastructure connecting low-income people because of low market value. In the end, the affordability problem has become a hindrance to universal digitalization and network evolution.
5. Others

Microwaves Transmission: The access network in Indonesia is mainly microwave, and the bearer network architecture and technology need to upgrade in order to support future broadband demands and services. Referring to Indonesia geographical, high-speed microwave and high-quality performance are key requirements to serve broadband services, low price spectrum licenses can contribute to providing microwave networks.

Infrastructure sharing: On the one hand, it is necessary to open more public facilities to deploy network infrastructure, encourage private ROW to open up and provide norms; second, try to share the network itself, establish a unified broadband infrastructure in remote areas, and Share to reduce the burden on all parties.

Figure 3. 20 Digital Urban Area Will Fully Digitized

Source: (Mckinsey,The Rise of Digital Challengers, 2019)

STRATEGIES TO ACHIEVE THE GOALS

The development of broadband infrastructure cannot be realized by solely relying on participants within the ecosystem. Instead, the development requires supports from the government in three major aspects: investment, innovation, as well as competition. The government plays a vital role in forming a favorable environment to enable the fast and healthy development of broadband, and hence, benefiting a country's economics and societal wellbeing to the most. These three principles introduce the strategy to address challenges:

- **Create a favorable environment for broadband investment**
- **Encourage innovation adoption**
- **Establish a competitive market**

SUPPLY SUFFICIENT SPECTRUM FOR MBB AT INCLUSIVE PRICE

1. Supply multi-band for 5G evolution

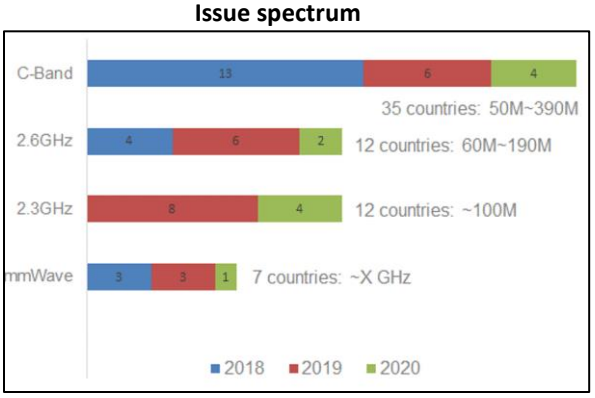
5G enables to utilize increasingly wide frequency bands to support higher speeds and larger amounts of traffic, hence it needs a significant amount of new harmonized mobile spectrum with different bands to support all use cases. These include enhanced mobile broadband service (eMBB), ultra-reliable and low-latency communications (URLLC) and massive machine-type communications (mMTC). The sufficient supply is pursued in all of the three macro-categories:

- sub-1GHz: 700 MHz
- 1-6GHz (mid-bands) : 2.3 / 2.6 / 3.3 / 3.5 / 4.9 / 6 GHz
- above 6GHz (mmWave): 26 / 28 GHz

Due to its propagation characteristics and the potential for large contiguous bandwidths, the 3.5 GHz band is an ideal frequency band for 5G as it is able to provide both capacity (the amount of data traffic it can support) and coverage (the distance the radio signals travel). High-speed enhanced mobile broadband services need to be capable of delivering peak download speeds of at least 20 Gbps, a reliable 100 Mbps user experience data rate in urban areas, and 4 ms latency. The 3.5 GHz band will be key for delivering eMBB and to enable good 5G service performance. 2.6/2.3GHz are the second choice in mid-bands. 80-100 MHz of contiguous spectrum per operator is preferred to release the full potential of 5G services. For above 6GHz, with the advantage of its huge available bandwidth, 400 MHz-1 GHz needs to be available for each operator for 5G unique service in hotspot.

The majority of 1st wave countries have chosen mid-band to deploy 5G, which accelerates the maturity of the 5G industry in this band. In the US, FCC announced a spectrum release plan to provide 844 MHz additional spectrum supply in bands of 2.5 / 3.5 / 3.7-4.2 GHz, after allocation of above 6 GHz.

Figure 3. 21 Number of Countries Issued/will Issue spectrum



Source: GSA report, 2019

In Indonesia, there are incumbent users in priority 5G bands so meeting the supply targets can be challenging. It is essential to make every effort to make this spectrum available for mobile broadband use, including:

- Providing incentives for incumbents to migrate ahead of awarding the spectrum
- Moving incumbents to alternative bands

A roadmap is suggested to be adopted to release the spectrum:

- Planning and decision
  - Review current use of potential bands
  - Assess the potential for coexistence (co- and adjacent-channel)
  - Assess options available and conduct a cost-benefit analysis

- Implementation
  - Co-channel – notify incumbents on measures and implementation timescale
  - Adjacent channel – notify incumbents of measures to minimize interference
  - Cross-border coordination and arrangements
- Award spectrum
  - Determine technical conditions for released spectrum
  - Design appropriate award taking account of national objectives
  - Implementation of award

A wise approach to spectrum allocation is to refer to previous lessons and follow successful experiences. The following three principals have become the consensus of 5G spectrum allocation:

- Avoid inflating 5G spectrum prices (e.g. through excessive reserve prices or annual fees) as they risk limiting network investment and driving up the cost of services.
- Consult stakeholders to ensure spectrum awards and licensing approaches consider technical and commercial deployment plans.
- Adopt national spectrum policy measures to encourage long-term heavy investments in 5G networks (e.g. long-term licenses, clear renewal process, spectrum roadmap, etc.).

The price of the spectrum becomes to be a temptation driving many countries to use spectrum auctions to maximize revenue, which should be avoided. Instead, the spectrum is supposed to be allocated with the aim of fulfilling their connectivity objectives. Whereas the spectrum is allocated by auction or beauty contest, the spectrum should be allocated to the actor who values it the most (i.e. actor willing to make the necessary network investments to maximize the use of that spectrum).

From a market perspective, high spectrum prices have been linked to more expensive, slower mobile broadband services with worse coverage. High spectrum prices and fees also increase the costs of MNOs which are ultimately paid by consumers affecting primarily the affordability of mobile services in countrywide. Effective spectrum pricing policies are vital to support better quality and more affordable 5G services, usually including:

- Set modest reserve prices and annual fees, and rely on the market to determine spectrum prices
- Avoid limiting the supply of 5G spectrum as scarcity can lead to excessive prices
- Develop and publish a 5G spectrum roadmap with the input of stakeholders to help operators plan for future availability
- Consult with stakeholders on license terms and conditions and take them into account when setting prices

The U.K. allocates the spectrum with the price of 5G per Hz as 5% of that of 3G and half of 4G. For spectrum auctions, a reserve price below a conservative estimate of market value is suggested to be set to ensure scope for competition and price discovery in the auctions. A reserve price at a modest, but non-trivial, level will deter the frivolous entry of noncompetitive firms while ensuring that winners pay at least the "opportunity cost" of having denied the next best use for the spectrum, such as in satellite TV broadcasting, for the 2.3 / 2.6 GHz band.

China allocates the spectrum in a different way, which is more like the government's investment in the 5G industry, not just only the management of resources. MIIT (Ministry of Industry and Information Technology), firstly, assign the spectrum directly to the operators without auction eliminating the cost of obtaining the spectrum; secondly exempted the 5G license fee from operators for the 1st to 3rd year, and would charge the license fee for the 4th to 6th year at a rate of 25% / 50% / 75%. All the effort of MIIT on spectrum allocation is one of the measures to motivate the stakeholders to accelerate 5G investment and construction.

2. Supply the Digital Dividend Spectrum by Two Stage

While certain 2.6 GHz frequencies should become available for mobile in the coming years once the current licenses expire, a more practical and effective way is needed to quickly release 700 MHz spectrum for increasing mobile broadband coverage and adoption in countrywide and release the potential of digital dividend from this band.

The two-stage release is a potential strategy worth adopting.

In the first stage, for the short term, to release the 2 x 10 MHz bandwidth out of the whole 2 x 45 MHz, and develop a reallocation roadmap zone by zone. Then link the spectrum reallocation and the universal service construction: once the bandwidth is released from broadcast, it can be assigned immediately for the extension of universal service. A zoning plan and implementation roadmap, to synchronize the spectrum release with the assignment to MBB, will accelerate the provision of digital universal service to remote areas in the next five years.

In the second stage, a long-term reallocation plan for the rest 2 x 35 MHz is needed to complete the conversion of a TV broadcast to MBB in this band, which becomes a key means for urban deep coverage.

3. Roadmap

If the spectrum in one range is assigned in multiple phases in order to gradually migrate incumbents (e.g. assigning 3.4-3.6 GHz then 3.6-3.8 GHz), the process should involve re-planning the band afterward to allow operators to create larger contiguous blocks. Long-term 5G roadmaps should be developed in consultation with stakeholders as soon as possible so operators understand how much spectrum will be made available by when, and what will happen to incumbents to help inform spectrum trading decisions.

ENCOURAGE SITE DEPLOYMENT TO LEVERAGE SPECTRUM

Mobile services are a key enabler of socio-economic development, and achieving ubiquitous access to mobile services for citizens is a major government policy objective in most countries. To deliver continuous mobile coverage in dense urban areas and across rural expanses, mobile network operators must build and manage an array of sites (also base stations) - free-standing masts, rooftop masts and small cells - equipped with antennas that transmit and receive radio signals, providing voice and data services to their customers in the area.

Governments that enable mobile network investment and remove barriers to the deployment of network infrastructure will accelerate the provision of mobile services to their citizens. A favorable climate is to be established for site investment and to reduce the ongoing costs of providing mobile:

- **Streamlined planning and administrative processes**

  Administrative efficiency is key to ensure mobile operators are able to meet the expectations of coverage and connectivity.

  Planning permission processes are an obvious example of administrative inefficiency in some markets. From the analysis of GSMA Connected Society, it is mentioned that in Indonesia, operators are requested to ask 2 to 3 administrative bodies for planning permission prior to building out a site: the ministry, the governorate, and the district. In this case, a fast track process could lighten the administrative hurdle.

  To improve administrative efficiency, the government is encouraged to improve the digital administrative channel. Making forms and even processes digital will help save valuable time and support operators in their effort. Governments are also encouraged to centralize all statistical and geographical information suitable to support mobile broadband network roll-out.

  Site approval time can also be further shortened in those improvements. Within One Single Submission System (OSS), Central Government guarantee completing the approval within 30/60 days and improving the efficiency in the process of network site deployment.

- **Non-discriminatory access to public infrastructure**

  Site access is one of the barriers to invest in network infrastructure for stakeholders. It is a big boost for the MBB deployment and improvement to develop an access specification offering open and non-discriminatory access to public infrastructures, such as state-owned buildings, roads, railways and ducts for utility services. Such kind of access convenience will significantly accelerate the network rollout process.

Where feasible, operators should be granted access to publicly owned facilities to set up radio sites. Such a policy will bring a high efficiency of site roll-out.

Encourage tower companies to obtain site construction towers, and share site infrastructure has become a trend to avoid duplicate construction and make operators focus on services.

▲ It may:
- Reduce site acquisition time.
- Accelerate the rollout of coverage into underserved geographical areas.
- Strengthen competition.
- Reduce the number of antenna sites.
- Reduce the energy and carbon footprint of mobile networks.
- Reduce the environmental impact of mobile infrastructure on the landscape.
- Reduce costs for operators.

▲ **Open site standard for cross-industry infrastructure sharing**

Increasing site density requires deploying more sites, and the openness and utilization of existing infrastructure will encourage stakeholders to deploy more sites in a cost-effective manner. The light pole, as an example, has been a typically shared carrier.

It will improve the utilization of existing infrastructure with less effort and avoid redundant construction to organize stakeholders from related industries to develop a cross-industry standard defining supportive functions and docking interfaces between telecommunication, power supply, lighting, road piping, building support and etc.

PROMOTE NETWORK PERFORMANCE TO MAXIMIZE THE VALUE

Network performance is the result of spectrum and sites, and at the same time is the compass for specifying policies to maximize the value of spectrum.

Mobile broadband connectivity extension, from urban areas to indoor scenarios, sub-urban and rural areas, has more citizens connected by high-speed access channel as shown in Figure 3.22. Based on 4G/5G, a national ubiquitous digital platform should be established, carrying digital services with rich information.

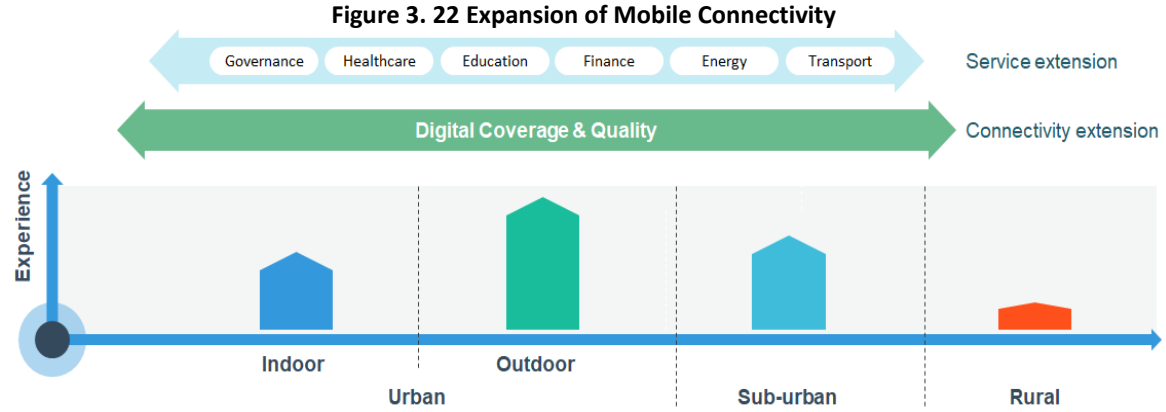
▲ **Enhance the market competition by benchmark and regular assessment**

To ensure that competition and innovation thrive, it is essential that policymakers create a level playing field across the digital ecosystem. All competitors providing the same services should be subject to the same regulatory obligations which link to the goals of the national development plan.

This should be achieved through a combination of benchmark and regular assessment on service quality.

Establishing a market benchmark is a popular method of accelerating network construction and achieving goals of digital infrastructure. That is why a set of goals and roadmap have been defined in this chapter.

Figure 3. 22 Expansion of Mobile Connectivity



Source: (Huawei International, Expansion of Mobile Connectivity, 2019)

From the perspective of a consumer, wireless broadband service is recognized as a commodity product. The experience is the key quality of the product. However, it is difficult for ordinary users to accurately evaluate it in a professional manner. This could easily lead to a network that is not properly maintained, leaving room for performance degradation or development stagnation. The independent regulator, therefore, needs to formulate clear regulations to enhance the assessment of experience in various locations and scenes, and then publish the report to the public. The reaction of subscription will, in turn, create a market pressure that motivates the potential of network operators and service providers to constantly improve their services.

Actively cooperate with evaluation agencies to conduct a periodic assessment of domestic MBB. This sets the direction of investment and innovation for each role of the industry, drives the entire industry to improve services through market competition, and continuously provides better and better experiences, which also enables the MBB platform to meet the requirements of more new services.

- **Expand the high-quality experience all over the countrywide to bridge the digital divide and to build a single digital community and market**

  As population density decreases, the commercial drivers of network infrastructure investment are getting smaller. To promote universal service, public investment organized by the government is essential. One has to take a no that collecting the USO fund is relatively easy, but spending the fund for infrastructure is far more difficult administratively.

Investigating and identifying places where operators are not willing to build networks, is increasingly common in global to provide universal services through state-owned company investments. With the permission to access to low-frequency, on the basis of the achievement of the submarine cable project, the government is able to enhance the investment and development of the construction of 4G universal services, and then unlock the value of the public investment. This is also the protection and utilization of submarine cable investment.

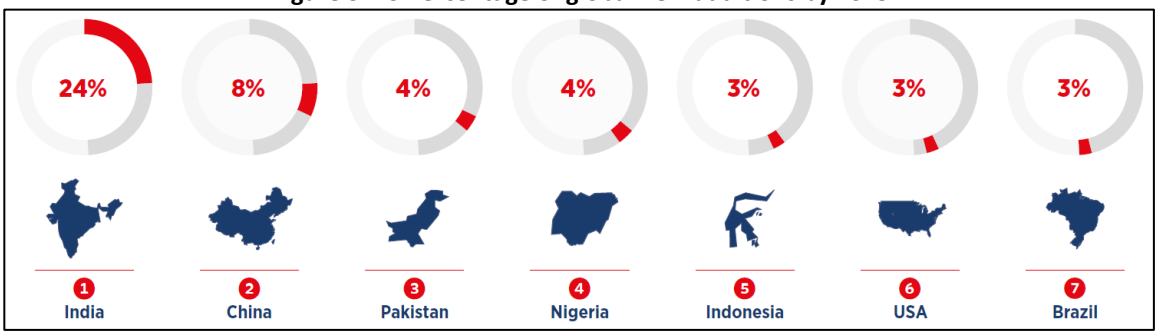
Access to 700MHz is the key factor in the short-term. A zoning plan and a frequency-release roadmap according to different zones constitute an efficient method for universal service deployment. Once the target spectrum is released, it can be assigned immediately so that the extension of universal service can be carried on. Synchronizing the spectrum release with the assignment to MBB will accelerate the provision of 4G universal service to remote areas in the next five years.

IMPROVE AFFORDABILITY TO PROMOTE BROADBAND OWNERSHIP

Indonesia is the fifth largest country in the world with the additional potential digital user as shown in Figure 3.23.

Affordability is the most critical obstacle to unlocking this potential. Making the majority to adopt the future digital connection is the first step of user readiness.

Figure 3. 23 Percentage of global new additions by 2025



Source: (GSMA, Mobile Economy, 2019)

- Encourage the definition and introduction of entry-level LTE terminals to the market to fasten the pace of digitalization upgrade and adoption.
- Encourage End to End cost reduction for end-user price ⩽ $50 or 5% GNI per capita to improve affordability. For the entry-level terminal, by lowering the consumption tax, the VAT rate, and even the zero-tax rate, it provides a digital opportunity for the low-income group to make this part of the user reach readiness.

The policies on affordability are not only the benefit for the low-income citizens but also a boost of subscription migration from 2G and 3G to 4G and 5G. Such policies will be an accelerator for technological evolution and replacement processes in the market.

MINIMIZE THE BARRIERS FOR FBB

1. Utility sharing

Wired networks rely on cables and conduits attached to poles, public roads, bridges, and tunnels. Securing rights to these infrastructures is often a difficult and time-consuming process that discourages private investment. Because of permitting and zoning rules, local government often plays a significant role in network construction. The government also regulates how broadband providers can use existing private infrastructure like utility poles and conduits. Many foreign governments have taken steps to encourage and facilitate fiber conduit deployment as part of public works projects like power wiring construction.

2. One-stop for approvals

One-stop for approvals strategy is to simplify and standardize the unrealistic and complicated processes related to broadband construction.

3. Financing ICT

Indonesia is currently undergoing an economic transformation that promotes sustainable economic development with social inclusion and integration into the global economy. Companies in traditional verticals have felt the biggest pinch, and are casting a hopeful eye in ICT's direction as a way out. By studies, national broadband development cannot be left entirely to the private sector. The private sector used to aim at profitable business and lack of motivation to do non-profit investment in the universal service obligation area, which defined as rural, border areas and schools, etc. The fund, called universal service obligation (USO) fund, is expected to be the major resource to accelerate the construction of the national broadband ecosystem.

4. Nationwide digital infrastructure

ICT has been the engine of progress for the past decade, profoundly changing our daily lives. Today, ICT brings new innovations to and enables further convergence of the digital and physical worlds. A comprehensive digital strategy addressing all sectors horizontally is vital to stimulate the Indonesia economy and overall competitiveness.

ACCELERATE BROADBAND CONNECTION BY WTTX

WTTx (Wireless-To-The-X) is a combination of FBB and MBB. It connects households and organizations through cellular technology for last-mile access. The continuous evolution of 4G and the high performance of 5G will make WTTx as one of the options to provide a high-performance broadband connection for households and organizations.

Table 3. 19 WTTx Relative advances in spectrum efficiency

Downlink / Uplink	Condition	Spectral Efficiency (bps/Hz)
Downlink	GSM (with HR + VAMOS)	0.22
	UMTS (with 2*2 MIMO + 64QAM)	1.2
	LTE (with 2*2 MIMO + 64QAM)	1.7
	WTTx LTE-evolution 64T64R (with 8*8 MIMO + 256QAM)	13
Uplink	GSM (with HR + VAMOS)	0.08
	UMTS (with 1*2 MIMO + 64QAM)	0.6
	LTE (with 1*2 MIMO + 64QAM)	1
	WTTx LTE-evolution 64T64R (with 8*8 MIMO +64QAM outdoor CPE)	6

Source: (OVUM)

By 2020, 350 million households will be connected by WTTx, forecasted by OVUM. The reasons resulting in the sharp rise of the WTTx. First, the Massive MIMO evolution significantly improves the capacity of 4G connectivity and 5G connectivity in

the future by multiplying the spectrum efficiency. Second, the absence of the cable, fiber, etc. in early buildings and communities, and high the difficulty and cost of re-entering hindered the rapid increase of FBB penetration rate.

At present, WTTx is able to provide a single connection speed of 20 to 100 Mbps, and the adoption of 5G technology will provide 1 Gbps speed, which is the same level as Fiber and is therefore called a fiber-like broadband service. Essentially, WTTx is an extension of the fiber that provides the last mile of connectivity. In the national broadband infrastructure framework, WTTx should be included as a complemented option, using its own characteristics to enhance the broadband penetration for households, communities, organizations, and SMEs (small and medium-sized enterprises) across the country.

WTTx has proven itself an essential component in national broadband in developed countries as well as developing countries. Governments in Australia, Germany, and Norway endorse WTTx and hope to provide universal broadband services and improve the broadband experience using WTTx networks. To fulfill this goal, they have created preferential policies or concrete measures to promote WTTx development. In Germany, the government demands that operators provide universal broadband services in rural areas using the 800 MHz frequency band. The Australian government has set up the NBN Company to implement its national broadband plan. The Norwegian government provides an ultra-broad spectrum at preferential prices to operators who build cost-effective and high-quality WTTx networks.

Wireless first is a more practical and efficient strategy for fast deployment and sustainable broadband connectivity for scenarios where fiber is not available, or difficult to enter, including the communities without a planned fiber pipeline in cities, the schools, healthcare facilities, and public service offices in rural areas.

INDOOR DIGITALIZATION DEVELOPMENT STATUS ANALYSIS AND DEVELOPMENT STRATEGY

▲ A. Awaken the Awareness of the Developers and Policy Driven

In the current 4G era, mobile ATMs and mobile pay in many countries have become very popular, replacing traditional cash transactions, greatly enhancing the digital life of the people, and letting the people experience the efficiency and convenience brought by digitalization.

However, these applications are difficult to be widely used in shopping malls, restaurants, and commercial buildings in Indonesia. Because indoor 4G coverage is poor or the data transmission rate is slow, it cannot support these digital applications to apply in these buildings. The reason why Indonesian Mobile Network Operators reluctant to build 4G coverage indoors is that the owners of these buildings are still in the old business model. They think that digitalization has no value to them. And the owners of buildings instead required the Mobile Network Operators to pay expensive rents if the operators build 4G in their building.

Of course, this phenomenon has also occurred in the neighboring country - Singapore. To solve this problem, Singapore IMD (INFO-COMMUNICATIONS MEDIA DEVELOPMENT AUTHORITY) issued THE CODE OF PRACTICE FOR INFO-COMMUNICATION FACILITIES IN BUILDINGS ("COPIF"). In which:

Table 3. 20 IMDA Indoor coverage Standard

Performance Indicators	QoS Standards	Effective date (for incumbent operators)	Effective Date (for new Operator)
Tunnels Coverage	For monitoring a Quarterly basis and publication	Prior to 1 July 2018	-
	>99% coverage with signal strength of -109dBm or better all road and MRT tunnels	01-Jul-18	January 2020 (for road tunnels) January 2022 (for MRT station/lines)
in-Building Coverage	For Monitoring on a monthly basis and Publication	01-Jan-18	-
	>85% Coverage with signal strength of -109dBm or better in each building	01-Jan-19	01-Jan-20

Source: (IMDA, COPIF 2016, 2016)

1. In the COPIF 2013, developers/owners are required to set aside a specified amount of **rent-free** space known as Mobile Deployment Space ("MDS"), within their developments at the request of Mobile Network Operators ("MNOs") to facilitate their deployment of mobile equipment to ensure good in-building mobile coverage
2. In the COPIF 2016, IMDA published the Indoor coverage Standard as below, for each instance of non-compliance, a financial penalty of up to S$50,000 may be imposed for each standard. For aggravating cases, for example, for continual or serious breaches, IMDA may increase the quantum of the financial penalty to beyond S$50,000.

And IDMA has further defined the detailed areas which are included in the indoor service coverage indicator: bomb shelters, storerooms, toilets within an individual premise, lifts, plant rooms, mechanical and electrical rooms, lift motor rooms, lift houses, water tank areas, warehouses, ventilation facilities, vaults, in-building carparks located at second level basement and below, all in-home basements of private landed residential properties, mechanical and plant facilities/rooms and emergency stairways.

Table 3. 21 Mobile deployment space to be provided in a development consisting of 1 or more multi- Storey residential buildings

Total number of residential units in the development	Mobile deployment space (m^2)	Minimum height of mobile deployment space (m)
80 to 200	24	3
201 to 600	36	
601 to 1500	54	
> 1500	To consult IMDA	

Table 3. 22 Mobile deployment space to be provided in a development consisting of 1 or more non-residential buildings (all of which are not tunnels)

Total mobile coverage area ('000 m^2)	Mobile deployment space (m^2)	Minimum height of mobile deployment space (m)
> 2 to ≤ 6	24	3
> 6 to ≤ 20	36	
> 20 to ≤ 100	54	
> 100 to ≤ 200	72	
> 200	To consult IMDA	

Source: (IMDA, COPIF 2018, 2018)

3. In the COPIF 2018, IMDA has further defined the detailed requirements to property developments about indoor Mobile Deployment Space (MDS) as below, to guarantee the property developments provide enough free space for indoor mobile deployment. Therefore, the relevant department of Indonesia government can issue a policy similar to Singapore's IMDA COPIF to break current bottleneck of indoor digitization.

▲ **B. Indoor 5G-Oriented Products is a Shortcut**

In the 5G IoT era, a large number of indoor 5G applications require accurate positioning technology support by wireless networks, for example walking robots serve the people, such as leading the way, delivering objects. Or else, these 5G applications will be very dangerous if there is no powerful wireless network support with accurate positioning function.

The DAS (Distributed Antenna System), which was previously popular indoors, cannot support accurate positioning from the own design principle since the headend is not digital but passive.

It can be said that DAS can meet the demands of 2G/3G era voice and mid-to-low-speed data services. But in the era of 4G/5G, this technology has been eliminated.

However, currently, some uninformed developers/ Mobile Network Operators/Tower companies in Indonesia continue to build DAS that cannot evolve to 5G, which will be a huge investment waste. We should provide education and consulting service or publish the policy to guide them that they should take shortcut and select a 5G-Oriented Digital Indoor System (DIS) to realize one step to 5G, to avoid repeat investment.

▲ **C. Indoor 5G-Oriented system deployment Authorization to TP (Tower Provider).**

In the era of 2G/3G in Indonesia, the government has implemented an efficient mobile network deployment policy, which encourages the tower was built by TP (Tower Provider) and be leased to four mobile network operators. This mechanism can avoid the four mobile network operators building their own towers and waste resources and costs. And this mechanism has also been copied in the Indoor domain. Therefore, the mode of indoor DAS sharing in the 2G/3G era is very popular in Indonesia.

With the coming of the 5G era, indoor 5G 2C applications are also very suitable for this sharing mode. TP was encouraged to continue to give play

their advantages indoors, but since the DAS system has been eliminated, the end of the DIS system that meets the 5G requirements is Active, so TP needs to be authorized by the government to build an active 5G DIS system or to building the 5G-Oriented DIS system in the current 4G era, to accelerate the progress of urban digitization.

▲ **D. Indoor 5G spectrum allocation is easy than outdoor. Indoor 5G deployment first.**

Due to the shielding of the external walls of the building, there is a low probability of co-frequency interference or adjacent-frequency interference between the indoor frequency and the outdoor frequency, even satellite communications frequency (C-BAND). So Indoor 5G spectrum allocation in Indonesia is easy than outdoor, namely, indoor 5G deployment has no spectrum barriers, so Indoor 5G deployment can be started first.

DATA CENTERS

Because of Cloud Computing take up it is estimated that by 2025, 80% of enterprises will have shut down their traditional data centers versus 10% today. Therefore, we are seeing the rise of Mega Public Shared Data Centers to support both cloud providers as well as legacy enterprise applications.

A focus has also been placed on initiatives to reduce the enormous energy consumption of data centers by incorporating more efficient technologies and practices in data center management. Data centers built to these standards have been coined "green data centers."

Data Centers are critical for enterprises operating in the present borderless global world. Whether private or public, the data center is essential for hosting mission-critical applications. A data center store computer systems and associated components commonly including a raised floor, backup power supplies, redundant data communication connections, environmental controls (such as for air conditioning and fire suppression), and security devices.

Data centers may operate on two main models. One is for an organization to build, operate, and manage its own data center for internal purposes, known as a **captive data center.** The other is the **outsourced data center**, where organizations lease space and hosting services from external data center providers.

In the outsourced data center model, data center providers can offer a combination of services:

COLOCATION

Colocation refers to pure space rental, including floor space, cages or racks in different sizes. Basic infrastructure-level support such as power, cooling, and physical security measures, as well as basic network connectivity, are provided.

MANAGED HOSTING

Managed hosting services include the provision of servers. Customers do not need to purchase their own servers. Instead, they rent the servers from the data center operator together with other specified equipment. Managed Hosting also can include Cloud IaaS, where the customer is offered virtualized server and storage capacity.

Data Centers are major users of energy. At the global level, data center energy use was estimated at 1.1% of total energy use in 2012 and by 2020 it is expected to increase to 2.5%. This study estimates that Indonesian data centers used about 1.5% of total electricity-generating capacity in 2014 and will reach between 2.0% and 3.0% by 2017. This will further strain the electricity supply capacity in Indonesia. Additionally, Indonesia's Government Regulation No.71/2019 requiring all Indonesian-related data to be contained in data centers within the country, will drive information technology growth and further increase energy requirements.

Table 3. 23 Data Center Categories and Energy Use

DATA CENTER SIZE	ENERGY CONSUMTPTION	ESTIMATED % OF TOTAL ENERGY
Small (in-house server rooms / cupboards)	10kW - 150 kW	39%
Medium	150 kW - 750 kW	21%
Enterprise	750 kW - 2,500 kW	32%
Mega	2,500 kW Plus	8%

Source: (Dynamic Intelligence)

INDONESIA CAPTIVE DATA CENTERS

A BroadGroup study estimates that on average, 85%–90% of companies in Asian countries have their data center located in-house. Their estimate for each country varies from 75% in

Singapore to 95% in Indonesia. These types of data centers often have a high total cost of ownership, power savings are not considered, and general disaster recovery is an afterthought. This market should be a target for conversion to an outsourced data center model, where costs can be minimized and more state of art energy-saving equipment is used e.g. power and air conditioning. However, to achieve this enterprise will need to feel confident in its Data Center Provider.

For the Government of Indonesia, conservative estimates suggest that there are around 120 data center facilities of either medium or enterprise-level supporting government agencies. Additionally, there are around 155 SOEs each of who will have a data center. This puts the estimate at around 275 data centers which could double if each of them has a backup data center making the number around 550. Developing larger Enterprise and Mega Data Centers for the government should be a priority and where clouding computing virtualized infrastructure should be used to consolidate and reduce operating costs. The government should also consider a standard approach to backup and disaster recovery.

INDONESIA OUTSOURCED DATA CENTERS

A 2015 survey by Sharing Vision has identified 84 data center service types and 39 data center providers in Indonesia:

- 5 meet Tier I standards
- 63 meet Tier II standards. There was and one company with "Tier II" design certification.
- 16 data centers meet Tier III and IV standards. However, only 10 data centers were certified by the Uptime Institute. There were only two companies that had the "Tier IV–Fault Tolerant" design certification and 10 companies with "Tier III–Concurrently Maintainable" design certification, and 2 companies received "Tier III–Constructed Facility" design certification.

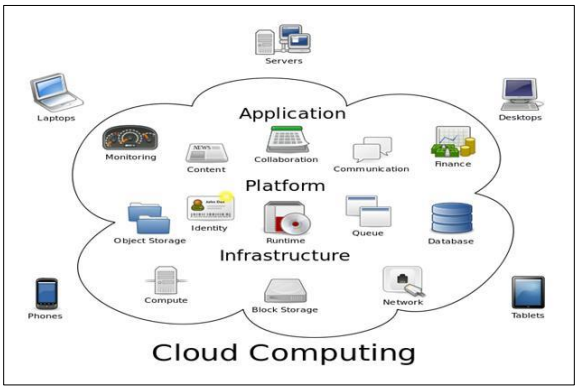
One of the main obstacles is the lack of adherence to Industry Data Center Standards and Guidelines. The Data Center Industry has strict standards and guidelines on what is required to be a certified Data Center for each tier level. Certification and regular checks need to be put in place to ensure data services meet specifications. A guideline, manual, or code of conduct on data center design and energy efficiency and sustainability should be developed to support the industry, particularly the local operators who have minimal experience. It is difficult to define design requirements and project growth estimates of the ultimate load. Such uncertainty often results in over-provisioning of IT; heating, ventilation, and air conditioning systems; power supplies; and other equipment.

Therefore, the objective should be to develop an environmentally friendly, sustainable and regulated Data Center industry in Indonesia to support the move to a digital economy.

CLOUD AND BIG DATA

Cloud Computing is the use of virtualized scalable computing services (IaaS Infrastructure, PaaS Platforms, and SaaS Applications) over a network. Other computing systems or individuals can gain access to a shared network of computing resources and pay for only the level of computing capacity used. Before the advent of cloud computing, many companies couldn't leverage big data because of the associated costs of IT systems. Now, we can have all the computing power we need just with a few clicks.

Figure 3. 24 Cloud Computing System



Source: (Wikimedia)

By 2020, a minimum of one-third of all data will be stored and analyzed using cloud computing.

Five short years ago, cloud computing was a new tool — a next-generation technology that promised to help companies and countries unlock greater productivity and expanded economic growth. It was with that perspective that BSA the Software Alliance launched the Global Cloud Computing Scorecard — a resource to help policymakers shape the proper legal and regulatory environment to encourage the growth of the cloud in their markets.

Cloud computing is now a widely adopted technology that powers global businesses and helps governments better connect with their citizens on a daily basis.

Based on that evolution BSA the Software Alliance regularly tracks change in the relevant international policy landscape. With companies and governments increasingly moving their key IT processes to the cloud, the mix of important policy considerations has become increasingly clear:

PRIVACY LAWS

Must ensure the proper protection for users' data without restricting the ability of companies and users to move data across borders to maximize its value.

SECURITY LAWS

Must help shape an environment where cloud computing providers can implement cutting-edge cybersecurity solutions without being handcuffed by requirements to use specific technologies. Users also must be able to trust that cloud computing providers understand and properly manage the risks inherent in storing

INFRASTRUCTURE

Countries must invest in the appropriate infrastructure. Cloud users must have access to robust, ubiquitous, and affordable broadband, which requires policies that provide incentives for private sector investment in broadband infrastructure and laws that promote universal access to broadband.

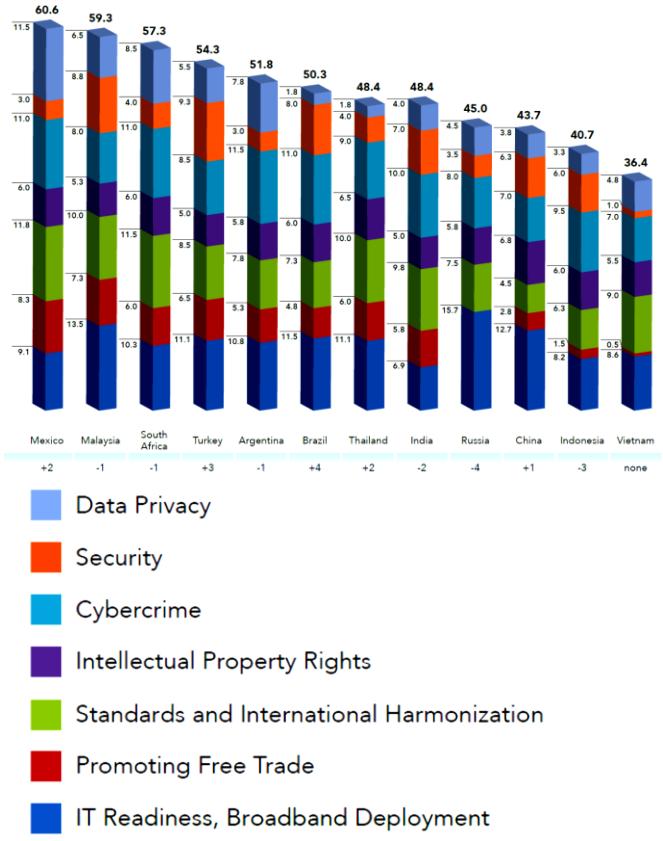
INDONESIA CLOUD MARKET

Cloud Computing is an equalizer, allowing small and medium enterprises with access to IT tools that they could not previously afford. Cloud enables a number of new cutting-edge technologies such as;

- IoT and Big Data - allows the collection, storage, and analytics of vast amounts of data.
- Artificial Intelligence - uses vast amounts of data to "train" algorithms to solve complex problems and achieve certain goals.

Emerging markets continue to lag in the adoption of cloud-friendly policies, hindering their growth. Indonesia continues to update and reform laws and regulations in the information technology (IT) sector, but the result has not been positive for cloud computing with Indonesia falling points over the previous 12 months.

Figure 3. 25 Indonesia Cloud Scorecard



Source: (BSA, 2018 Global Cloud Computing Scorecard for large developing markets)

Cloud Computing in Indonesia is rapidly growing and will likely be driven by the take up of e-Commerce, particularly for small and medium enterprises who required infrastructure to support online digital marketing.

BIG DATA

Big Data Analytics is a set of techniques and tools used to process and interpret large volumes of data that are generated by the increasing digitization of content, the greater monitoring of human activities and the spread of the IoT.

Businesses, governments, and individuals are increasingly able to access unprecedented volumes of data that help inform real-time decision making and provide predictive outcomes by combining a wide range of information from different sources.

Originally, data scientists maintained that the volume of data would double every two years thus reaching the 40 ZB point by 2020. That number was later bumped to 44ZB when the impact of IoT was brought into consideration.

Big data analytics also enables machine learning, a driver of Artificial Intelligence (AI) and is widely used in Virtual and Augmented Reality (AR). These are new technologies that will provide human-like cognitive functions and three-dimensional computer-generated environments that replace the normal reality.

International Data Corporation (IDC) forecasts revenues for big data and analytics (BDA) in the Asia/Pacific (excluding Japan) will reach $14.7 billion in 2018, an increase of 14.4% over 2017.

"Big data will be a game-changer for enterprises and governments around the Asia Pacific, enterprise across the region are adopting Big Data and analytics for an added advantage but most are yet to take-off with full-scale implementation and the vast majority are currently taking an ad-hoc and opportunistic approach," said Ashutosh Bisht, Research Manager at IDC Asia Pacific.

Banking, telecommunications, discrete manufacturing, federal/central government, and professional services are the five potential and leading industries which will make the largest investments in big data and analytics solutions in 2018, accounting for more than 55% of the total spending. However, over the forecast period (2016-21), professional services, healthcare providers and resource industries will grow at the highest pace.

INDONESIA BIG DATA

From a geography perspective, China will be the biggest market followed Australia. However, the countries that will see the fastest growth in Big Data spending over the five-year forecast period will be Indonesia (19.7% CAGR), Philippines (19.0% CAGR) and Thailand (18.2% CAGR).

One such partner is Pulse Lab Jakarta (PLJ), a unique joint initiative of the United Nations and the GOI that is working to support innovation in the use of big data and human-centered design for inclusive

development in Indonesia. Pulse Lab Jakarta (PLJ) was established as a data innovation lab in part to test the feasibility of using digital data signals to inform the country's economic strategy and policy decisions and is used by Indonesia's Ministry of National Development Planning (BAPPENAS).

CONCLUSION

1. New Regulation

   Government Regulation No. 71/2019 classifies electronic system operators into public and private. Public Electronic System Operators are state institutions or other institutions appointed by a state institution that operates an electronic system. Private Electronic System Operators are persons, business entities or communities that operate an electronic system.

   Only Public Electronic System Operators must place their electronic systems and data in Indonesia. Private Electronic System Operators can place their electronic systems and data in or outside of Indonesia unless otherwise regulated. However, Private Electronic System Operators must allow "supervision" by government agencies, including granting access to the electronic systems and data for monitoring and law enforcement purposes (all of which will be subject to further implementing regulations).

2. Data Center

   - ▲ Indonesia should consider stronger regulation/certification and police for data center levels (Tier I, II, III) including cybersecurity regulation.
   - ▲ Additional incentives should be considered to entice local public data center development by international and local providers.
   - ▲ The government should also define its strategy for internal data centers and the use of external outsourced centers.

3. Cloud Computing

   - ▲ Indonesia should consider defining standards for internal use of cloud computing for example; what government data and applications should be resident on a private cloud versus public cloud as well as standards around virtualization tools.
   - ▲ Additional incentives should be considered to entice international public cloud providers to locate clouds in Indonesia. Also, some governments are also looking at creating consumer reports about various cloud service providers to support enterprise selection of providers.

4. Big Data

   - ▲ For Big Data, Indonesia should consider the formation of a data standard including data ownership so that information can be easily shared with agencies as well as enterprises.
   - ▲ The government may need to consider acting as a largely trusted clearinghouse for some of the IoT sensor data.

INTERNET OF THINGS (IOT)

IoT comprises devices, such as Sensors, which collects information from an object and in some cases, this object can be remotely controlled through the sensor. The information is then sent across a network to be processed and analyzed.

There are literally thousands of applications that could use this technology for example; remote monitoring of personal health, measuring floods or soil quality for agriculture, city services such as environment, water, energy, and traffic monitoring, building and residential control such as lighting, heating, and security, and applications associated with city safety such as CCTV monitoring.

These devices are a key source of data that are feeding big data analytics.

IDC Forecasts Worldwide Spending on the Internet of Things to reach $772 Billion in 2018, an increase of 14.6% over the $674 billion that was spent in 2017. By 2020 it should $1 trillion

- IoT hardware will be the largest technology category in 2018 with $239 billion going largely toward modules and sensors along with some spending on infrastructure and security.
- Services will be the second-largest technology category. Services spending will grow at a faster rate than overall spending with a CAGR of 15.1% and will nearly equal hardware spending by the end of the forecast.
- Followed by software and connectivity. Software spending will be led by application software along with analytics software, IoT platforms, and security software. The software will also be the fastest growing technology segment with a five-year CAGR of 16.1%.
- By 2021, more than 55% of spending on IoT projects will be for software and services

NB IoT (Narrowband IoT) being utilized globally as part of essential technology to accelerate IoT ecosystems. System metering (water meter, gas meter, electricity meter, street light) and intelligent monitoring are rapid growth significantly starting year 2020. It's forecasted that within 3 years, most of the metering system and intelligence monitoring in the city area will be reached closed to fully utilized by NB IoT. It is encouraging that NB IoT coverage aligns with demand forecast to cover cities area also.

The industries that are expected to spend the most on IoT solutions in 2018 are

- **Manufacturing** – operations and production asset management ($189 billion)
- **Transportation** – Traffic, Freight Monitoring and Fleet Management ($85 billion)
- **Utilities** – Smart Grid for Electricity, Gas, and Water ($73 billion)
- **Cross-Industry** IoT spending, which represents use cases common to all industries, such as connected vehicles and smart buildings ($92 billion)
- **Consumer** – smart home including home automation, security and smart appliances ($62 billion)

IOT IN INDONESIA

In Indonesia, the Internet of Things is increasingly in demand by many companies. Over the course of 2016 the Indonesia IOT Ecosystem started to emerge;

- Multiple small IoT applications were launched as of Jakarta's effort to evolve to become a Smart City. Jakarta's plans include; the deployment and implementation of Jakarta One Card, City Surveillance System, Dump Truck Tracker, and Smart Street Lighting. Smart City initiatives will be some of the early adopters of IoT in Indonesia
- In February 2016, Indonesia introduced a venture capital policy to provide incentives for the financing of tech startups. This policy should support the development of IoT applications for the Indonesia Market
- Telkomsel and Indosat have both entered the IoT market. Telkomsel launched the Telkomsel Innovation Center Program. This program summarizes various activities to form the IoT ecosystem in Indonesia such as; provision of laboratories, mentoring and boot camps with

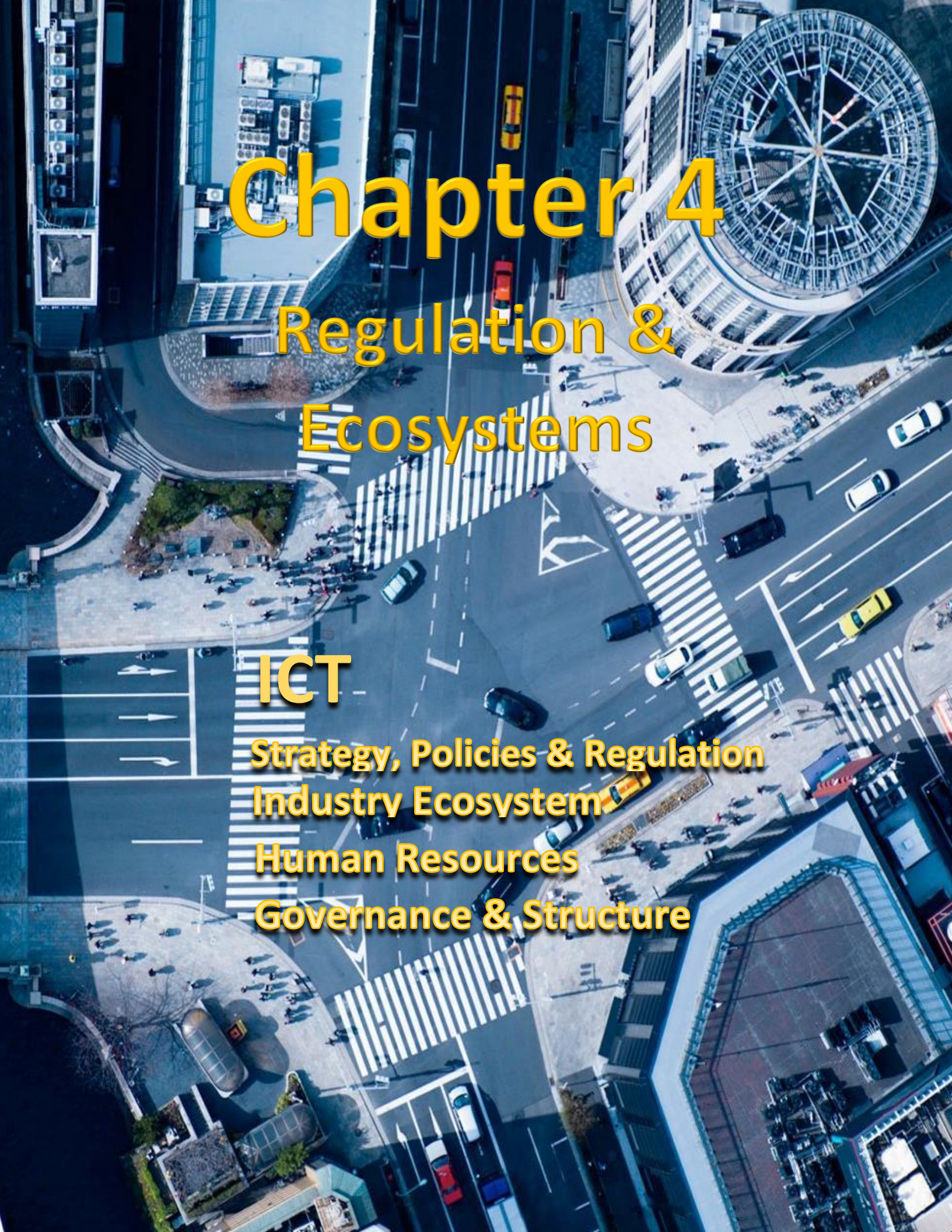
experts, access to connectivity for startups, developers and systems integrators. Current services on offer include; bike-sharing, fish feeder, and aquaculture, and smart bin waste management.

CONCLUSION

Indonesia government should consider the development of IoT policies and regulations to support the further development of this market for Additional pilots and proof of concepts should be developed in conjunction with learning institutions and private enterprises to provide an example of the value of IoT and also to support needed IoT skill development.

example; regulations on where sensors can be located and the sharing of those locations, sensors standards, regulations around the network to connect the sensors.

Additional pilots and proof of concepts should be developed in conjunction with learning institutions and private enterprises to provide an example of the value of IoT and also to support needed IoT skill development.



Chapter 4

Regulation & Ecosystems

ICT

Strategy, Policies & Regulation
Industry Ecosystem
Human Resources
Governance & Structure

ICT STRATEGY, POLICIES, AND REGULATION

Enterprises and their customers are at the heart of efforts to increase the competitiveness of Indonesia. Setting the National Strategy, Policies and Regulations should consider the following objectives.

- To reduce the regulatory burden on enterprises and make it easier for enterprises to work smarter.
- Availability of high speed and open infrastructure; Public Networks, Public Data Centers and Cloud Providers, Open Internet.
- Provision of safe, reliable and secure infrastructure and enforcement of cybersecurity regulations.
- Skilled ICT workforce as more people are needed with the skills required to apply ICT in practice within companies.
- Creating a conducive environment for the ICT Industry to develop.

SETTING POLICY OBJECTIVES AND STRUCTURE

The following has been extracted from the OECD document on ***"OECD Digital Outlook 2017"*** and serves as an example of the ICT Policy focus for countries.

OECD Policy objectives for the development of the digital economy and society and which are largely pursued by National Digital Strategy NDSs are a high priority across all OECD countries.

The following table shows a priority ranking of 15 policy objectives, based on responses from 35 countries. Overall, 68% of the objectives were considered to be a high priority, 15% medium-high, 14% medium, and only 3% low or medium-low priorities.

Table 4. 1 Priority Ranking of Policy Objectives For Digital Developments

POLICY OBJECTIVE	2017 RANKING	2020- 2025 CHANGE
Strengthen e-Government Services	1	—
Develop Telecommunication Infrastructure	2	▼ 3
Promote ICT Skills & Competencies	3	—
Strengthen Security	4	▲ 2
Enhance Access to Data	5	▲ 1
Encourage ICT adoption ICT by businesses	6	▼ 1
Encourage ICT adoption ICT by sectors e.g. Health	7	▲ 1
Strengthen Privacy	8	—
Strengthen Data Identities	9	—
Promote ICT Sector including Internationalization	10	—
Promote e-Commerce	11	▼ 1
Tackle Global Challenges e.g. Internet Governance, Climate	12	▲ 1
Strengthen Consumer Protection	13	▼ 1
Advancing e-Inclusion e.g. elderly	14	▲ 1
Preserving Internet Openness	15	—

ADDITIONAL OBJECTIVES FOR NATIONAL DIGITAL STRATEGIES
Fostering science, innovation and entrepreneurship
Ensuring access to the Internet, services and information
Developing digital content and culture
Increasing the use of digital technologies
Developing a sound regulatory approach for digital environments

Source: (OECD, Digital Economy Outlook, 2017)

Governments sited several challenges working towards the policy objectives listed as listed above. Among the 10 main challenges identified by 31 countries, the three most prominent are:

- A lack of awareness, implementation, and enforcement
- Insufficient skills, training, and education
- Co-ordination, including multi-stakeholder, multi-lateral and multi-level governance coordination.

Table 4. 2 Main Challenges in Achieving Policy Objectives

MAIN CHALLENGES 2017	2017 RANKING	2022 RANKING
Awareness, implementation, enforcement	1	1
Skills, training, education	2	3
Coordination multi-stakeholder and multi level of governance	3	2
Policy design and measures	4	8
Laws and regulations	5	7
Technical including standards and interoperability	6	5
ICT adoption, business digitization, innovation	7	9
Public invest or funding	8	4
Private investment or access to finance	9	10
Trust, including privacy, security, consumer protection	10	6

Source: (OECD, Digital Economy Outlook, 2017)

ICT POLICY FRAMEWORK

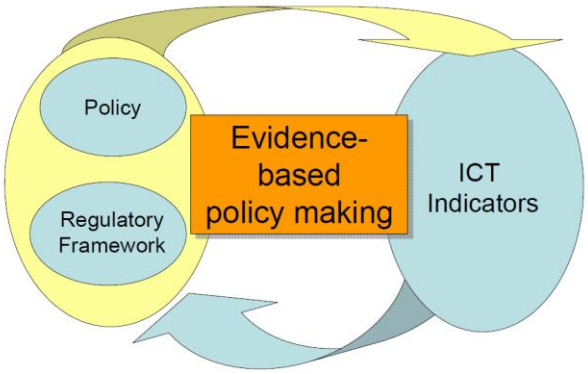
Information and Communication Technologies are increasingly widespread in the world and are fast becoming the basis of economic development.

While the key elements of an integrated National ICT Policy Framework are now well known, their implementation at the country level is still often inadequate. This partly reflects the absence of a coordinated national response and regular reviews.

Today Indonesia has numerous ICT Policies and Regulations across many ICT domains. It is recommended that a holistic Policy Framework be developed to ensure appropriate policies and regulations are in place.

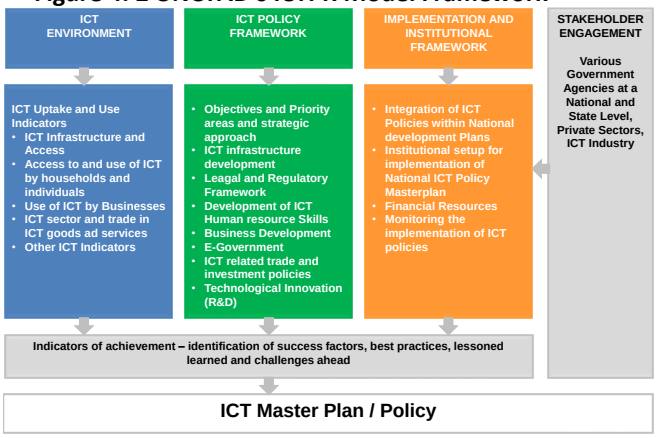
The United Nations Development Policy Framework is a good example of an approach to developing a National Policies and regulatory framework based on Key ICT targets/Indicators.

Figure 4. 1 UNECSAP ICT Policy and Regulatory Framework



Source: (UNESCAP)

Figure 4. 2 UNCTAD's ICTPR Model Framework

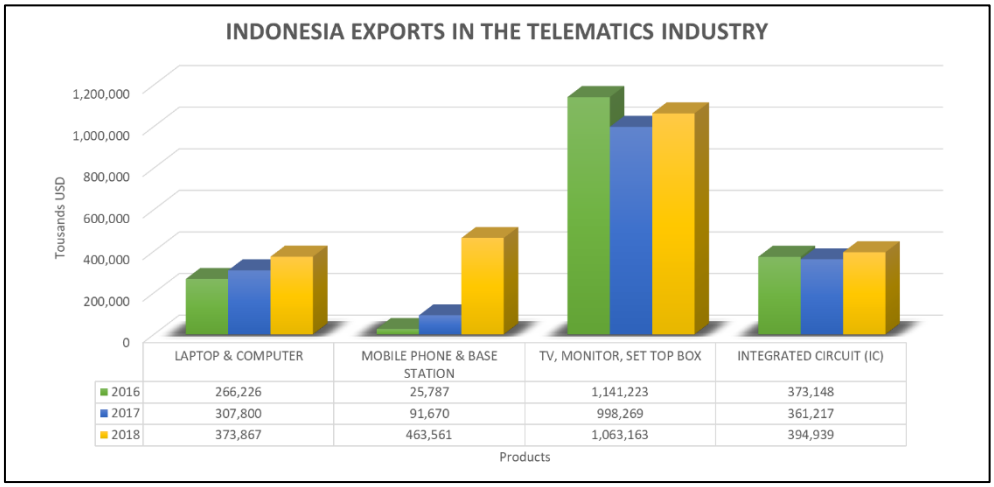


Source: (UNCTAD, Framework for Information and Communications Technology Policy)

ICT LOCAL CONTENT

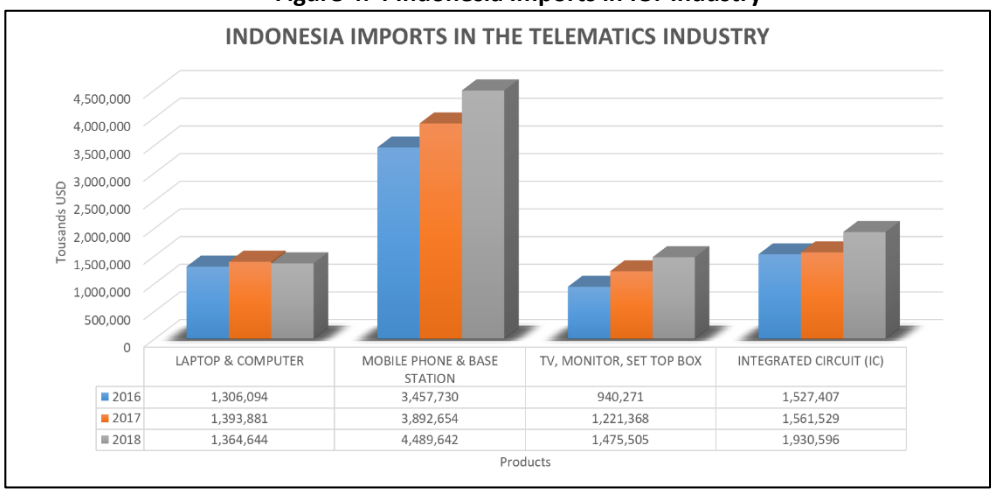
The rapid development of information and communication technology (ICT) in every element of society resulted in the emergence of a number of needs for the government, business, and society. With regard to this, decision-makers need to look for technologies that can provide solutions and drive the expected changes at local, national and global levels in innovative ways. This rapid development of information and communication technology will affect ICT devices, in this case, telecom-munications devices as supporting elements in the development of the telecommunications sector.

Figure 4. 3 Indonesia Exports in ICT Industry



Source: (Ministry of Industry, 2019)

Figure 4. 4 Indonesia Imports in ICT Industry



Source: (Ministry of Industry, 2019)

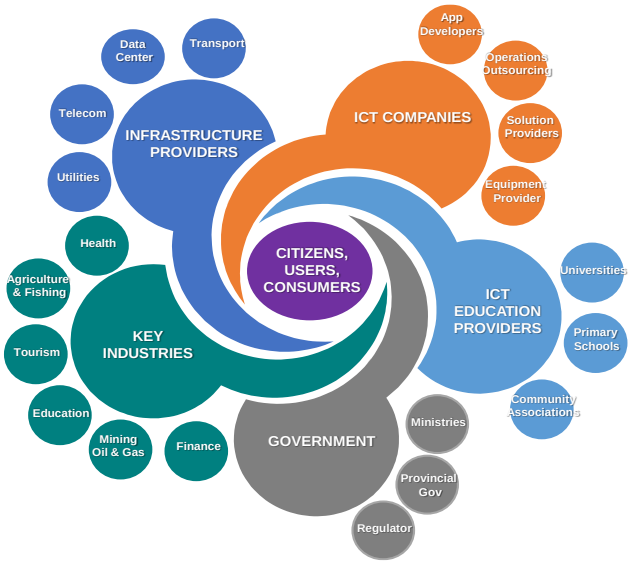
The high dependency on telecommunication devices imports has resulted in increasingly high selling value of telecommunications devices to the public as users of telecommunication services in the domestic market and created obstacles in the development of information and telecommunication industry in Indonesia. Statistically, Indonesia is the world's 6th largest Internet user country, but the penetration rate of 64.8% (APJII latest data) with an even larger potential for development. According to data, more than 90% of the investments made by telecommunication operators to develop their ICT networks were used to import devices. Meanwhile, the majority of personal ICT devices, such as computer or cellular phone handsets, are imported goods and only a few of these are local products. The potential market size in the Indonesian telecommunication sector, in macro figures, is approximately Rp 500 trillion, while investment

spending in this industry sector has reached around Rp 60 trillion to Rp 80 trillion per year. The national telecommunication manufacturing industry sector is heavily dominated by imported products. Unfortunately, any significant positive impact on the local ICT industry growth in Indonesia has not been observed so far.

Local Content (Kandungan Dalam Negeri, KDN) defines the use of ICT and supporting material/ devices, design and engineering that contains elements of domestic manufacturing, fabrication, assembly, finishing and services performed by local experts and involving local software. Local Content Requirement or TKDN is the proportion of Local Contents in goods, services, and combination of goods and services. TKDN is not limited to hardware but also includes software. TKDN applies to both subscriber station (SS) or handheld device, and to base subscriber sub-system (BSS) or hardware.

The Government has implemented various key policies to encourage the local ICT industry in the development of telecommunication products. One of these policies is the regulation of the Local Content Requirement (TKDN) which stipulates the minimum local content requirement for telecommunication devices for use in Indonesia. Other policies include:

- Government Regulation (Peraturan Pemerintah) Number 29 Year 2018 concerning Industrial Empowerment



- Presidential Decree (Keputusan Presiden) Number 24 Year 2018 concerning National Team for Increased Use of Domestic Products
- Regulation of the Minister of Communication and Information Number 27 Year 2015 concerning Technical Requirements for Long Term Evolution Technology-based Telecommunication Equipment and/or Devices
- Regulation of the Minister of Industry Number 68 Year 2015 concerning Provisions and Procedures for Calculating Local Content Requirement Score in Electronics and ICT Products
- Regulation of Minister of Industry Number 68 Year 2015 concerning Provisions and Procedure for Calculating Domestic Component Level Value of Electronics and ICT Products
- Regulation of Minister of Industry Number 29 Year 2017 concerning Provisions and Procedures for Calculating Domestic Component Level Values for Cellular Phone Products, Handheld Computers, and Tablet Computers
- Regulation of the Minister of Trade Number 48 Year 2015 concerning General Provisions Relating to Imports.

ICT INDUSTRY ECOSYSTEM

MCIT Regulations 07/2009 and 19/2011 requires that equipment used in certain wireless broadband services contain local content of at least 30 percent for subscriber stations and 40 percent for base stations and that all wireless equipment contains 50 percent local content within five years. Indonesian telecommunication operators are also required, pursuant to Decree 41/2009, to expend a minimum of 50 percent of their total capital expenditures for network development on locally sourced components or services. In 2015, KOMINFO issued Regulation 27/2015, which requires all 4G enabled devices to contain 30 percent local content, and all 4G base stations to contain 40 percent local content by January 2017. The U.S. Government continues to engage the Indonesian government on these issues.

Digital Ecosystems drive Digital Transformation. As Gartner Research defines it: "A digital ecosystem is an

interdependent group of enterprises, people and/or things that share standardized digital platforms for a mutually beneficial purpose, such as commercial gain, innovation or common interest. Digital ecosystems enable you to interact with customers, partners, adjacent industries — even your competition."

Digital ecosystems can also be thought of as the sum of people, processes, and technologies needed to implement an ICT "line of business."

For example, a smartphone manufacturer may rely on other companies to provide and support the hardware components, the operating system, and user applications. Apple also had opened Developer Academy in 3 places in Indonesia. This step is one of Apple's ways of fulfilling the Domestic Content Level (TKDN) policy in Indonesia in hardware scheme, software scheme, and investment scheme.

Digital ecosystems can become quite complex and inter-related. Major ecosystems have developed around Social Networking, Mobility, Analytics and Big Data, Cloud Computing, Internet of Things, Smart City, e-Commerce, and Blockchain.

There is a wide range of manufacturers, vendors, and consortia involved in the formalization and evolution of these ecosystems. There is also a wide range of standardization initiatives in these areas.

Indonesia Government needs to consider which Ecosystems are important to the future development of a Digital Indonesia and how the government will foster the creation and ongoing development of these ecosystems.

DIGITAL ECOSYSTEM AT WORK

Example of key players in the Digital Ecosystem

- End Users: At the center of the Ecosystem is the Citizen, End User or Consumer of the ICT based e-Commerce Services
- Key Industry Stakeholders: Agriculture, Fisheries, Tourism, Finance
- Infrastructure Availability: Telecoms, Public Data Center, Transport Supply Chain Network, Electricity Supply
- ICT Availability: Solutions to support e-Commerce and Supply Chain/Logistics, Hosted SME Web Sites
- ICT Education: SME ICT Literacy and Online Marketing Training

Government Policies and Regulations: Online Financial Transactions and Supply Chain Management, Cyber Security

ICT INDUSTRY DEVELOPMENT

Countries of all income levels are developing policies and infrastructure to capitalize on the dynamism of this sector and promote further growth.

GOVERNMENT ICT POLICIES

Governments around the world have policies to support the growth of the ICT Sector. Most target

- Innovation measures
- Promotion of ICT sector investment
- Development or expanding ICT exports

This support is delivered through a variety of ways including; tax incentives, loans, research and development subsidies, export subsidies, block grants, loans, incentives and tax exemptions, and educational training programs.

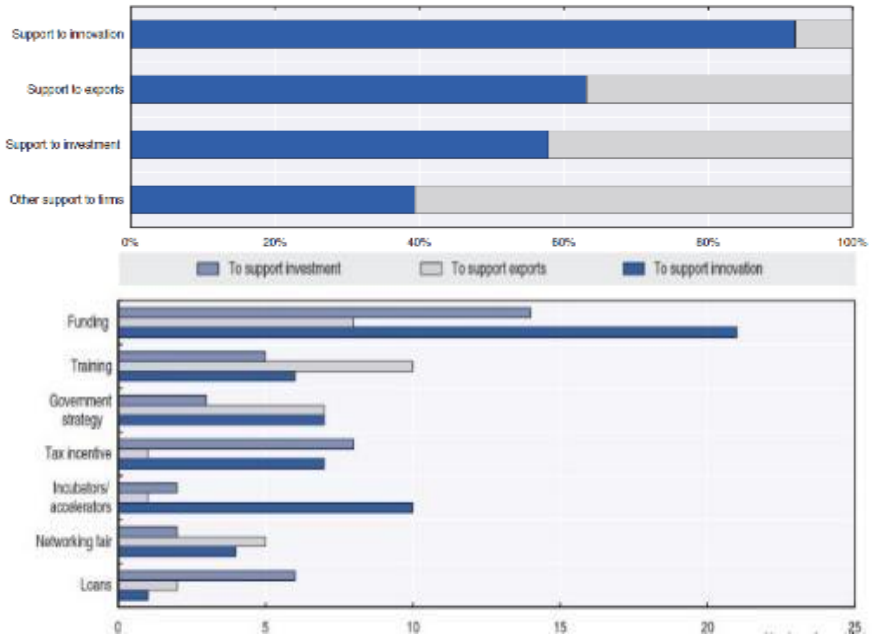
ICT Policies are to and to support ICT Innovation, Exports, Investment, Sector / Business development

The most prevalent governmental policy measures to strengthen the ICT sector are; funding, training, incentives, incubators, fairs, and loans.

INCUBATORS AND ACCELERATORS ARE POPULAR TOOLS TO PROMOTE INNOVATION IN ICT START-UPS AND SMALL AND MEDIUM-SIZED ENTERPRISES

Several governments, in an effort to promote innovation, have launched initiatives aimed at helping start-ups or young SMEs through accelerators or incubators. For example the Singapore government's Incubator Development Program, the Brisbane City Council Startup Hub, the Chinese Internet of Things

Figure 4. 5 Example: Policies to support ICT sector growth



Source: (OECD, OECD Survey Report, 2017)

Centre, the Advanced Manufacturing Partnership in the USA and the Indian Cyber-physical Systems Innovation Hub.

Governments are also nurturing digital entrepreneurs through technoparks. All three of Morocco's technoparks host start-ups and small and medium-sized enterprises (SMEs) specializing in ICTs, along with green technologies and cultural industries. These technoparks are supported by the Ministry of Industry, Commerce, Investment and the Digital Economy.

By 2014, there were over 90 technology hubs across Africa. These hubs are developing mobile phone applications in sectors ranging from agriculture and health to crowdsourcing weather information for disaster risk reduction. In parallel, African governments are putting infrastructure in place.

MULTINATIONAL ENTERPRISES ARE DRIVING THE DEVELOPMENT OF DIGITAL ECONOMIES

Based on UNCTAD's World Investment Report 2017: Investment and the Digital Economy, the digital market is dominated by 100 or so multinational companies, one-third of which did not exist a decade ago.

Digital MNEs make about 70% of their sales abroad, with only 40% of their assets based outside their home countries. The assets of these MNEs increased by 65% and their operating revenues and employees by about 30%, against flat trends for other top 100 MNEs. The importance of digital MNEs – including ICT and internet platforms, e-commerce and digital content firms – is also growing rapidly.

MNE CASE STUDIES

Costa Rica

The arrival of Intel, Hewlett Packard, and IBM in Costa Rica in the late 1990s had generated about 100,000 jobs by 2010, including by fostering the creation of domestic firms specializing mainly in software production. According to the latest UNESCO Science Report (2015), more than 300 companies produce software for local and international markets today, making Costa Rica's software sector one of Latin America's most dynamic industries.

India

India is also heavily dependent on foreign digital multinational firms. In 2013, 93% of Indian IT patents were secured by foreign-owned multinationals which account for 61% of patients in 2012. Foreign multinational companies have undoubtedly nurtured India's information technology (IT) industry. In 2017 Information technology/business process management (IT-BPM) sector in India delivered 7.7% of India's overall GDP.

CONCLUSION

Digital MNEs should be a target for Indonesia Government to encourage them to operate and invest further in Indonesia.

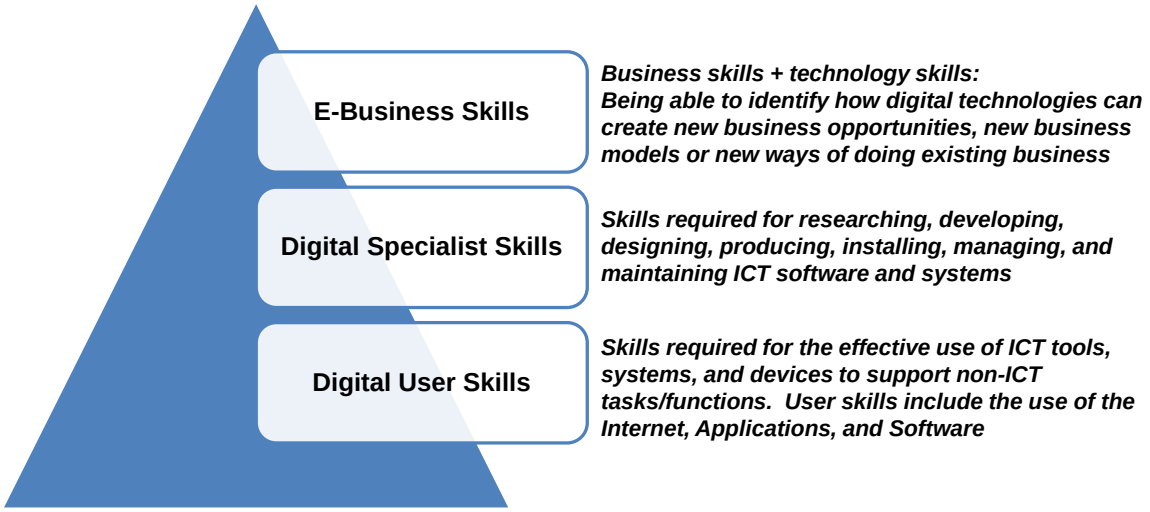
ICT HUMAN RESOURCES

One to the top problems facing all nations is a shortage of ICT skilled Human Resources. Without the appropriate level of Digital Skills, it will be difficult to develop a Digital Nation. Skills are required across the board; sectors, enterprises, government, and end-users need skills and skilled resources to:

- Understand ICT and the opportunities that it offers at a business level and have the skills to be able to develop ICT Strategy and Plans
- Have the right level of capability to Design, Build, Integrate, Implement, and Operate the ICT Infrastructure.
- Ensure end users are digitally savvy and can for example; embrace the internet and utilize online services such as Mobile Banking, e-Commerce, Social Media, etc.

FRAMEWORK FOR ICT SKILLS

Figure 4. 6 ICT Skill Types



ICT SKILL TYPES	PURPOSE
ICT Generic Skills	To perform everyday work, such as work with word processors and access websites
ICT Specialist Skills	To program, develop applications, and manage ICT infrastructure
ICT Complimentary Skills	To perform multiple and aggregated tasks, such as processing complex information, communicate with others, solve problems, and manage teams

Source: (Lavin, 2016)

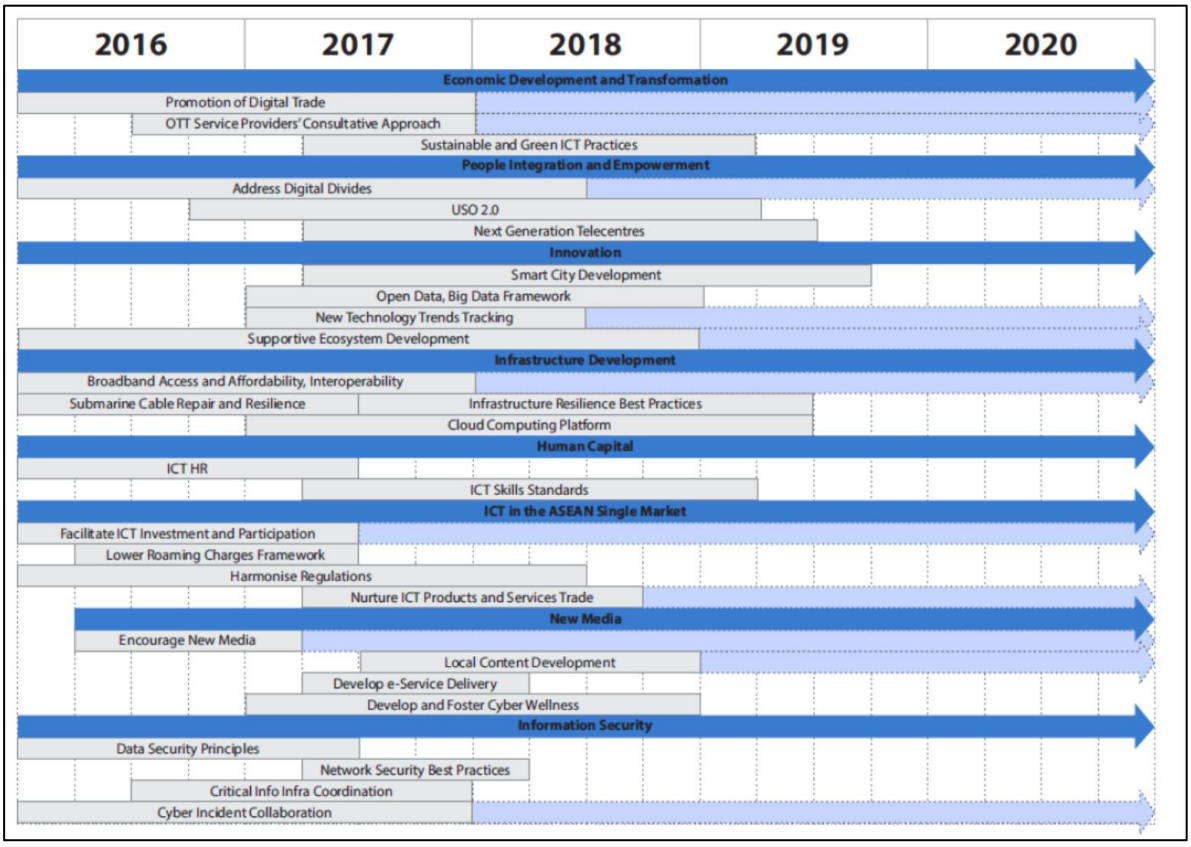
INDONESIA ICT HUMAN RESOURCE DEVELOPMENT

The World Bank has recently has undertaken a study with multiple Indonesia Agencies and ICT Industry leaders "Preparing ICT Skills for the Digital Economy in Indonesia" March 2018. This was in conjunction with the plan for meeting ICT Skills Demand: ASEAN ICT Masterplan 2016 – 2020. Indonesia's key skill challenge is "ICT graduates' skill sets often fall short of what the industry requires" and the skill there is a substantial sill shortage of 9 Million skilled and semi-skilled ICT workers 2015 – 2030".

The Government of Indonesia has started programs to address digital infrastructure requirements, human resources capability, and to bridge regulation and incentive gaps

- Digital infrastructure to improve access Submarine Cable and Wireless Connectivity projects
- Digital Government e.g. Online services
- Human Resources Capability gap: Nongsa Digital Park program in Batam, improving skills of workers, creating jobs in technology-based entrepreneurship and revamping of vocation education institutions
- Regulation and incentive: Presidential Decree No 74/2017 on e-Commerce Road Map in which skills development is included and tax incentives for startups and venture capital
- An MOU on Vocational education development was signed in November 2016 among 5 Ministries (Ministry of Industry, Ministry of State-

Figure 4. 7 Outline of The Major Skills Needed



Source: (https://www.researchgate.net, 2016-2020)

owned Enterprises/BUMN, Ministry of Manpower, Ministry of Education and Culture, and Ministry of Research Technology and Higher Education

- The Ministry of Industry is working on Industrial 4.0 roadmap focusing on four technologies; IoT, e-Smart SMEs, startup incubation, and the use of digital technology for industries (big data, AR, Cloud, Cyber Security)
- National ICT Occupational Qualification Roadmap – Ministries and National Professional Certification Body (BNSP) are preparing job competency standards based on SKKNI and KKNI. Additionally, MICT supported by Industrial and professional associations has completed the National ICT Occupation Map with 9 levels of competencies and 16 occupational areas

COMMENTS FROM THE INDONESIA ICT INDUSTRY

The Industry demand emphasizes the need for more complex skills of technical ICT, and the soft skills of leadership, communications, and business/marketing skills.

"It is the all-rounders that we are looking for. People with advanced technical skills and communication skills. On the technical side, the company values skills in computing artificial intelligence and resolution architecture for customization." Obert Hoseanto, Microsoft Indonesia

IDENTIFIED KEY CHALLENGES

- Good talent is expensive and difficult to keep
- Provision of skills lie on education curriculum and infrastructure/facilities – ICT graduates' skill sets fall short of what the industry requires. Education curriculum on technology vocational skills are outdated and need to be adjusted with the most current development.
- Access to technology - around 51,000 schools (23.95%) are still not connected to the Internet. Some of this is due to a lack of electricity. Teaching factories need sound delivery of e-Learning and good connections to online national examinations
- Need to further focus on educator's skills and ICT literacy for use in their everyday teaching

KEY RECOMMENDATIONS

Here are some of the key recommendations delivered in the World Bank Study

- Develop or adopt a more comprehensive ICT Skills Framework
- Strengthen Vocational Skills development Policy
- Strengthen Government-Industry Collaboration to define Digital Skills Needs through the creation of a Digital Skills Ecosystem
- Improve Access to Technology – Industry–Schools–Government Collaboration / Ecosystem framework
- Connect all schools in Indonesia and enhance student computer/device ratio
- Enhance / Optimize the use of ICT in Vocational Education – optimal use of the Internet and use of technologies such as Augmented Reality
- Create a Technology Pool linked with Teaching Factory

ICT GOVERNANCE AND STRUCTURE

IMPORTANCE OF ICT GOVERNANCE

The role of ICT has evolved over the past decades from a supporting, back-office function to a key function, enabler and driving force for governments, enterprises, and citizens. It has become a dynamic and strategic asset of an organization, whether that be an enterprise and government, for the successful achievement of its mission and goals. Hence, organizations are becoming increasingly dependent on a well-functioning ICT infrastructure. At the same time, the expenditure and costs for ICT have grown significantly over the past years. The approximate total ICT costs in the United Nations system organizations range from about 2% to 13% off the total annual budget of the organizations, with most organizations spending about 4% to 7% of the total annual budget on ICT.

ICT governance is an important factor in generating business value. A study on ICT governance was conducted by MIT Sloan School of Management's Centre for Information System Research (CISR). The study covered more than 300 enterprises in over 20 countries and concluded that ICT business value directly results from effective ICT governance. The research indicated that firms with superior ICT governance have at least 20 percent higher profits than firms with poor governance, given the same strategic objectives

Effective ICT governance also contributes to better harmonization and coherence with respect to ICT strategies, objectives, and targets, as well as ICT Solutions and Products, Development, and Operations. Effective ICT governance structures facilitate appropriate awareness of the strategic importance of ICT among key stakeholders and promote ICT as a strategic tool and enabler for enhancing a nation's effectiveness and efficiency.

To ensure success across complex environments, with multiple stakeholders, and various interests, string ICT Governance, and Structure are critical.

GOVERNANCE STRUCTURE AND FRAMEWORK

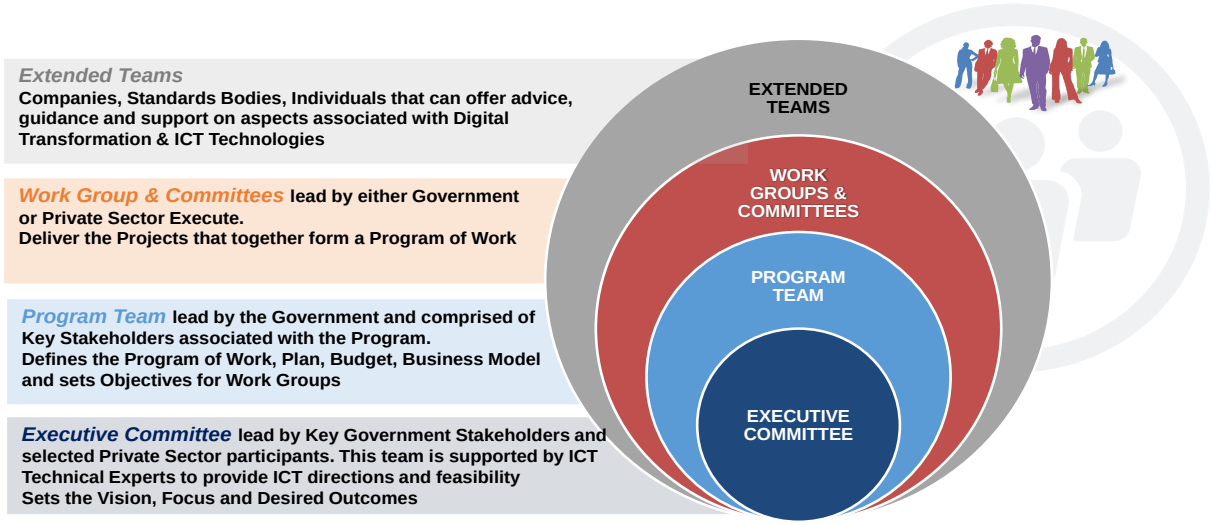
Large-scale and cross-cutting ICT projects that are of national importance generally require various levels of governance comprising; steering committees, project teams, working groups and task forces, and extended teams

The central element is the ICT governance committee/s or equivalent, composed of key stakeholders providing overall guidance and direction on national ICT strategic thrusts, targets and initiatives. The committee or board is often supported by a technical committee that provides technical advice and support. Program and working group(s) or task force(s) support major ICT programs or initiatives, for example, Program Management for all ICT Policies and Regulations with workgroups support specific Policy areas e.g. ICT Infrastructure Policies or Policies to drive ICT Industry development. Extended teams, which are generally external to the government, provide advice, guidance, directions, etc. on ICT practices and infrastructure. The digital committee layer structure is described in Figure 4.8.

WHO SHOULD TAKE THE GOVERNANCE LEAD?

Current approaches to governing National ICT and Digital Strategies (NDS) vary across countries. Information from 35 countries provides an overview of the responsibilities allocated for the development, coordination, implementation, and monitoring of NDSs.

Figure 4. 8 Digital Committee Layer



Source: (Deputy Assistant for ICT and Utility)

The lead on strategy development is often taken by a ministry or body that is not dedicated to digital affairs. However, having a ministry or body that is dedicated to digital affairs is on the rise. Almost all countries engage multiple private stakeholders and public bodies to contribute input to developing their NDS.

Effective co-ordination is essential for developing and implementing a whole-of-government approach with an NDS. Bodies responsible for monitoring the implementation of the NDS tend to be the same as those who lead the development and the co-ordination of the NDS. Additionally, many governments have set up measurable targets within a specific time frame to monitor the implementation of their NDS.

Table 4. 3 Example National Digital Strategy Governance Lead

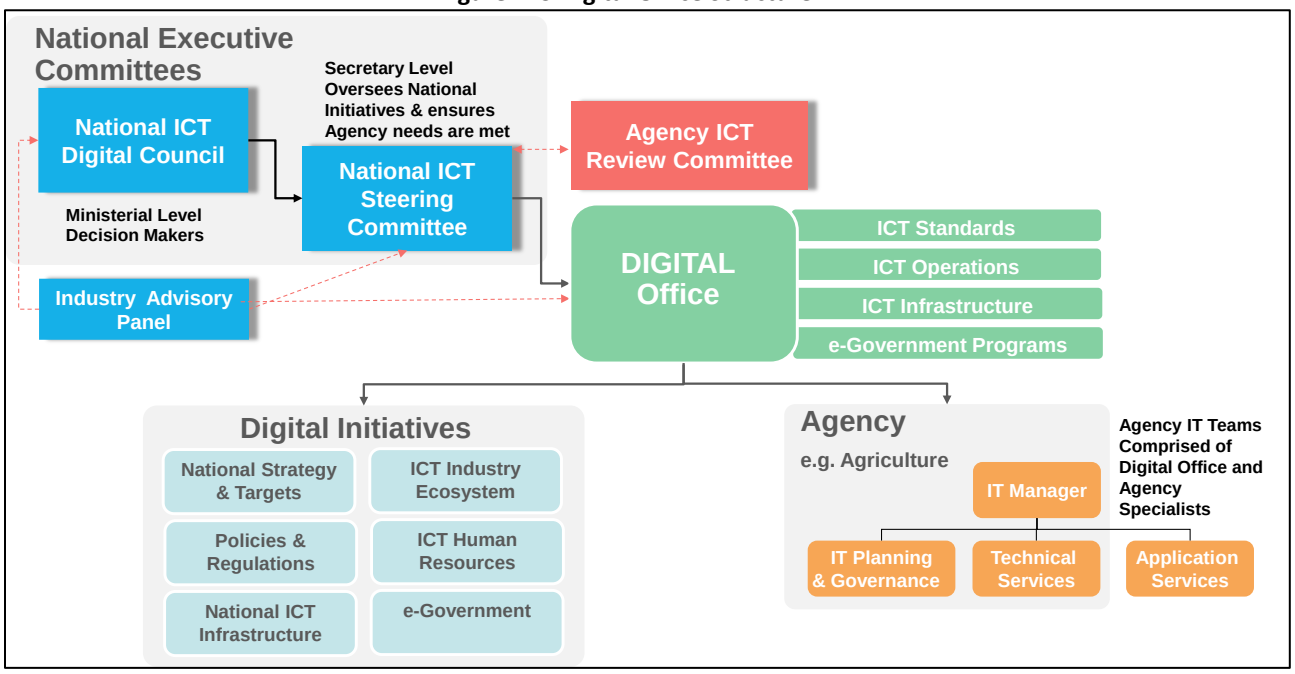
	LEAD	CONTRIBUTE INPUT	COORDINATE	IMPLEMENT	MONITOR
Government e.g. Prime Minister, President, Ministerial Councils	4	0	5	1	6
Digital Affairs Ministry or body or Ministerial position	8	1	10	3	8
Ministry or body not dedicated to digital affairs	15	2	13	1	11
Several ministries, bodies or institutions	6	14	5	26	7
Multiple public and private stakeholders	1	17	0	3	0

Source: (OECD, Digital Economy Outlook, 2017)

OVERALL ICT STRUCTURE

Central to the organization structure is the Digital Office. The Digital Office takes directions from the Executive Committee.

Figure 4. 9 Digital Office Structure



Source: (Deputy Assistant for ICT and Utility)

National Executive Committee

Sets the thrust, targets, directions for ICT objectives and initiatives. This could be supported by an Industry Advisory plan, which would offer suggestions and recommendations for Sector Development and take-up of new technologies. An Agency Review Committee would offer input to the Executive Committee to ensure all agency needs are considered in the overall setting of directions.

The Digital Office

Dedicated Team of ICT Professionals: Central to the organization structure is the Digital Office. The Digital Office takes directions from the Executive Committee.

- Sets the overall ICT vision, standards, rules and guidelines, development and operations approach, architectural governance, and investigates the application of new technologies
- Overseas and manages the delivery of the National ICT Programs through a Program Office function
- Manages the overall National level ICT strategy, plan, and budget
- Supporting agencies with ICT skills e.g. support agencies in the development of their ICT plans provides technical support and guidance, etc.

Program Teams, Work Groups

I would be responsible for delivering the various programs and sub-projects.

Chapter 5

Indonesia Sector Digitization

National Resilience & Governance

- **Disaster Management**
- **Smart City**
- **E-Government**

Industry Development

- Agriculture
- Tourism
- Transport & Logistics

Socio Development

- Health
- Education
- Finance

National Resilience

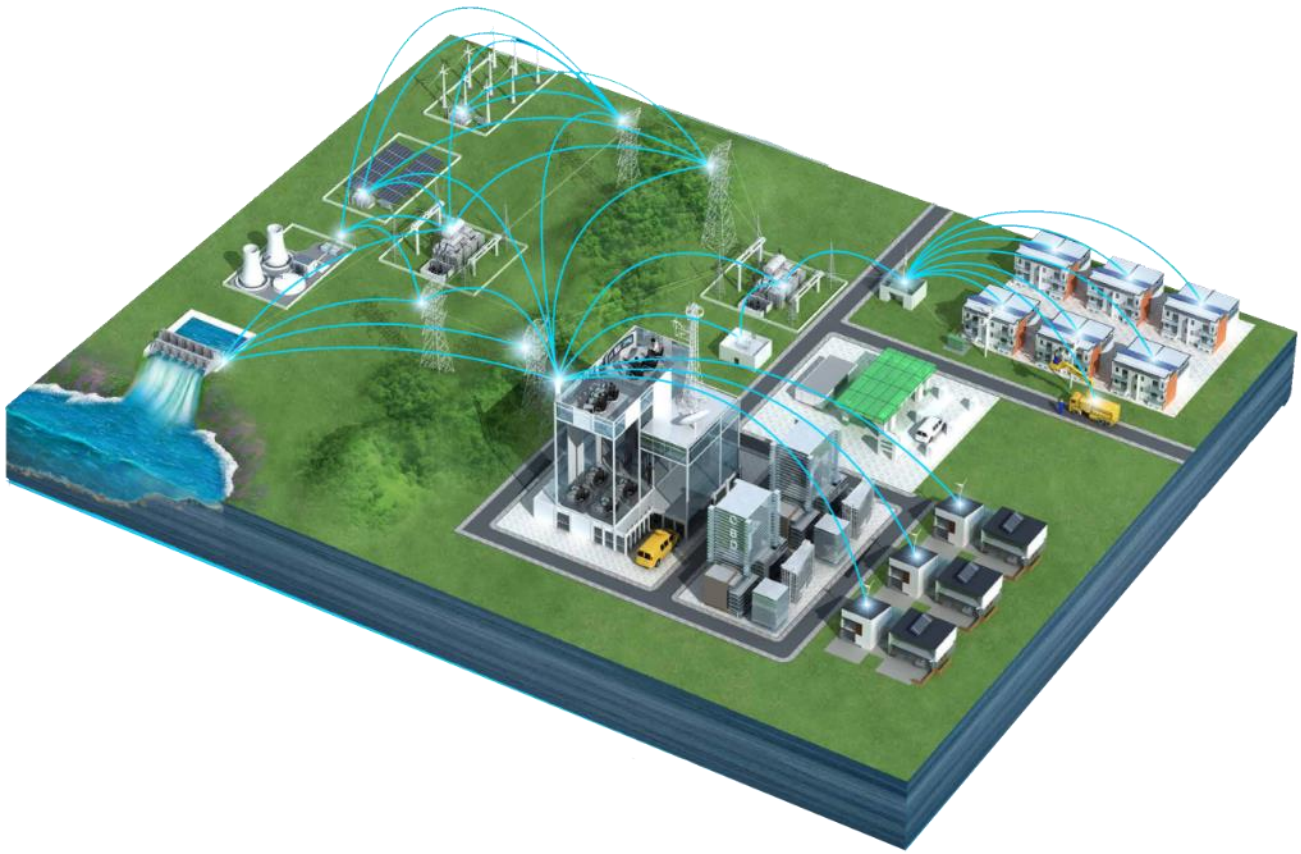
&

Governance

Disaster Management

Smart city

E-Government



DISASTER MANAGEMENT

Every area of the world is vulnerable to disasters; whether they are natural events such as earthquakes, floods, and hurricanes, or man-made disasters such as terrorism, chemical spills, or nuclear accidents (EDRP, 2014). They have the characteristics of causing danger to different social entities on our planet, however, this danger is not only a result of natural vulnerability, but it is also the result of human systems and their related vulnerabilities (human vulnerabilities). When both types of vulnerability have the same coordinates in space and time, natural disasters can occur (Alca, 2002).

Disasters often strike with little or no warning, and the damage can be in the billions of dollars. Communities can face dramatic social and humanitarian consequences in the wake of a disaster, as well as sudden economic losses and dislocation. Not only have disasters become more frequent in recent years, but also their impacts have become costlier.

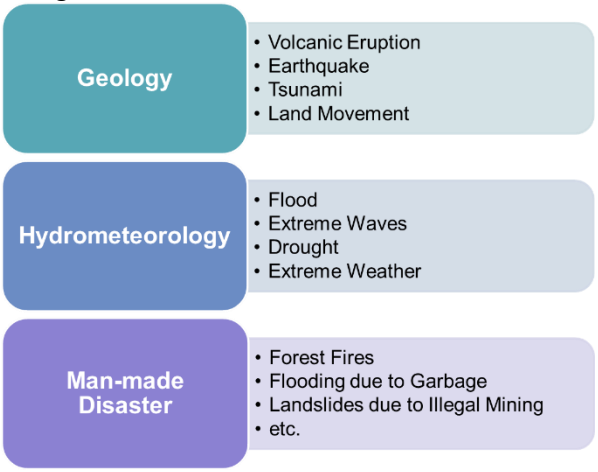
The greater impact of natural disasters is in developing countries, where they are often occurred (Alca, 2002). In most cases, based on Alca (2002) natural disasters in these countries are caused by two main factors. First, there is a relationship with geographical location and geological – geomorphological arrangements. Developing or poor countries are in zones that are mostly affected by volcanic activity, seismicity, floods, etc. The second reason is related to the historical development of these poor countries, where economic, social, political and cultural conditions are not good, and consequently act as a factor of high vulnerability to natural disasters (economic, socio-political and cultural vulnerability).

Talking about vulnerabilities and losses that occur due to disasters, disaster management is needed properly and systematically, because of the nature of the disaster that will inevitably occur. Awareness of the importance of disaster risk reduction efforts began to emerge in the 1990-1999 decade which was declared the International Disaster Risk Reduction Decade (Bappenas and BKNPB, 2006). Efforts to reduce disaster risk systematically require joint understanding and commitment from all stakeholders concerned, especially decision-makers.

INDONESIA DISASTER ENVIRONMENT

Geographically, Indonesia is a country that is prone to disasters, both hydro-meteorological and geological disasters, including earthquakes, tsunami, volcanic eruptions, floods, drought, typhoons, and landslides. Additionally, due to climate change, their exposure to a range of climate-related disasters has been magnified in part in recent years, resulting in a newfound threat to Indonesia's living standard and development.

Figure 5. 1 Disaster Classification in Indonesia

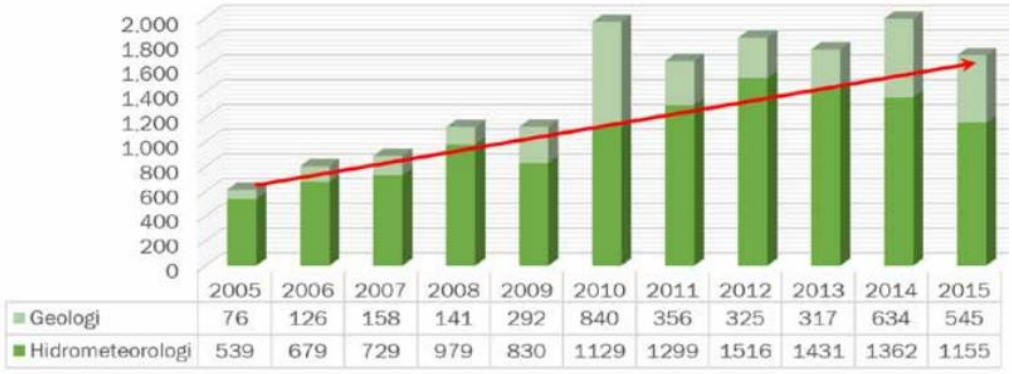


Source: Deputy Assistant for ICT and Utility, 2019, in the presentation "Peningkatan Ketahanan Infrastruktur Ekonomi Tangguh Bencana", in July 2019.

According to data compiled in the Indonesia Disaster Information Data (DIBI – BNPB), it is seen that from about 1,800 disaster events in the period 2005 to 2015 more of 78% (11,648) disaster events are hydrometeorology disasters and only about 22% (3,810) are geological disasters (BNPB, 2016). A number of disasters caused by geological factors are not very significant compared to the number of disasters caused by hydrometeorological factors. Nonetheless, geological disasters, in particular, earthquake, and tsunami, have quite a big impact in terms of victims and economic losses.

Most of Indonesia's territory is located above the path of major earthquake sources from the megathrust subduction zone of active plates and

Figure 5. 2 The Number of Disasters 2005 - 2015



Source: Badan Nasional Penanggulangan Bencana, 2016.

faults so that it has not only the potential to cause damage to infrastructure and basic connectivity but it can also cause huge loss of life. Around 217 million (77%) of the population are potentially exposed to earthquakes and 4 million live 1 km from active faults; About 3.7 million people are potentially exposed to tsunamis; About 5 million residents live and move around active volcanoes (Moerdijat, 2019).

The influence of climate change also contributes to an increased incidence of hydrometeorological disasters (BNPB, 2016). With a high frequency of occurrence, this disaster group also has a very large impact, especially on the economic sector and the environment, both the direct impacts of disaster events and the indirect impacts. Human activities also contribute to worsening environmental conditions, such as forest encroachment plantations and settlements, or development activities affecting ecosystems and ecology in buffer zones.

Major natural disasters in Indonesia in the last 15 years have resulted in losses of up to 166.6 trillion rupiahs until 2016 and from 2016 to 2019 it reached 68.66 trillion rupiahs (Masduki, 2019).

Disaster-prone areas are classified as high risk to support development so it needs to be considered as a limitation in planning development. Therefore, zones with high levels of disaster vulnerability need to be prioritized as protected areas in spatial planning, rather than as cultivation areas. If this cannot be avoided, then it needs to be supported by an increase in adaptation efforts and disaster risk reduction to reduce losses due to disasters.

Facing increasing vulnerability to natural disasters, and on the other hand, technological advances are also increasing, it is necessary to build initial systems and mobilize well-connected resources from end to end throughout the country. The latest technological developments, such as NB-IoT, 5G, drones, integrated communication, and remote sensing, provide new ways of disaster mitigation, by providing faster and more efficient responses that will save more lives.

KEY CHALLENGES / ISSUES IN DISASTER MANAGEMENT

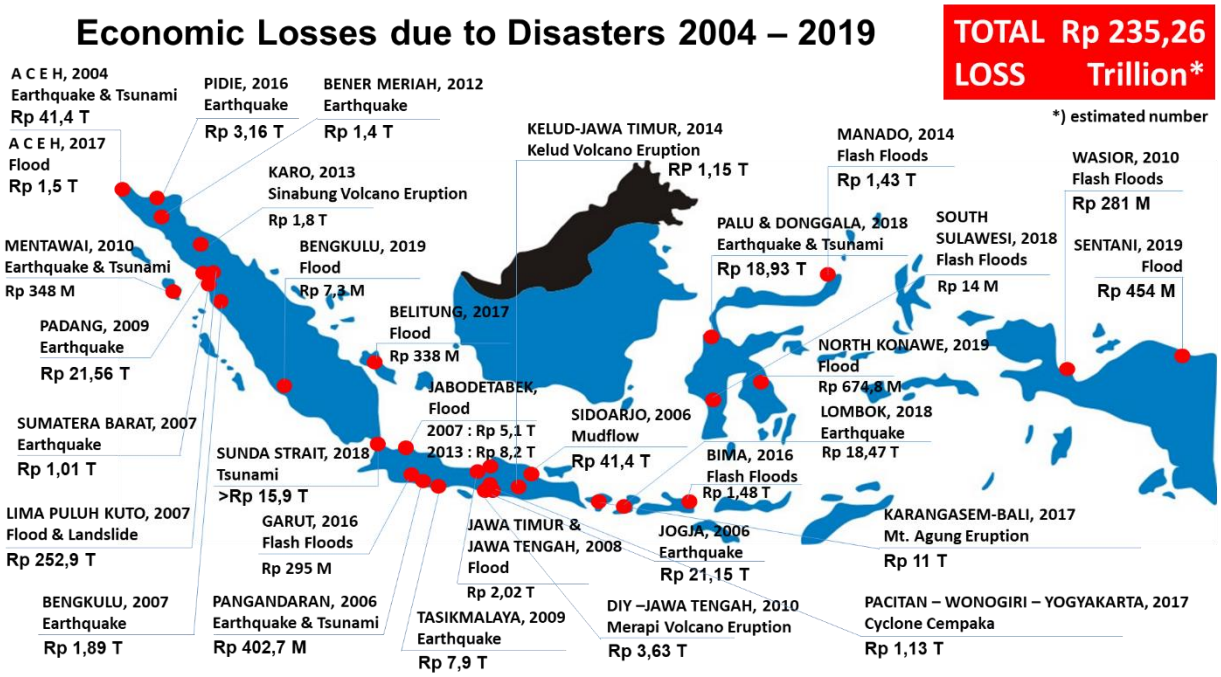
Knowing the challenges and obstacles to disaster risk reduction will help us to understand better the immediate actions needed to move beyond the barriers. Then a better roadmap could be designed to achieve our goals. In general, there are 8 (eight) areas of challenges in disaster management:

1. **Lack of effectiveness of a centrally managed disaster management system.** Disaster management usually requires collaboration between institutions and organizations (both vertical and horizontal), and mobilization of resources from various sources. A centrally managed system produces limited reporting channels, slow responses, and limited information for disaster analysis.

[1)] Delivered in the National Seminar on Disaster Building Sustainable Infrastructure Resilience on 01 August 2019 at the Graha Badan Nasional Penanggulangan Bencana, Indonesia.

2. **Unoptimized Early Warning System (EWS) which causes inaccurate predictions and information on current/future disasters**. This happens because of the lack of digital sensors for early detection to send data in real-time. This results in a lack of real-time data and historical data for further analysis.
3. **Less synchronized of standardization and collaboration of policies between ministries/institutions in disaster response**, for example in terms of integrating policies on the implementation of Single Emergency Number (SEN). When a disaster occurs, the communication system is usually cut off so that it inhibits evacuation. The availability of SEN is expected to facilitate communication and evacuation processes in an emergency.
4. **Unavailable of a contingency plan**, seen from the response to disasters that are still slow. Effective disaster management depends on contingency planning at all levels of government and non-government.
5. **The hazard maps have not been integrated into a single unit.** Meanwhile, the available maps have not been used as a reference for the preparation of spatial plans and its derivatives (spatial planning is not yet responsive to disasters);
6. **The level of vulnerability of buildings (to earthquakes) is relatively high.** Meanwhile, regions that have a Building Expert Team (TABG) are still less than 10% (City / District).
7. **Evacuation routes that have been prepared are usually still not sterile**, still used for other purposes, such as street vendors and celebration;
8. **Unavailable of a disaster funding mechanism**, which is structured appropriately and multi-stakeholder, including not yet developing special disaster insurance.

Figure 5. 3 Economic Losses due to Disasters 2004 – 2019



Source: Deputy Assistant for ICT and Utility, 2019, in the presentation "Peningkatan Ketahanan Infrastruktur Ekonomi Tangguh Bencana", on July 2019.

Figure 5. 4 Main Duties and Functions of the Several Ministries/Institutions of the Republic of Indonesia Related to Disaster

Source: Deputy Assistant for ICT and Utility, 2019, in the presentation "Peningkatan Ketahanan Infrastruktur Ekonomi Tangguh Bencana", on July 2019.

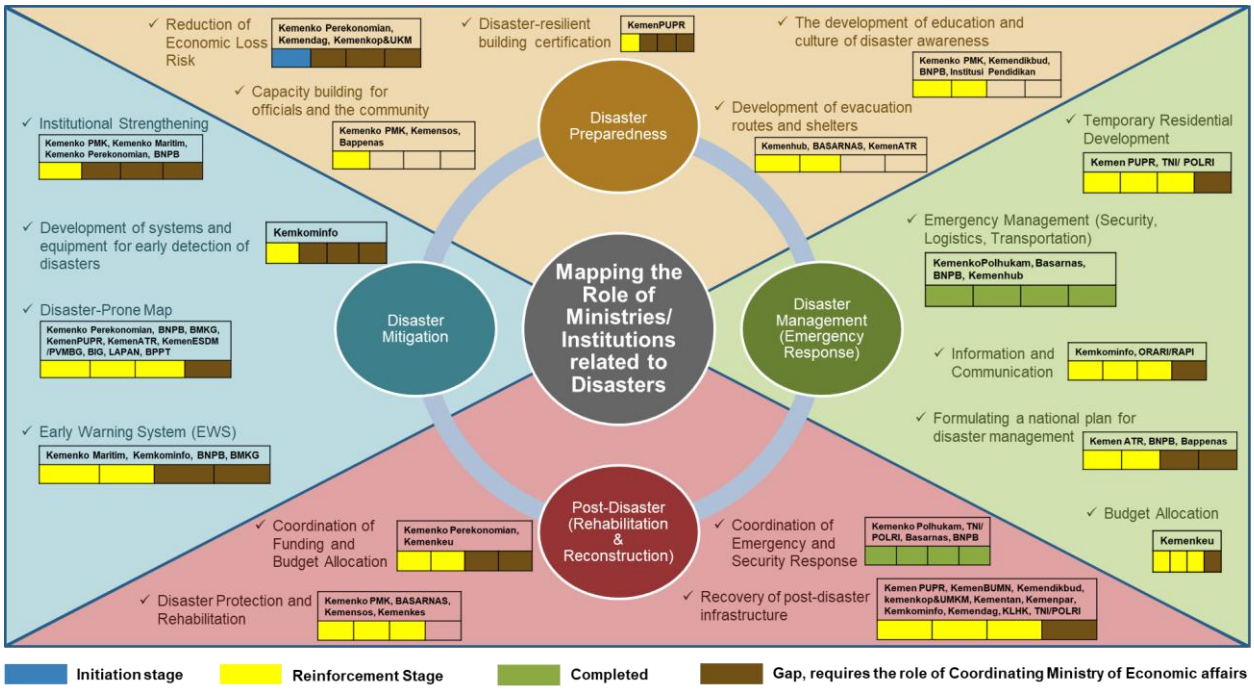
INSTITUTIONAL DISASTER MANAGEMENT PLANNING/ PROGRAM IN INDONESIA

The leading institution responsible for disaster recovery in Indonesia is the National Agency for Disaster Management/Badan Nasional Penang-gulangan Bencana (BNPB). It is engaged in disaster mitigation, emergency response and post-disaster recovery (rehabilitation and reconstruction). In addition, several related Ministries/Agencies of the Republic of Indonesia have made efforts to mitigate disasters, such as Ministry of Communication and Information of the Republic of Indonesia by implementing the Disaster Information Submission program (SMS Broadcast) and Emergency Call program 112, BNPB with the INARisk, BMKG system with the InaTEWS system, and Telkom has supported the installation of IoT devices in public service place.

Until now, the development of an early warning system that has been carried out by BNPB, BMKG, BPBD, and some related stakeholders is considered good. This is evidenced by the increase in the capacity of preparedness and early warning systems through the latest technology to reduce the impact arising from disasters. Currently, the BMKG has installed an earthquake information and tsunami early warning dissemination system in all cities/districts in western Sumatra with Warning Receiver System (WRS) equipment integrated with telecommunications operators and mass/print media. But the obstacle faced was that some TV stations did not broadcast the disaster information quickly.

Seeing the system development that has been carried out by each ministry and government institution, proves that there is an increase in the capacity of preparedness and early warning systems through the latest technology to reduce the impact arising from

Figure 5. 5 The Role of Ministries/Institutions of Indonesia related to Disasters

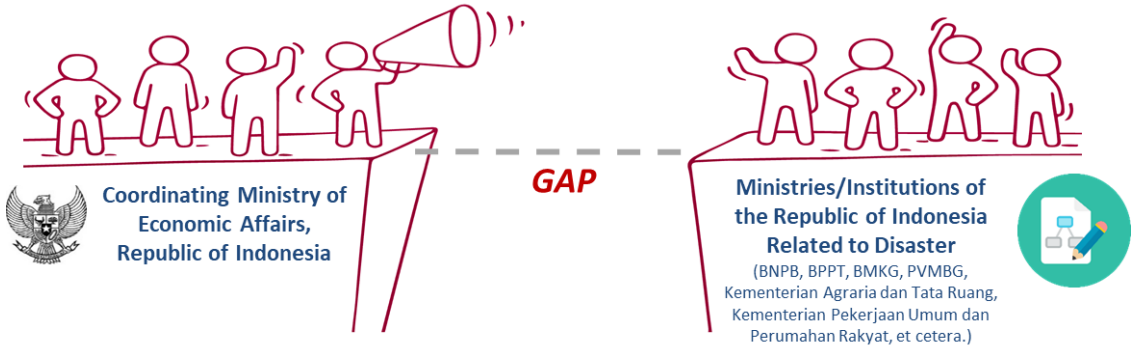


Source: Deputy Assistant for ICT and Utility, 2019, in the National Seminar "Kebijakan dan Strategi Peningkatan Ketahanan Infrastruktur Ekonomi Tangguh Bencana" on August 2019.

disasters. The problem with the application of single emergency number 112 is the objection from stakeholders to carry out integration such as number 113 belonging to the fire department, number 110 belonging to the Police, number 115 belonging to National Search and Rescue Agency of Indonesia (BASARNAS), and number 119 for health services.

Currently, Coordinating Ministry for Economic Affairs (CMEA) of Republic of Indonesia is initiating a program to accelerate post-disaster economic recovery. It is based on President Instruction (Inpres) that CMEA facilitates the coordination of ministries/institutions in solving problems concerning post-disaster economic recovery, as stipulated in Presidential Instruction No. 5 of 2018 concerning the

Figure 5. 6 Ilustration of the Role Gap between Coordinating Ministry for Economic Affairs and another Ministries/Institutions related to Disasters



Source: Deputy Assistant for ICT and Utility, 2019, in the presentation "Leaders Offsite Meeting" on July 2019.

Acceleration of Post-Earthquake Rehabilitation and Reconstruction in the Districts of West Lombok, North Lombok, Central Lombok, East Lombok, Mataram City and affected areas in West Nusa Tenggara Province and the Presidential Instruction No. 10 of 2018 concerning the Acceleration of Post-Tsunami and Earthquake Rehabilitation and Reconstruction in Central Sulawesi Province and other affected areas. In addition, in a Limited Meeting on Improving Disaster Preparedness on January 14, 2019, it was revealed that "Disaster management readiness should be coordinated and made more detailed at the Coordinating Minister level so that it will be ready in an emergency situation".

Figure 5. 7 Signatory of the Padang - Hildesheim Sister City (KSSC) Cooperation Memorandum of Understanding (MoU)

Source: Deputy Assistant for ICT and Utility, 2018, in the Seminar "Pengembangan Smart City Berbasis Mitigasi Bencana di Wilayah Pesisir Barat Sumatera di Kota Padang, Provinsi Sumatera Barat" on August 2018.

Noting the main tasks and functions of the Ministries/Institutions related to disaster management, as well as the results of several meetings and discussions, the role of the Coordinating Ministry for Economic Affairs of Indonesia is still needed in the synergy and coordination of disaster management (Figure 5.6).

Furthermore, Indonesia is one of the member countries of the IORA (Indian Ocean Rim Association).

Figure 5. 8 Indonesia – Indian Ocean Local Government Forum (IIOLGF) on 6th August 2018

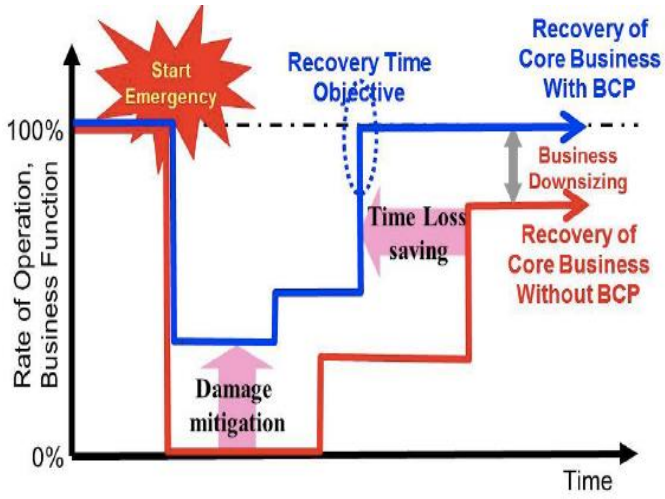
Source: Deputy Assistant for ICT and Utility, 2018, in the Seminar "Pengembangan Smart City Berbasis Mitigasi Bencana di Wilayah Pesisir Barat Sumatera di Kota Padang, Provinsi Sumatera Barat" on August 2018.

The existence of the IORA has an important meaning, especially as it is the only cooperation platform for countries around the Indian Ocean. With this membership, Indonesia has the opportunity to build partnerships and grow non-traditional export markets.

One of the priorities of the IORA cooperation in Disaster Risk Management. To realize the IORA collaboration, Indonesia – Indian Ocean Local Government Forum (IIOLGF) was formed. This is the initiative of the Padang City Government started in 2015. IIOLGF synergized Local Governments in the west coast of Sumatra, the southern coast of Java, NTB, NTT to Rote Island in South Maluku to optimize natural resources in the Indian Ocean in a strategic way. The similarities in disaster-prone areas make it possible to increase cooperation in disaster mitigation, especially earthquakes and tsunami threats.

Meanwhile, the Padang City Government has carried out mitigation measures in terms of regulations, education, and earthquake-safe building construction to create Padang as a smart and resilient

Figure 5. 9 Business Continuity Plan Flowchart



Source: Pusat Penelitian Mitigasi Bencana ITB, 2019.

city. The city government also prepares shelter, evacuation routes, functioning Early Warning System (EWS) and intelligent disaster socialization to the community. The Padang City Government has had the Padang City Disaster Preparedness Day, every September 30 to be prepared as a culture for the entire community.

In addition, the Padang City Government realizes that to create Padang as a smart and resilient city, collaboration with various parties is needed to make it happen, one of which is implementing sister city cooperation with Hildesheim. This collaboration will continue in several fields, including disaster mitigation. Hildesheim will help secure construction technologies for earthquake and help prevent disasters.

CURRENT DISASTER MANAGEMENT PLANNING / PROGRAM

To accelerate post-disaster economic recovery, the Coordinating Ministry of the Economy has begun to be active in developing the Business Continuity Plan (BCP). The compilation of the BCP is intended so that the company can run its business/business again as it was before being affected by disruptions, such as disasters (Cerullo and Cerullo, 2004). This was also implemented in the rapid recovery of the industry after the disaster impact (PPMB ITB, 2019).

Three components that need to be considered in the preparation of BCP include:

a. Business Impact Analysis (BIA)

   BIA identifies the vital functions of a business that makes it still able to run its business, such as making money, providing services, etc.).

b. Disaster Contingency Recovery Plan (DRCP)

   In the contingency plan, the main team members and alternatives are identified and their tasks specifically identified.

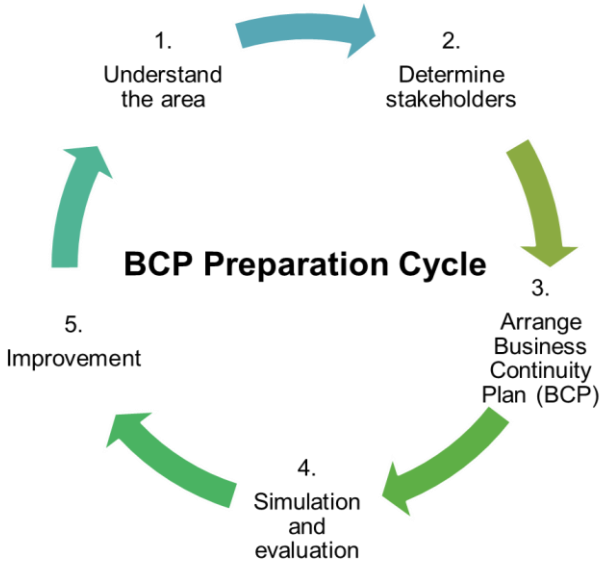
c. Training and Testing

   There is no plan that can be implemented without going through testing beforehand whether the plan is effective, is right with the threat of disasters, and can be implemented. Therefore, it is necessary to test the plan on an ongoing basis.

In developing BCP, there are three interrelated objectives, namely (JICA, 2015):

a. Understanding the area, including identifying the main risks that can disrupt the business/business;
b. Determine who will be involved in both the preparation of the BCP and at the time of BCP implementation;

Figure 5. 10 BCP Preparation Cycle



Source: Adoption from JICA, 2015.

c. Develop plans to reduce the impact of risks identified through risk assessment;
d. Train employees and test plans to make sure they are effective;
e. Make improvements to the plan if deemed ineffective and adapted to the results of an updated risk assessment.

The role of the bottom-up for BCP implementation is huge. In another sense, it can not only rely on the role of government but also Non-Government parties. Islamic Relief, one of the NGOs engaged in humanity (including economic recovery after the disaster), successfully implemented the BCP in Tiku, West Sumatra (Islamic Relief, 2019).

DISASTER MANAGEMENT STRATEGY

Figure 5. 11 Implementation of BCP in Tiku, West Sumatra

Best Practice

Implementation of BCP in Tiku, West Sumatra

The strategies taken include:

1) Move production sites to higher ground to reduce the impact of the tsunami;
2) Map the suppliers of goods for production in anticipation of a supply chain breakdown;
3) Alternative economic activities that can be carried out after a disaster, for example with quail farms at the evacuation site; and
4) Promoting disaster insurance for buildings that have important functions.

Source: Islamic Relief Worldwide, 2019.

Mitigate and Prevent

Mitigation is defined as "sustained action that reduces or eliminates long-term risk to people and property from natural hazards and their effects". During the mitigation stage, the leading agency for disaster management (i.e. BNPB) gathers information and allocates resources to prevent hazards from developing into disasters or to reduce the effects when disasters happen. It is focusing on a regular, long term base, measure to reduce or eliminate risk. The government shall monitor the status of high-risk areas and lessen the impact that disasters have on people and property.

ICT tools used during the mitigation stage are usually efficient and cost-effective, including measurement of sea level, climate change analysis, a satellite image of volcanos, and predictive analysis for landslide, etc. In non-nature disaster mitigation, technical tools could be used to analyze crowd information, public safety, traffic and the possibility of terrorist attacks.

It is equally important that citizens must be made aware of what natural hazards they are likely to face in their communities. Public awareness and education through social media and internet channels will prepare the officials, as well as the citizens, for the upcoming hazards with the most effective mitigation efforts.

Warning and Preparedness

Preparedness is the process of turning awareness of natural and non-natural hazards into actions to save lives and to minimize damage when an emergency occurs. A unified command and control center with efficient awareness, unified call numbers, and multi-broadcasting channels could improve the capability of disaster management to respond to and recover from disasters. During the preparedness phase, BNPB officers need to monitor the status of a high-risk zone closely, develop emergency population warning methods combined with emergency shelters and evacuation plans, and manage the disaster recovery-related facilities, equipment, and vehicles.

When an emergency case happens, officers in the command and control center shall activate multiple broadcasting channels and make sure accurate information is delivered to the public on time. The broadcasting channels usually include social media, radio, TV and mobile channels. The effectiveness of an early warning channel ensures

that when a disaster strikes, officers and citizens can provide the best response possible.

At present, several social media platforms are used in disaster management, such as LINE, Facebook, Twitter, and several local platforms in each country. This innovation is motivated by the disconnection of information and communication networks (mobile phones, SMS) when a disaster occurs, thus requiring other communication devices that can be used when a disaster occurs.

Rapid Response

The response phase includes the activation of emergency SOPs from the central command and control center and mobilization of the necessary emergency services and first responders in the disaster area. During disaster outbreak, BNPB officers shall be able to activate fleet and resources near the disaster area and keep effective communication with the team in the field. Effective communication shall also be established among central command and control center and local disaster management offices, as well as related agencies like firefighting departments, police, hospitals, army and related non-governmental organizations (NGOs).

Advanced technologies are also proved useful during this stage. For example, live images brought by drones and sensory data transmitted back through high-speed LTE/5G network provides valuable first-hand information for the officers to make the right decision at the right time.

In addition to blasting information, communication technology plays an important role in optimizing disaster risk reduction including supporting the evacuation and security processes during disasters, helping to map disaster-affected areas from informants on social media, and increasing public awareness (users) on disaster risk mitigation.

Emergency preparedness and response to disasters can be obtained from human movements and communication technology (social media), i.e.:

a. by understanding human behavior, actions and movements/movements of people before/after the evacuation period.
b. detect potentials and problems on a real-time basis (congestion, evacuation locations, food, and beverage need in the field, real-time monitoring, real-time communication, and so on).
c. streamlining disaster response and evacuation procedures, through the Intelligent Spatial Decision Support System.

Recovery and Relief

It is important to learn from each disaster to reduce the risk of loss of life, property and natural resources in the future. Disaster knowledge management database shall be created and valuable information shall be acquired following a disaster, including the immediate effects of disasters on people, buildings, personal property, lifelines, economic activities, and natural resources, etc. The information will be used for post-disaster studies and to enhance the effectiveness of hazard assessments, awareness and education, preparedness, prediction and warning, and mitigation.

DISASTER MANAGEMENT SOLUTION

An effective disaster management system shall have full awareness in real-time, cover all phases of disaster management and respond in moments after a disaster hits to try to reduce the chance of it happening in the first place or to reduce the impact of a disaster. The overall structure of a national-wise disaster management system contains 4 main layers as shown in the following diagram (Disaster Management Solution):

Front-end Awareness

Various types of sensors installed to collect information and provide early warnings at the event of natural or non-natural disasters. For example, water sensors could be used for monitoring of sea/water levels, imminent disasters, and volcanic activity. Other types of front-end awareness sensors include natural fire sensors, hydrology sensors, and optical fiber sensors for landslide detection, meteorological monitoring sensors, geological monitoring sensors, hazardous chemical detection

sensors, pipeline sensors, and smart meters, as well as drones for flexible or fast-response missions.

Image-capturing equipment like CCTV cameras and satellites are usually useful in complicated situations like climate change prediction and movement of a natural fire. In a non-natural disaster situation, surveillance cameras will be able to capture useful information covering people, buildings, traffic.

Agile Networks

The traditional communication network includes a fiber-based backbone network that connects major cities and disaster recovery data centers and a 2G/3G/4G network that covers high-risk zones. The recent development of NB-IoT and 5G technology allows high speed, real-time communication with devices at long distance, and therefore promotes the deployment of smart sensors with edge computing capabilities in mission-critical areas. For example, smart cameras with analysis features will be able to label objects from the image captured automatically, highlight the highly risky items, and then transmit structured data to a backend system for further analysis.

Unified ICT Platform

Unified ICT platform consists of core technical modules that support all critical operations in disaster mitigation, response and post-disaster recovery. It is in the form of a cloud-based ICT platform and an emergency backup platform to prepare for the situation of main cloud failure. Key modules supported by the platform include cloud computing, integrated communication, video cloud, big data, and digital map. It is usually build-together with national command and control center for disaster management.

The platform shall include a GIS-based digital map at the national level with yearly updated satellite images covers all high-risk areas. It shall also include an Integrated Communication Platform (ICP) + emergency collaboration service platform to realize the unified reporting, distribution, and handling of various daily events.

Disaster-related databases and platforms from international sources shall also be integrated into a unified ICT platform. For example, Artificial Intelligence for Digital Response (AIDR), an open-source software is capable of "parsing through social media content to tag thousands of posts every minute as disaster-related, structuring the data for use in software systems to visualize the disaster-affected areas via maps, dashboards, or other systems that can analyze the data". Software and databases like this will provide tools and data useful for local disaster prediction and mitigation.

The localized platform shall be set up in the provincial and city level to manage the local natural and non-natural disaster, as well as used as a local command and control center that links to national command and control center for disaster management.

Disaster Management Systems

The disaster management system covers all four different phases of disaster management and targets to provide a centrally managed platform for disaster management across the whole nation. The key ICT systems for each phase includes:

1. Mitigation and Prevention
    - Awareness System displays real-time sensory data in all high-risk areas on GIS-based platform, with different color highlights the level of risk, as well as live climate information from surrounding regions. Non-sensitive data shall be put on an open data network for public awareness and commercial ICT service integration;
    - Simulation and Predictive Analysis System for hazards or disaster predication. This may include typhoon track forecast, tsunami forecast after a major earthquake, volcanic eruption forecasting and impact analysis, etc.;
    - Standard Operation Procedures (SOPs) for disaster management to promote collaboration among public sectors and government agencies include BNPB, ministry of communication and information technology, fire department, emergency department, national police, military force, Regional and local governments, as well as related international organizations;
    - Training and Drill Event Platform for the public and officers. Result of the training and

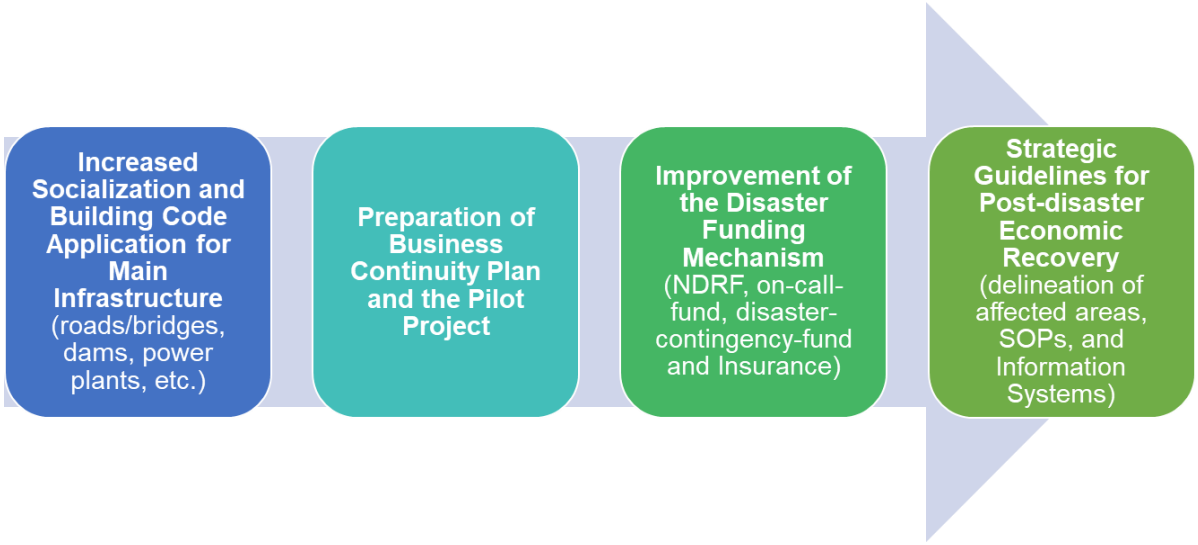
drill could be used to improve disaster analysis and SOPs;
- Increased Socialization and Building Code Application for key infrastructure (roads/bridges, dams, power plants, etc.);
- Preparation of Business Continuity Plan and the Pilot Project;
- Improvement of the Disaster Funding Mechanism (NDRF *, on-call-fund, disaster-contingency-fund and Insurance);
- Strategic Guidelines for post-disaster economic recovery.

2. Monitoring and Control
- Unified Call Center that merges disaster-related call numbers into one. For emergency cases and disaster-related case, the public shall be able to call 112 instead of 115 for fire, 110 for police, and 119 for emergency;
- Risk Monitoring and Evaluation System that links to local and regional hazard monitoring systems and evaluates risks. The system analyzes causes of disasters from multiple aspects including their types, temporal and spatial distribution characteristics, intensity, and frequency. Based on incident and plan chains, the system shall predict the type of a potential disaster and identify relevant risk areas of a single disaster or a disaster chain;
- Warning Broadcasting System that activates multiple channels for disaster broadcasting include social media, short messages, radio, television, Internet, multi-media broadcasting screens, public loudspeakers, etc.;
- Facility Management System that manages on GIS-based platform all related facilities, equipment, and vehicles;
- Coordination meetings between ministries/institutions related to disaster;
- Lesson Learned: Post-disaster recovery in several areas.

3. Rapid Response and Disposal
- GIS-based resource allocation Platform that manages all related facilities, equipment, fleet and vehicles to effectively respond to disasters through multi-channel coordination. In case of emergency, resources could be activated and the fleet could be dispatched through the platform. All resources managed shall be labeled with tracking devices and displayed at real-time on digital map (e.g. IOT module on vehicles, Satellite + SIM module on mobile devices);
- Integrated communication systems to support resource mobilization, include trunked communication for field officers, converged video conference in critical support operation rooms, and video surveillance that covers critical areas can be viewed by field officers through a mobile communication channel;
- Impact Analysis System that analyses the current situation and impacts after each wave of emergency response efforts for government officers and experts to make decisions on the core functions that should be undertaken next.

4. Recovery and Relief
- Knowledge management (KM) database including post-disaster data collection, sharing of mega-disasters information among all affected countries, facilitate interaction and assist the exchange of knowledge and provide necessary first-hand information for experts to research to prepare for future disasters;
- Post-disaster analysis system that sets up a framework that can be used for monitoring and evaluating the progress of activities by the various agencies to promote tighter collaboration and greater transparency in the future;
- Accelerated post-disaster economic recovery (implementation of the Business Continuity Plan).

Figure 5. 12 The Main Programs of CMEA to Accelerate Post-disaster Economic Recovery



Source: Deputy Assistant for ICT and Utility, 2019, in the presentation "Leaders Offsite Meeting" on July 2019.

DISASTER MANAGEMENT CASE STUDY

IoT and Big Data

Mitigating the hazards caused by heavy rainfall

IoT and Big Data

IoT sensors are used to monitor the water level of drainage systems, as well as garbage levels of the public waste bins. Together with data on weather information, tidal information, GIS information for flood hazard mapping and simulations of flooding, these tools help a city to mitigate the heavy damages caused by flooding.

Case Study

Buenos Aires experiences severe flooding, whereby in 2013, a disastrous flood and heavy rainfall resulted in the need for evacuations of thousands of residents, as well as more than 50 casualties arising from the incident. The government decided to invest in a smart disaster management solution to achieve real-time status of key information such as water levels in drainage, citizens' feedback on blockages due to unattended refuse, as well as weather reports to allow the city to take timely actions in times of possible flooding crisis. The decision support system also help the city to make predictions on flooding so that the government can notify the city residents of potential dangers.

After deployment the solution, the city has been able to clear its 30,000 storm drains even if it suffers heavy rainfall and has stayed flood-free. Through dashboards and metrics, Buenos Aires has been able to collect information for more reliable decision making and determining precisely the amount of work outstanding. These replace the previous manual system of data collection and maintenance.

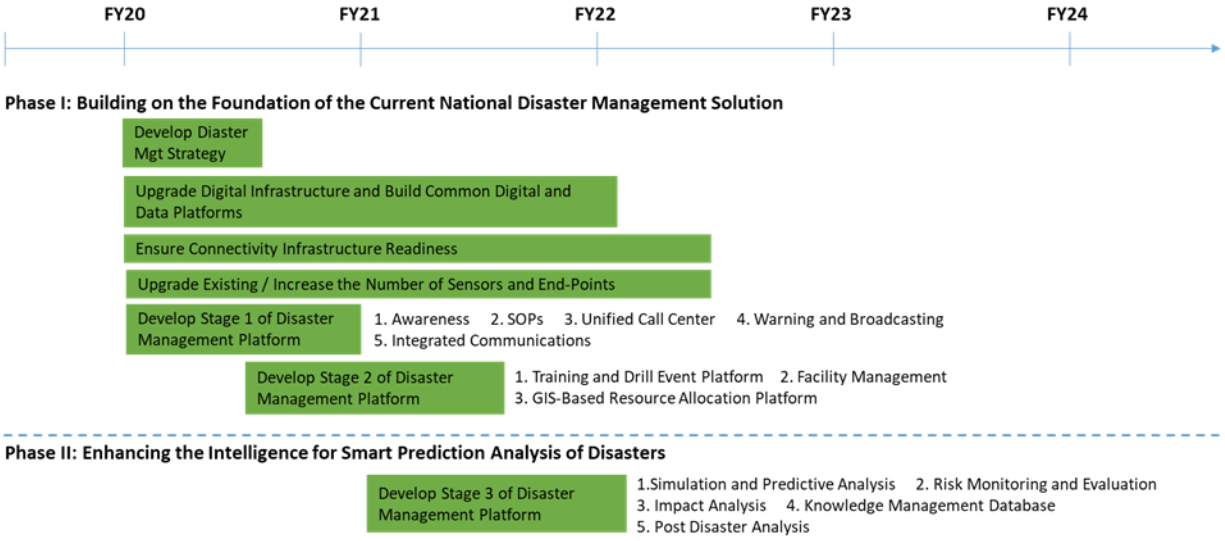
DISASTER MANAGEMENT DIGITAL MATURITY

Disaster Management Digital Goals

Disaster Management Digital Goals	CONNECTED *Broadband, IoT*	INFORMATION ACCESS *Big Data, IoT, Cloud, Data Center*	APPS & PROCESS AUTOMATION *IoT, Cloud, Data Center*
MONITORING AND COLLECTING DATA	City sensors & CCTV cameras are deployed across Narrowband and Broadband networks to support the monitoring of critical infrastructures.	IoT Platform enables the collection of all information, providing a consolidated repository for data analytics.	Applications to support Sensors and Data e.g. Disaster Management, Waste Bins, Water Level Drainage Logging etc.
UNIFYING APPROACH TO DISASTER HANDLING	City workers, emergency services etc. are connected to each other and to the City Management Centre and to enable them to communicate, access city information and provide on the spot information back to the city management centre.	Consolidation of all city information including sensors / CCTV data as well as GIS information, city assets to support operation and planning.	Applications to support city operations e.g. command and control, planning, GIS, asset management etc.
DEVELOPING SMART AND PREDICTIVE CAPABILITIES	City resources are located automatically on GIS, allowing for computer-aided dispatch of the nearest and most relevant resources to the scenes.	Data from relevant models are taken into account, together with the city data to enable better predictions of future disasters.	Applications with AI / data analytics capability to support modelling and predictive analysis e.g. flood hazard modelling, weather modelling, sea level modelling etc.

Source: (Huawei International, Disaster Management Digital Goals, 2019)

PROPOSED IMPLEMENTATION ROADMAP



SMART CITY TRANSFORMATION

There is no doubt, cities are being shaped by the innovative power of Information and Communications Technology (ICT). Digital technologies are being integrated into government management, citizen services, public safety, industry development, and other urban activities.

Smart Cities are rapidly emerging from the implementation of these digital technologies. As a new development stage following industrialization, urbanization, and informatization — Smart Cities will bring new ideas and create opportunities to improve citizens' lives. The development of Smart Cities is characterized by evolution, not a revolution, it has a starting point and no endpoint.

Cities are responsible for about 75% of global energy consumption, contributing to more than half of the world's greenhouse gas emissions. This trend is set to continue, given that most countries are focused on urban and economic development.

The UN has also projected that 68% of the world population will live in urban areas by 2050[2]. Given that Indonesia's urban population is currently estimated at 55%, this means a 13% increase in people living in the cities. With this fast pace of urbanization, some of the key challenges that will be faced (or already facing) by Indonesia are traffic congestion, scarcity of resources, waste management, human health concerns, inadequate/deteriorating/ aging infrastructures, and environmental pollution.

World Bank's research estimated that every 1 percent of urbanization in a country should lead to a significant increase in the country's per capita gross domestic product (GDP). Thus, a controlled pace of urbanization is still an important strategy for Indonesia. However, compared to India and China's per capita GDP growth of 13% and 10% respectively, Indonesia's per capita GDP expanded only by 4% for each 1% of urbanization. There is a need for Indonesia to invest its capital projects wisely so as to increase the benefits of urbanization while reducing the associated negative effects.

DIFFERENT CITIES, DIFFERENT THEMES

As resources are usually limited in the implementation of smart city development, there is a need for a planned approach to implementing smart city technologies and enablers. Evidence suggested that leading smart cities such as Singapore, San Francisco and London (among others) are each focusing on areas that are appropriate to the economic and social priorities of the city, as well as to the different stages of development. For example, Singapore, an island nation, with a high population density and a rapidly aging population has chosen to focus its Smart Nation efforts on Transport / Mobility, as well as Health / Enabled Aging.

Figure 5. 13 Different Themes for Different Cities

Source: (Huawei International, Different Themes for Different Cities, 2019)

Given this, Smart Cities have the potential to "give back" to each city dweller 15 days every year ((Juniper Research, 2018), such as 60 hours savings from mobility investment (in smart traffic systems), 35 hours in public safety (crime prediction/emergency service vehicles routing), 9 hours saved in healthcare (with Telehealth and improved administration for reduced waiting time, as well as 21 hours in productivity (efficient city management). Similarly, Indonesian cities should also focus on the relevant areas that are of high priority to reap immediate benefits.

INDONESIA SMART CITIES

MCIT launched the IoT Roadmap Draft, with a focus on connectivity. Other government support includes the Venture Capital Policy which provides incentives to finance tech startups. The policy seeks to emulate the accelerator and incubator concept of Silicon Valley.

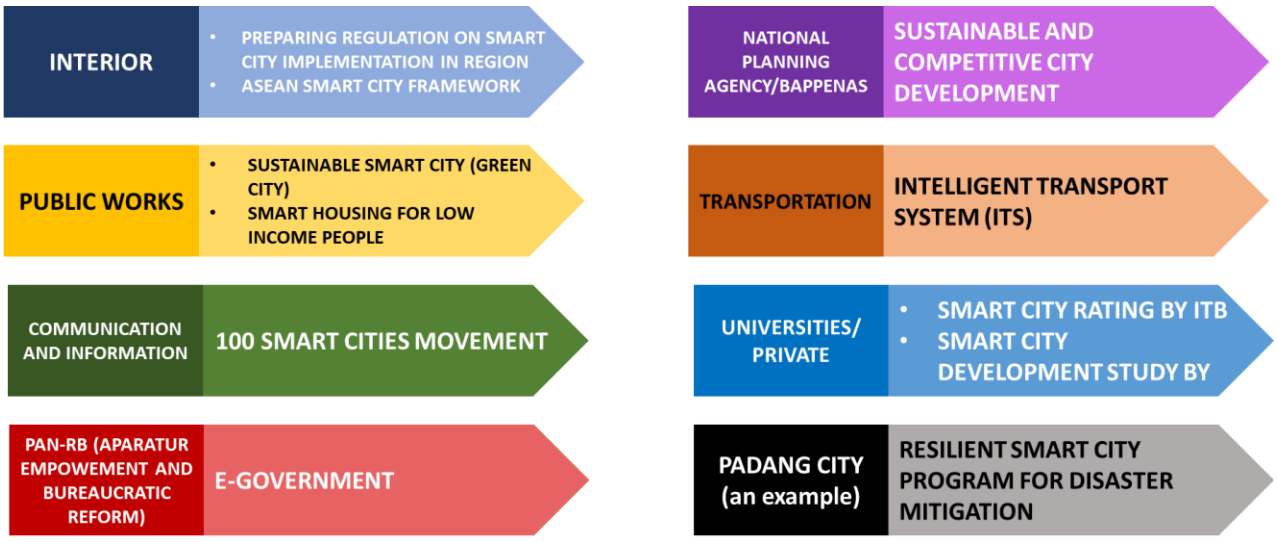
The Indonesian government is also aggressive in pushing for smart city initiatives. Under its Movement to 100 Smart City plan, the country aims to achieve smart connectivity, smart solutions, and smart user. Three Indonesian cities will be included in the ASEAN Smart Cities Network (ASCN). The cities are the national capital Jakarta, the provincial capital of South Sulawesi province, Makassar, and Banyuwangi on Java Island. The 26-city network is Singapore's flagship initiative for its ASEAN chairmanship this year. President Joko Widodo said the ASCN will help tackle complex urban challenges in ASEAN cities, to develop inclusive and sustainable cities based on innovation and technology.

MCIT has launched a movement towards 100 smart cities by creating 25 smart cities in 25 districts and municipalities in the country. The movement towards 100 Smart City is a joint idea of the Ministry of Communications and Informatic Technology, the Ministry of Home Affairs, the Ministry of Public Works and People's Housing, the National Development Planning Agency, the Presidential Staff Office, academics and other parties.

With the recent announcement by the President of Indonesia on the proposal to move the central government out of Jakarta to a new capital city on the island of Borneo, it will also be an opportunity for the country to adopt a "greenfield" approach to planning and building the new smart capital city. As the urban and physical infrastructure planning takes place, it should dovetail with the smart city (i.e. ICT infrastructure) planning to ensure a holistic approach to designing the new city.

Deputy Assistant for ICT of Utility also encourages the implementation of smart city in several government institutions for increasing efficiency. Some of the smart city programs are shown in the next figure.

Figure 5. 14 Government Institutional Programs on Smart City



Source: (Deputy Assistant for ICT and Utility)

PROGRESS SO FAR

Many cities around Indonesia have embarked on the smart city journey.

Jakarta

Jakarta, like several other Indonesian cities, is undergoing the transition to a smart city as part of the regional government's efforts to increase living standards and ensure sustainable resource management, and in response to issues that have long adversely affected residents, such as poor air quality, vulnerability to floods and the perennial problem of traffic congestion.

The Jakarta Smart City program, launched in 2014, aims to promote and implement smart city initiatives, including people, mobility, living standards, economics, the environment, and government. It has since become the provincial government's hub for the latest technology.

Denpasar

Denpasar in Bali is going digital by implementing the "Damayana Denpasar Cyber Monitor", where various Smart City applications are centralized in one location. These include the 112 disaster and emergency number, Flood Monitoring, ATCS, Online Fraud, Geographic Information Systems, a fleet tracking system, a fishing tracking system, market price information, public safety (E-Sidap), integrated administration information system (Dirgens), and social media. Apps are being developed so that data and information can easily be shared with the island's population.

Bandung

Bandung in West Java has also been ambitious in developing its own smart city technologies. The city's Command Center was the first of its kind and the concept has since been implemented in other cities in Indonesia, including Jakarta. The local government has also expressed interest in incorporating a smart surveillance and monitoring system, as well as smart lighting.

Surabaya

Surabaya in East Java has implemented a form of e-government that allows financial matters to be managed through an online-based system.

Makassar

The city administration of Makassar in South Sulawesi issues residents with smart cards that can be used for cashless financial transactions. The city also implemented a surveillance system to monitor roads and traffic.

Medan

Medan in North Sumatra is currently working on a plan that puts the emphasis on a smart transportation system.

What is needed to progress the cities of Indonesia is Coordinated Vision, Capacity Building and Public Education. Malcolm Foo, a global adviser at PricewaterhouseCoopers Consulting Indonesia, believes the establishment of a dedicated unit focused on coordinating smart city initiatives and programs would help to enable effective implementation. "Proper planning – developing a smart city roadmap – is critical for gaining buy-in, resourcing and sequencing the initiatives, because some may have interdependencies with others," Foo said. It is important for regional and city governments to prioritize how those technologies can contribute to each city's sustainability, business development, and living standards while addressing unique needs.

SMART CITY DIGITIZATION

Cities and Urban Centers are realizing benefits derived from digital applications and data-driven innovation. This is impacting multiple sectors including Transportation, City Management, Emergency Response and more.

This is across various sectors that are increasing the use of digital applications, for example in their transport and electricity systems. Important effects of such applications are fuller capacity utilization through improved matching of demand and supply.

Whether via a mobile app that gives urban travelers the fastest connection from point A to point B, taking into account all available transport modes and traffic conditions or via a smart electricity meter that informs households and businesses of real-time electricity prices based on current demand and supply in the grid, making demand and supply transparent in real-time allows shaving peak demand by redistributing it in space (notably transport) and time (transport and electricity).

This reduces congestion on roads and lowers baseload requirements in electricity supply. In turn, people save time spent on transport and money on (and emissions from) electricity.

Several other sectors, such as water and waste management, also benefit from digital applications. In addition, the data collected by applications and sensors embedded in urban infrastructures can be used to further improve their functioning.

Beyond improving separate urban systems, synergies can be unleashed through deeper integration of systems across sectors. A city can be considered as a "system of systems", within which ICTs and digitized urban flows create the potential for deep system integration. A good example of a single system that is becoming increasingly integrated with other urban systems through the use of ICTs and real-time information exchange is the electricity grid. Such "smart grids" not only enable demand- and supply-side management with smart meters, but have a wider potential to integrate the energy system with other urban systems such as transport. For example, a smart grid can integrate electric vehicles as energy storage and supply to help shave peak load electricity demand and to balance out the fluctuating supply of renewable energy sources.

Examples of Urban Efficiencies through digital transformation

Smart electricity grids are expected to yield energy savings for homes and businesses, in particular, if combined with home and business energy management systems. Through the use of smart meters, European households are expected to save 10% of their energy consumption per year (e-control, 2011). In the United States, the savings from smart grids are estimated to be 4.5 times the needed investment of USD 400 billion (EPRI, 2011). Smart grids are part of the development of a smart city and with the rise of home solar power systems and electric vehicles, hardware and software technology will allow for the potential of better grid management, optimization of power production through different sources. Smart streetlights are an easy entry point for many cities since LED lights save money and pay for themselves within a few years.

Data-driven innovation in transport systems can save people time and money and reduce pollution and emissions in cities. A smart city supports multi-modal transportation, smart traffic lights, and smart parking. One of the key areas that are receiving a lot of focus is mobility - anything around transportation, traffic monitoring, and parking. These are areas where cities can see a fast return. The Intelligent Traffic System of London is expected to reduce congestion in London by around 8% annually between 2014 and 2018 (OECD, Digital Economy Outlook, 2017). Open data use in transport, such as real-time information on multimodal trips, prices, and traffic conditions, is estimated to generate value worth USD 720 billion to USD 920 billion per year (OECD, Digital Economy Outlook, 2017). Congestion charging in Stockholm reduced traffic by 22% (100 000 passengers per day) and CO2 emissions by 14% (25 000 tons annually) in central Stockholm, during its seven-month trial period (OECD, Digital Economy Outlook, 2017).

Digital improvements in water systems can reduce water losses and cut operations and maintenance costs. "Smart water solutions" are estimated to save water utilities globally USD 7.1 billion to USD 12.5 billion per year through smarter leakage and pressure management techniques in water networks, smarter water quality monitoring, smarter network operations and maintenance, and data analytics in capital expenditure management (OECD, Digital Economy Outlook, 2017).

Comprehensive and data-enabled strategies for waste reduction, recycling, material reuse, and waste-to-energy conversion can save money and emissions. New York state's "Beyond Waste" strategy

is estimated to save as much energy as is consumed by 2.6 million homes each year (280 trillion British thermal units) and to reduce New York's greenhouse gas emissions by around 20 million metric tons annually (OECD, Digital Economy Outlook, 2017).

Cities are developing incubation environments

Large-scale system innovations, such as in transport or energy, require experimentation and testing at scale, ideally in real-life settings. Cities have started to define themselves as "living labs", such as the 340 European cities that are part of the European Network of Living Labs which covers four key elements: co-creation by users and producers; exploration of emerging usages, behaviors and market opportunities; experimentation with the implementation of scenarios.

Cities are turning into data hubs with decisions at city level being increasingly supported by big data and data analytics with information captured by IoT

City administrations increasingly use crowdsourced and online data on urban conditions and activities in cities to become more effective e.g. citizens reporting on stray garbage, potholes, broken lamps, etc. via their smartphone directly to city management. Such data can be used by city governments to target maintenance and investments and to improve services, and by police for predictive data analytics and decision making by identifying potential crime hot spots. Cities are also using information about energy and water consumption to create tariffs and drive down usage.

More data and greater computing power also bring urban modeling back into the Spotlight of urban planning, with the potential to improve resource allocation in urban areas.

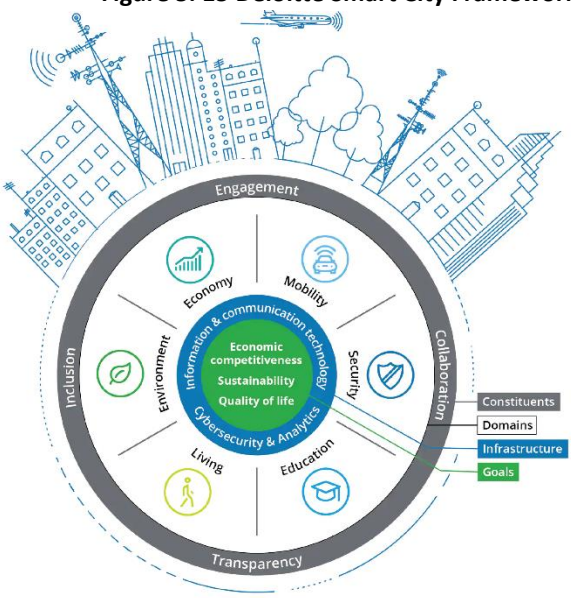
SMART CITY FRAMEWORK

Several key considerations have also emerged as being critical for smart city implementation.

Goals

The goals are essential as they provide the foundation for a smart city initiative. As mentioned above under "Different Cities, Different Themes", it is essential

Figure 5. 15 Deloitte Smart City Framework



Source: (Huawei International, Smart City Framework, 2019)

that Indonesia focuses on areas that are appropriate to the economic and social priorities of the country, as well as to the different stages of development for the various cities.

ICT Infrastructure

Modern Smart Cities are not possible without the foundational ICT building blocks of pervasive high-bandwidth network infrastructure both Mobile and Fixed, urban Cloud Data Centre as well as supporting common platforms such as IoT and Big Data. These are not easily achieved without sustained long-term investment on the part of the Government.

Analytics and Big Data. The massive amounts of data collected by a smart city must be analyzed quickly in order to make it useful. Open data portals are one option that some cities have chosen in order to publish city data online so that anyone can access it and use predictive analytics to assess future patterns.

It is expected that the expansion of open data policies will unleash an economic growth engine for urban innovation that we have never seen. Even the data collected by streetlights can be used to benefit citizens. Hidden within the exponential volumes of data collected from connected lighting systems and other IoT devices are valuable insights and information about how citizens interact with cities.

For instance, traffic data captured by streetlights can uncover a prime location for a new restaurant in a revitalized neighborhood.

Internet of Things (IoT). One of the key components that tie everything together in a smart city is IoT devices and platforms. CCTV Cameras, Sensors and Actuators are essential in a smart city capturing much need data on which to plan and operate the city.

Each of these technologies works together to make a smart city even smarter. As the world's population grows, and more people move into urban areas, the need for smarter cities will increase to make the best use of available resources.

Sharing Common Platforms. Long-term Smart City development requires all areas to be leveled-up in lock-step in phases.

Smart City solutions also tend to be multi-disciplinary and involve multiple municipal services, and hence cannot be developed in silos. Thus, the Operations Management Platform aims to achieve the following:

1. Bringing fragmented and unstructured urban information together to present in an overall and coherent manner to enable better sensing of the real-time operating status of a city and faster responses;
2. Enabling better collaboration across agencies, especially in times of emergencies, ensuring the service process of these agencies to be fully integrated;
3. Collating data and improving sense-making to better predict urban development trend and to make scientific decisions with regard to the planning of the city.

Domains

Depending on the goals to be attained, most of the solutions can be classed within the following urban domains, helping to seed change through the use of technology:

1. Economy
2. Mobility
3. Security
4. Education
5. Living
6. Environment

Additional Considerations

Develop a National Smart Nation Master Plan. Building a smart nation and its accompanying smart cities require proper planning and execution. This ensures a coherent strategy that enables vision alignment with all stakeholders, efficient allocation of resources, and greater citizen participatory in the country's smart city development journey.

Open, Efficient and Effective. Developing a smart city can be a daunting task. Hence, it is important to have a strong ICT ecosystem of local and international players to support the Government. Given this, the Government should consider building a platform that provides flexible and easy-to-use development tools and standardized interfaces and pre-integrated plug-ins, so as to allow developers to easily integrate their solutions and responding quickly to customer requirements.

To avoid rebuilding, key ICT technologies such as Integrated Communications Platform (ICP) over different access systems (such as voice, message, trunking communications, video conferencing), Computer-Aided Dispatching (CAD), Geospatial Information System (GIS), and Video Content Management (VCM) solution can be fully leveraged in a platform to enable ease of sharing of these resources by the various smart city applications. Besides wastage of resources in duplicating these capabilities, this will also support better data centralization.

From another perspective, the Government should also consider re-engineer its internal processes to reduce bureaucracy, update legislations and regulations to encourage government agencies to pursue smart city projects. Hence, it is important to maintain a balance between bureaucracy and efficiency to ensure proper governance.

Citizen Involvement. With the increase in data exchanges between citizens, businesses, and government, Indonesia should also focus on involving its citizens in its smart nation development journey. Such an information-sharing partnership can be thought of as a "city-as-a-platform". An example of how this was implemented can be seen by how Amsterdam successfully tap on its citizens, scientists, engineers, and designers to develop low-cost, easy-

to-build-maintain sensor kits to take certain environmental (e.g. light, sound, carbon monoxide, etc.) measurements and upload to an online platform, expanding the city's reach into street-level hyperlocal measurement (Deloitte Insights, Forces of change: Smart Cities, 2018). Other examples can be seen from the European Union's Open Data initiative, sharing non-sensitive data with its citizens and businesses to allow them to develop the raw data into new data sets and innovative applications for use.

Top Government Leadership. Besides opening doors and getting alignment from all ministries and agencies, Government can also set the lead by investing seed funding into Smart City projects, develop ICT literacy for the citizens, build up capable ICT personnel, as well as creating the right incentives and regulatory environment to develop the ICT industry.

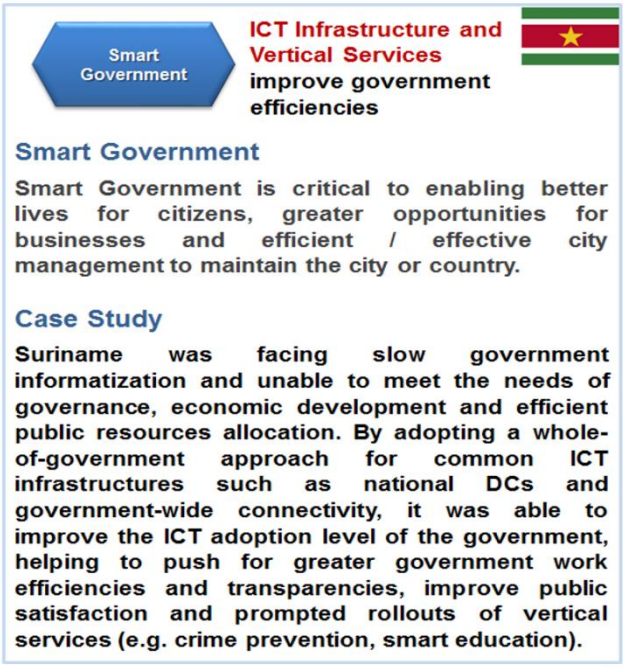
SMART CITY CASE STUDIES

Figure 5. 16 Smart City Use Case

Source: (smartdubai.ae)

Source: (Royal Commission for Jubail & Yabu)

Source: (Huawei, 2018)



Source: (Canto.org)

SMART CITY DIGITAL MATURITY

Digital Maturity is based on the degree of digitization of an Industry. The core elements of digitization are Broadband, Big Data, IoT, Cloud, and Data Center. The below represents the digital goals for Smart City.

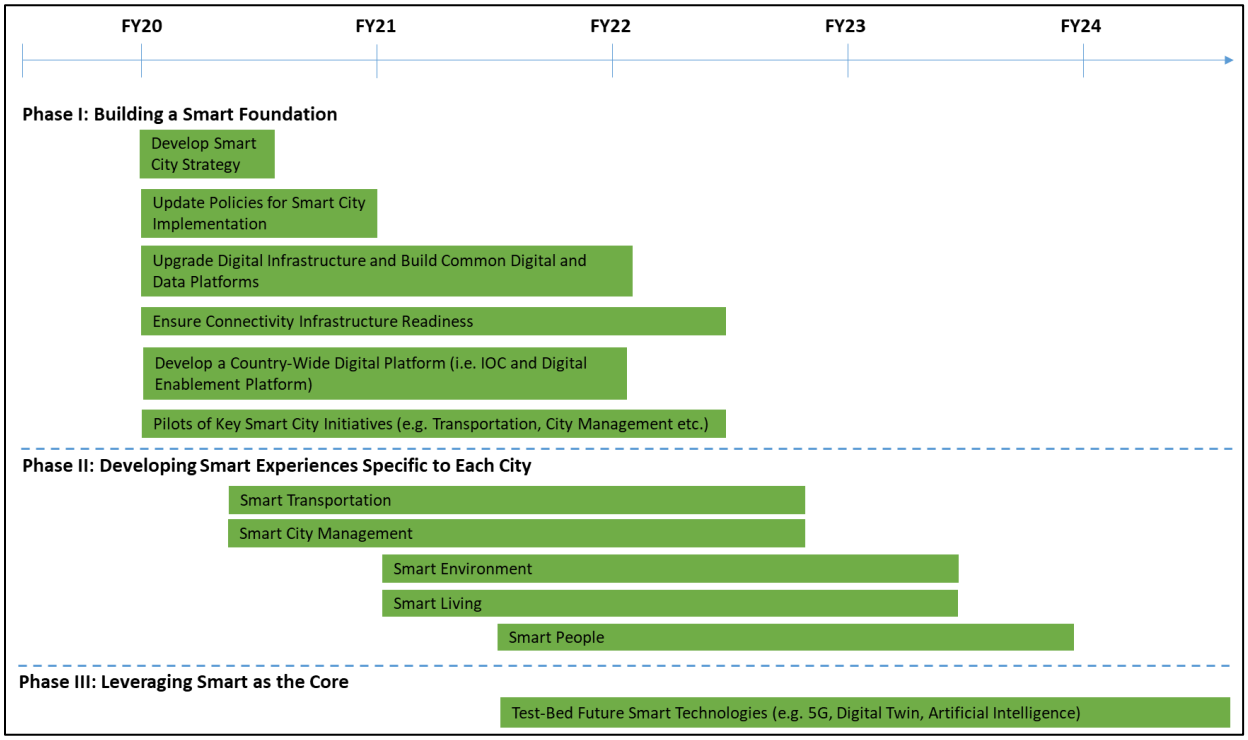
Figure 5. 17 Smart City Industry Digital Goals

SMART CITY INDUSTRY DIGITAL GOALS	CONNECTED *Broadband, IoT*	INFORMATION ACCESS *Big Data, IoT, Cloud, Data Center*	APPS & PROCESS AUTOMATION *IoT, Cloud, Data Center*
CITY SURVEILLANCE, MONITORING & PLANNING	City Sensors & CCTV Cameras are deployed and connected across Broadband and Narrowband Networks to support surveillance of Traffic, People, Crime, Disasters, Environmental, Buildings etc.	IoT Platform to enable collection of Information Consolidated repository of all surveillance data and video footage Data Analytics	Applications to support Sensors & Data e.g. Policing, Disaster Mgmt, Traffic Mgmt, Building Mgmt, Fire Hydrants, Parking Meters, Waste Bins
CITY OPERATIONS & MANAGEMENT	City workers, police, emergency services etc. are connected to each other and to the City Management Center and to enable them to, communicate, access city information and provide on the spot information back to the city management center	Consolidation of all City Information including sensor / CCTV data as well as GIS Information, City Assets to support Operation and Planning	Applications to support City Operations e.g. Command & Control Apps, Planning, GIS, Asset Mgmt etc.

Source: **(Huawei International, Smart City Industry Digital Goals, 2019)**

PROPOSED IMPLEMENTATION ROADMAP

Figure 5. 18 Proposed Implementation Roadmap Smart City



Source: (Deputy Assistant for ICT and Utility)

E-GOVERNMENT TRANSFORMATION

In the coming decade, several factors - an aging population, the rise of Millennial, budget shortfalls, and ballooning entitlement spending — could reshape the way the government delivers services. But the introduction of new digital technologies is likely to be the most important factor of all. Indeed, governments from across the world are in the midst of a digital transformation as they move from manual operations.

Governments are focusing on becoming digital by incorporating ICT tools internally as well as offering services online for individuals and businesses. Online handling of governmental administrative requests is the most common e-service offered and includes tax declarations, updating personal information and the civil registry, and consular services. Many governments also have policies to share public sector information (PSI) through open data portals.

GOVERNMENTS ARE OFFERING THEIR SERVICES ONLINE AND FOCUSING ON BECOMING MORE EFFICIENT THROUGH ICT TOOLS

Policies to promote the adoption of ICTs by public administrations can be split broadly into three categories:

1. Creating or promoting e-government services for individuals;
2. Creating or promoting e-government services for businesses;
3. Improving the internal functioning of governments themselves and making them more transparent through the public availability of information.

POLICIES TO PROMOTE ICT ADOPTION IN PUBLIC ADMINISTRATION

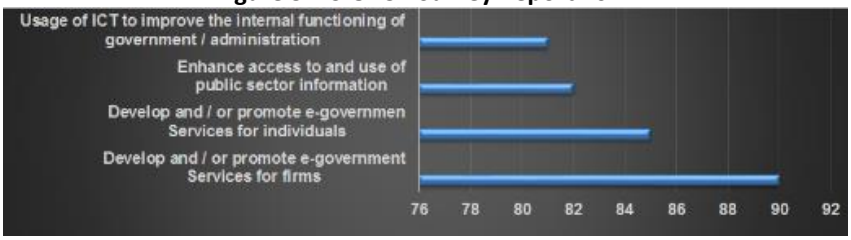
Governments are all developing various forms of e-Services for citizens and businesses such as pay taxes, submit various forms, voting, and update their personal information online. Some Governments have opted for Digital Communications e.g. Norway has adopted a “digital-by-default” approach forcing citizens to actively choose to receive paper mail in lieu of receiving communication digitally via a secure digital mailbox.

Given that many of these e-services include the transfer of personal data, some countries have developed e-ID and e-authentication services to make these online services more secure.

Many countries have a “one-stop” website to communicate relevant information related to the e-services provided by the government.

Unique to e-services for businesses is a large number of governmental processes directed towards a single online platform for public procurement. Another focus is on the processing of business administration to reduce regulatory burden to businesses and example of this is Canada’s initiatives to make internal processing more efficient for businesses and has adopted a standard identifier for businesses to be recognized across all government agencies.

Figure 5. 19 OECD Survey Report 2017



Source: (OECD, OECD Survey Report, 2017)

INDONESIA E-GOVERNMENT

The Indonesia Government is on a massive journey to improve and implement digital technologies within the government. E-Government has been established as an important part of the bureaucracy reform. From 2015, the Government of Indonesia has gradually been moving from a siloed approach for ICT to an integration shared approach. These approaches result in the ranking improvement as shown in Figure 5.20.

The objectives are four-fold:

1. Citizen oriented development;
2. Collaborative processes;
3. Connected with multi-channel access;
4. Continuous improvement.

Essential e-Government Infrastructure targets have been identified for core infrastructure budgets, procurement, etc.

Indonesia E-Government Experience

The Indonesian government is following the rapid development of technology, in-line with private sector investment. The emergence of new startups, many of whom are now using electronic trading systems to operate their businesses efficiently and effectively, is increasingly prevalent.

Figure 5. 20 E-Government Index

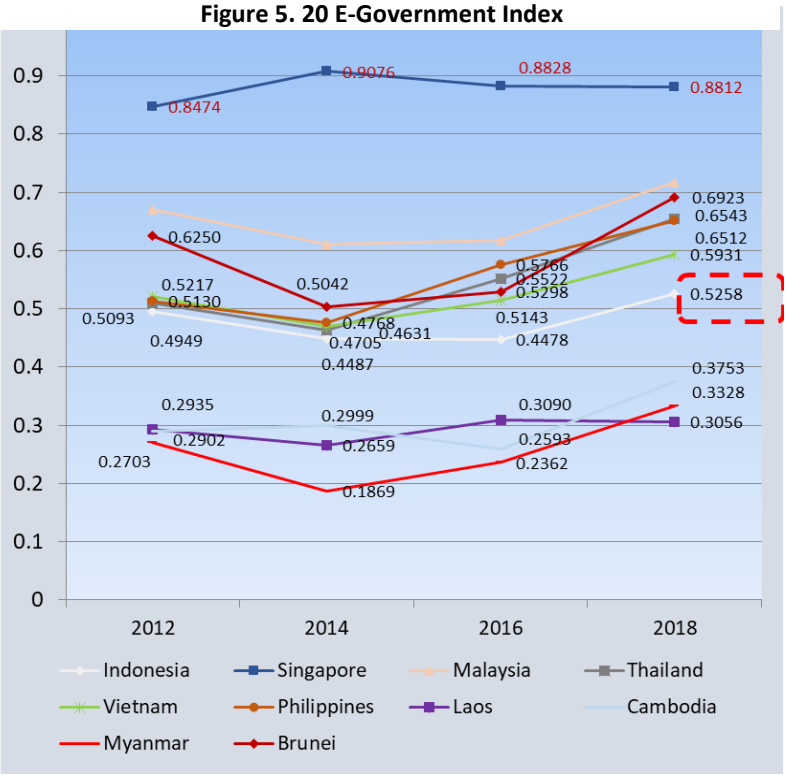


Table 5. 1 E-Government Ranking among South Asian Countries

Year	IDN	SG	MY	VTM	THAI	PHIL
2018	107	7	48	88	73	75
2016	116	4	60	89	77	71
2014	106	3	52	99	102	95
2012	97	10	40	83	92	88

Source: (Eddy Satriya, Maximizing eGov for a Better Governance and Capacity Building, presented in Digital Development Forum 2018, Manila 4-5 September 2018)

From the government side, service to the community continues to be improved. Cities in Indonesia began to develop electronic-based government systems for service efficiency and to prevent data redundancy. Seeing this, the government has issued Presidential Decree No. 95 of 2018 concerning Electronic Based Service Systems (SPBE). This Presidential Decree was made to realize clean, effective, transparent and accountable governance and quality, and reliable public services, all delivered by an electronically based national government system.

Previously, Indonesia had several regulations related to e-Government, including:

1. Presidential Instruction No. 6/2001 on ICT
2. Presidential Instruction No.3 / 2003 on National Policy and Strategy Development of E-Gov
3. Government Regulation No. 65/2005 on the Guidelines for Preparing and Implementing Minimum Standard Services
4. Law No. 11/2008 jo. Law No. 19/2016 on Electronic Information and Transaction

5. Law No. 14/2008 on Public Information Disclosure
6. Law No. 25/2009 on Public Services
7. Law No. 43/2009 on Archives
8. Government Regulation No. 82/2012 on Electronic System and Transaction Operation
9. Law No. 23/2014 on Local Government
10. Presidential Decree No. 96/2014 on Broadband Plan Indonesia
11. Presidential Decree No. 2/2015 on National Medium-Term Development Plan 2015 - 2019
12. Presidential Decree No. 74/2017 on the E-Commerce Roadmap
13. Presidential Decree No. 91/2017 on Online Single Submission
14. Presidential Decree No 44/2018 on Indonesia National Single Window
15. Government Regulation No. 71/2019 on Implementation of Electronic Systems and Transactions

Ministries in Indonesia also have implemented E-Government Applications [Satriya, Digital Development Forum 2018, 2018]: Management Integration and Data Exchange Application /Aplikasi Manajemen integrasi dan pertukaran data (MANTRA), Office Administration MAYA/ Administrasi Perkantoran MAYA (siMAYA), Civil Servant Mail / Pegawai Negeri Sipil Mail (PNS Mail), Private Network Security Box (PNS Box), Data Center e-Government, Planning, and Information Performance Budget / Perencanaan dan Informasi Kinerja Anggaran (KRISNA), Regional Incentive Funds / Dana Insentif Daerah (DID), e-budgeting and e-planning. Strategic government application as described in the next table.

Table 5. 2 Some E-Government Implementations

INSTITUTION	GOVERNMENT APPLICATION
Kemendagri (MoHA)	Sikomdagri → Media Interaction for Local Autonomy /Media Interaksi Otonomi Daerah (Medsosa) → Medsosa Chatting (M-Chat)
Kemen PUPR (MoPSPH)	• e-Human Resource Management (e-HRM) • Electronic Service Manuscript / Tata Naskah Dinas Elektronik (TNDE) • Geographic Information System Portal (SIGI) • Building Construction License/ Surat Izin Mendirikan Bangunan (SimBG) → Integrated with OSS
Kemenkeu (MoF)	• e-Prime for Echelon I • Treasury and Budget System Application/ Sistem Perbendaharaan dan Anggaran Negara (SPAN) • Financial System Application for Institution / Sistem Aplikasi Keuangan Tingkat Instansi (SAKTI) • Financial System Application for Regional / Sistem Aplikasi Keuangan Daerah (SIKD)
Bappenas	• Planning and Information Performance Budget / Perencanaan dan Informasi Kinerja Anggaran (KRISNA) Application • Planning Coordinator SPBE (Integrating planning, budgeting, procurement, accountability, and monitoring and evaluation)
KemenpanRB (MoABR)	• Roadmap e-Government • Governance Coordinator • Integrated apparatus data management, public services compliance, and archives (electronic manuscript)
Kemenkominfo (MCIT)	• Government Coordinator for Infrastucture • National Data Center • Intra-Government National Network • Government Service Bus
CMEA	Online Single Submission (OSS)
BSSN	Cyber Security Infrastructure
BPPT	Research and Development

Source: [Satriya, Digital Development Forum 2018, 2018]

The role of government in e-Government includes:

- Leadership
- Maintaining the reform process
- Synchronization and Collaboration between Government and People
- Having an Investment Strategy
- Encourage the participation of local governments and communities.

In implementing E-Government in Indonesia, several infrastructure foundations are needed that are expected to maximize the application of E-Government including:

- Connect the country with optical fiber + satellite
- Better cellular services
- Provision of Wifi, especially in the area of government offices and business districts
- The best policies about OTT, cloud services, the Internet and Service Providers, RFID, and Blockchain
- Reliable electricity source
- Guaranteed infrastructure and networks

DIGITAL GOVERNMENT

A Digital Government has Core Capabilities supported by Organizational Enablers as described in Figure 5.21.

CAPABILITIES

1. Government Services

Digitization of touchpoints, consolidated online access platforms, Citizen and business portals, Messaging platforms, Payment platforms.

2. Government Processes

Automation of transactional processes (e.g. grant applications), Digital enablement (e.g. e-health).

3. Decisions/Analytics

Deployment of sensors and advanced predictive analytics.

4. Data Sharing

Unified, open public registers, sharing of data, Correlation of solutions with the private sector and citizens.

DIGITAL ENABLERS

1. Digital Strategy

Close connection to broader government priorities, Aspirations translated into concrete targets, Focus on citizen and business experience

2. Organization Governance

Organizational design, Governance, and accountability, funding mechanisms for collaboration, innovation, and efficiency, regulations that allow open, joined-up citizen experiences

3. Leadership, Workforce, Culture

Leadership, Technical and implementation talent, Programs to attract and retain digital workers

4. Technology

Model for rapidly deploying new services, agile development, Analytics platforms, Cybersecurity measures and controls, Broadband Connectivity

Figure 5. 21 Capabilities and Digital Enabler

Source: (McKinsey Analysis, 2016)

Table 5. 3 Characteristics of A Digitally Maturing Government

	Early	Developing	Maturing
Strategy	Aimed at cost reduction	Aimed at improving customer experience and decision making	Aimed at fundamental transformation of processes
Leadership	Lacks awareness and skills	Digitally aware	Digitally sophisticated
Workforce development	Insufficient investment	Moderate investment	Adequate investment
User focus	Absent	Gaining traction	"Central" to digital transformation
Culture	Risk averse; disintegrated	Risk tolerant; accommodates innovation and collaboration	Risk receptive; fosters innovation and collaboration

Source: (McKinsey, 2018)

THE JOURNEY TO GOVERNMENTS' DIGITAL TRANSFORMATION

Deloitte recently conducted a survey of over 1,200 government officials from across 70 countries on digital transformation. Overwhelmingly, they reported that digital technologies are having a major impact on the government with three-fourths of respondents agreeing that digital technologies are disrupting the government.

"Truly transforming government through the power of digital technologies will be a journey."

Governments are at very different stages in this journey. While a small number are considered to be "maturing," The overwhelming majority are still in the early or developing stages of the digital transformation journey.

DIGITALLY MATURING ORGANIZATIONS HAVE:

1. A clear strategy aimed at fundamental transformation and a strategy to achieve digital transformation;
2. Digitally savvy leadership is a game-changer with early-stage organizations lacking an understanding of digital trends;
3. The lack of digital workforce skills represents a major obstacle to transformation;
4. Thriving innovation with a "digital mindset" of customer focus and agile development, and a culture of collaboration and change across agencies.

POSSIBLE INITIATIVES

Transform the Government Workplace. With the announcement on the proposal to move the central government out of Jakarta to a new capital city on the island of Borneo, there is an added imperative to consider the current mode of office automation for the Indonesian Government. The transition will require massive coordination to ensure that government employees can continue to work. Hence, an option is to allow the government employees to work remotely, so as to ensure minimal disruption during the transition.

The traditional PC office automation using desktops and laptops have several shortcomings, such as difficulty to manage and monitor distributed PCs and peripheral devices, as well as locally storing data resulting in potential security problems.

Hence, a possible solution is to consider the use of desktop cloud technology to construct an office automation desktop system with high information security, high reliability, using lightweight devices with power conservation characteristics. Through virtualization technology, the Indonesian Government will be able to centrally manage and schedule all IT infrastructure in unison, with full consideration for system security and performance requirements.

Such use of virtual desktop infrastructure technology can reduce ICT desktop deployment cost, enable efficient centralized operations and management of the ICT infrastructure and applications, and enhance security for government data. More importantly, it

allows a new model of working, such as teleworking, mitigating the need for hours of travel from home to office, reducing traffic congestions, and improving the quality of life for the employees and citizens in general.

E-VOTING

Electronic voting in polling stations is in place in some of the world's largest democracies, and Internet voting is used in some countries. Many countries are currently considering introducing e-voting systems with the aim of improving various aspects of the electoral process. Among South East Asian Countries, Indonesia is far behind compared to the Philippines which has implemented E-Voting. E-voting is often seen as a tool for advancing democracy, building trust in electoral management, adding credibility to election results and increasing the overall efficiency of the electoral process.

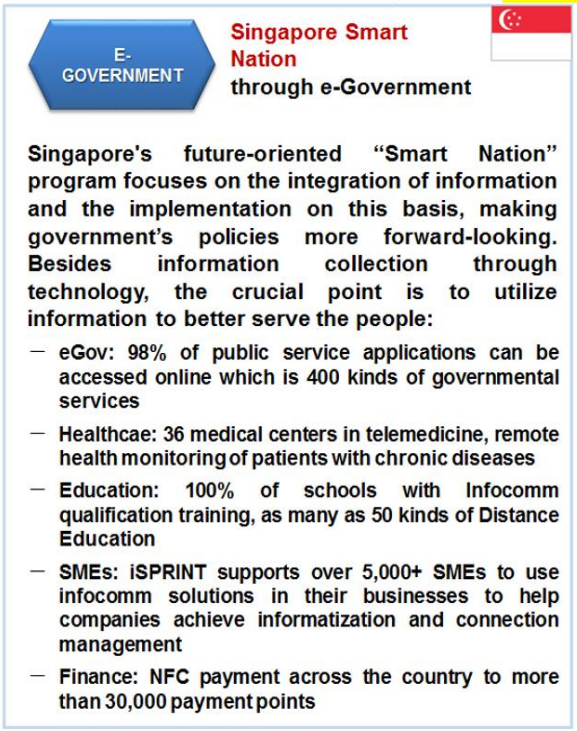
Properly implemented e-voting solutions can eliminate certain common avenues of fraud, speed up the processing of results, increase accessibility and make voting more convenient for citizens—in some cases, when used over a series of electoral events, possibly even reducing the cost of elections or referendums in the long term. Indonesia needs to make E-Voting Implementations Roadmap, with General Elections Commission (KPU) and Agency for the Assessment and Application of Technology (BPPT) continuing to test e-voting procedure and preparation for the next election. If Philippines can make it its way, why can't Indonesia?

Example e-Voting Capabilities

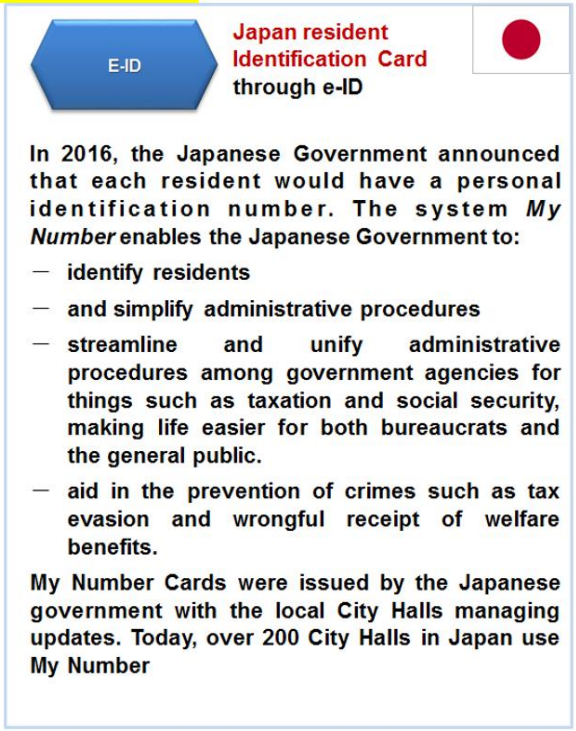
1. Electronic Voter Lists and Voter Authorization
2. Poll Worker Interfaces
3. Interfaces for casting votes
4. Special Interfaces for the handicapped, blind, physically impaired and illiterate.

E-GOVERNMENT CASE STUDIES

Figure 5. 22 E-Government Case Studies



Source: csc.gov.sg



Source: evolis.com

E-GOVERNMENT DIGITAL MATURITY

Digital Maturity is based on the degree of digitization of an Industry. The core elements of digitization are Broadband, Big Data, IoT, Cloud, and Data Center. The below represents the digital goals for e-Government.

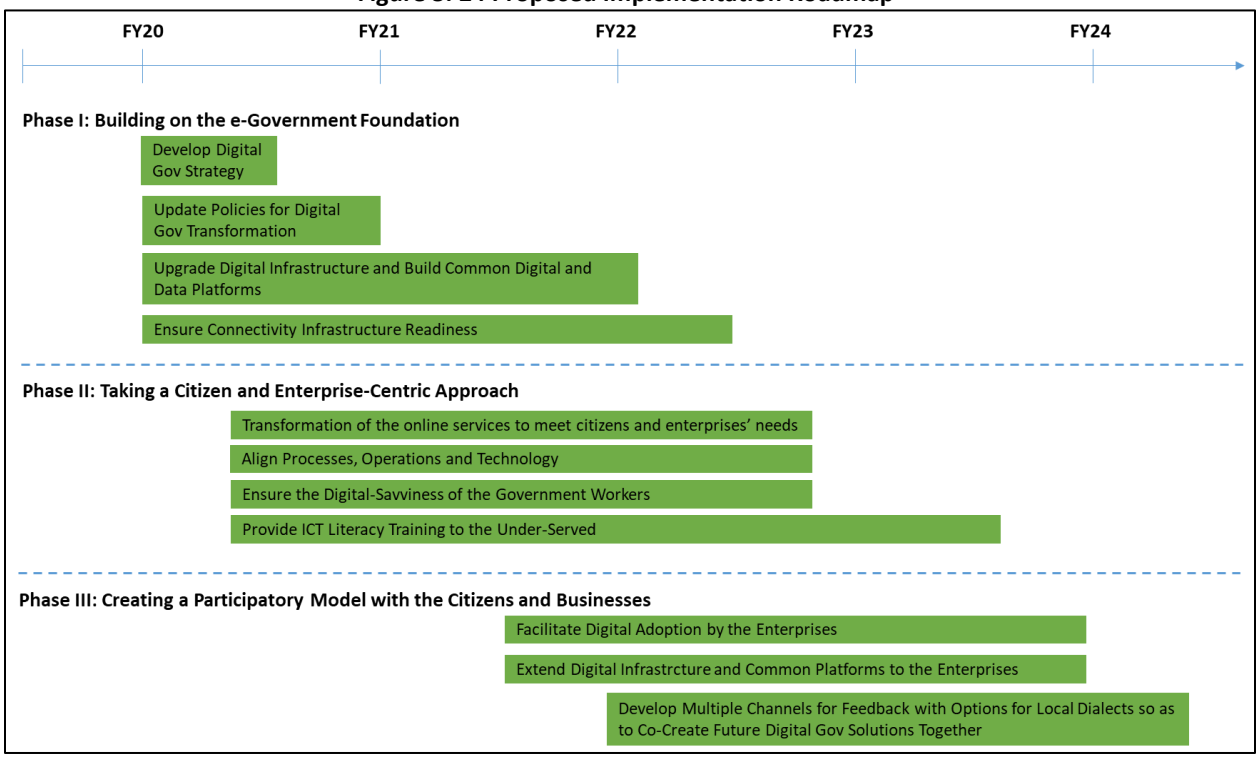
Figure 5. 23 E-Government Digital Goals

E-GOVERNMENT DIGITAL GOALS	CONNECTED *Broadband, IoT*	INFORMATION ACCESS *Big Data, IoT, Cloud, Data Center*	APPS & PROCESS AUTOMATION *IoT, Cloud, Data Center*
ONLINE GOVERNMENT ***Service Oriented***	Facilitate Government interactions & communications through secure access to Government Services, Information and Data for Government Employees & Departments, Citizens & Businesses	Information repository for Whole of Government Data Citizen Information i.e. e-ID Property Information	Applications to support Online Government e.g. – Access Information Portals, Government Apps Store – Business to Business Interaction i.e. Procurement & Logistics – Communications – Telepresence, Messaging, Collaboration
SMART GOVERNMENT PLANNING ***Informed***	Government Department access to planning information	Collect, Consolidate, Analyze Information from various sources to enable Government Planning and make informed decisions. Examples: – Health – Disease Surveillance MoH – Education – Trends in Learning MoE – Transportation – Roads, Traffic – Crime – Trends In Crime & Policing	Data Analytic Tools & Planning Applications
EFFICIENT GOVERNMENT ***Cost Effective***	Network Consolidation and creation of Government Virtual Private Network for inter agency communications and access to data centers and services	IT Infrastructure Consolidation and creation of Government Cloud based Data Centers to support Information and Applications	Government Applications to enable process efficiencies i.e. Finance, HR, Procurement etc.

Source: (Huawei International, E-Government Digital Goals, 2019)

Proposed Implementation Roadmap

Figure 5. 24 Proposed Implementation Roadmap



Source: (Deputy Assistant for ICT and Utility)

Industry Development

Agriculture

Tourism

Transport & Logistics

AGRICULTURE DIGITIZATION

The world is experiencing a rise in food demand across continents. Population growth and change in food consumption patterns are the two key drivers. The UK Food and Agriculture Association estimates that the world population will increase by 47%, to 8.9 billion by 2050. That's a huge food marketplace. Global agriculture must double in the next 30 years to sustain this type of population growth. It is imperative to ensure sustainable food production and supply to adequately serve local and global needs. Additionally, there is little arable land in the world. The result is that existing producers need to focus on smarter, better and more efficient growing in order to meet demand.

Considering these challenges, countries around the world are looking for technological solutions to optimize agriculture processes, improve efficiency, boost productivity and get products to market faster.

INDONESIA AGRICULTURE

Indonesia's agriculture sector has long been an important source of income for local households and has also contributed much-needed export revenue. The sector has historically served as a pillar of the Indonesian economy contributing 13% of GDP in 2016. Agriculture plays an important role in Indonesia's efforts to improve food security, reduce poverty, and promote inclusive growth. Agriculture employs 39 million people (almost one-third of the total workforce) and is the main source of employment in rural areas. In March 2017, about 13.9% of the rural population was classified as poor, compared to 7.7% of the urban population.

Figure 5. 25 PSAUER launched by President Joko Widodo (11 April 2016)

Source: Deputy Assistant for ICT and Utility

However, productivity in agriculture is still very low. Efforts to boost agricultural productivity include increasing smallholder yields, focusing production on high-value crops, developing agro-industry, and reducing post-harvest and value chain waste. Agriculture in Indonesia is dominated by smallholder farmers who face challenges in increasing productivity and commercializing their produce.

Due to limited processing capacity, much of the nation's commodities are exported as raw materials which means that potential spoilage of perishable items from the farm or fishing port to the customer is a challenge.

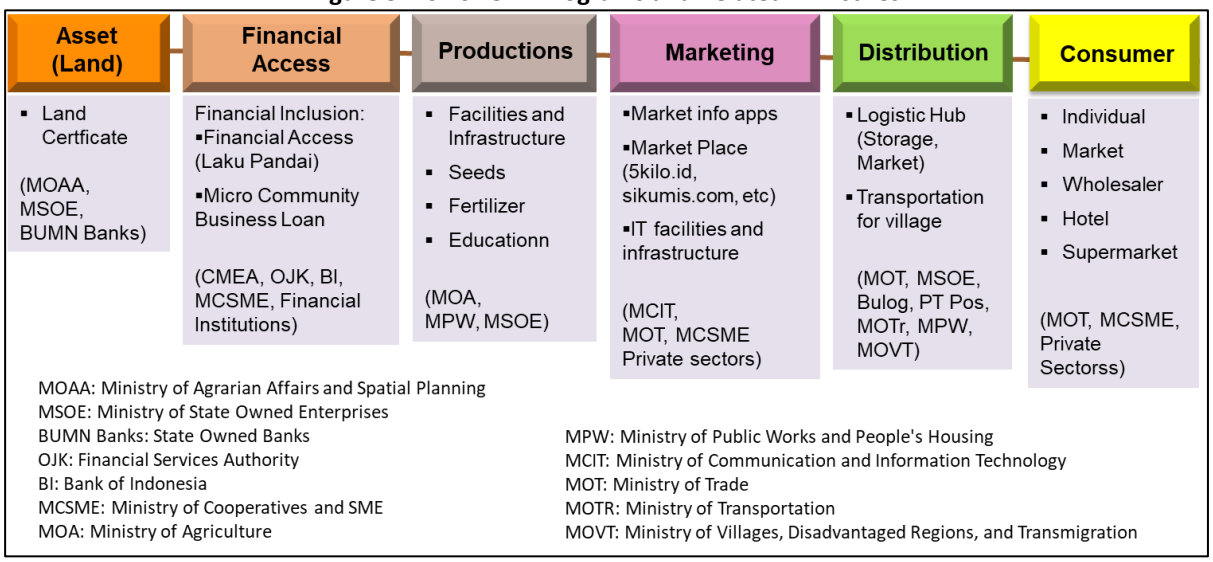
Indonesia Agriculture Experience:

Indonesia's economic growth over the past five years has been quite good amid the global economic downturn. The Central Bureau of Statistics has reported that Indonesia's economic growth continued into the third quarter of 2017 with an increase of 5.06%. The economic growth was evenly distributed, with the exception of government spending.

In terms of expenditure, economic growth was mainly driven by LNPRT Consumption (8.49% YoY), Gross Domestic Fixed Capital Formation (5.35% YoY), and RT consumption (4.3% YoY). The Information and Communications ICT sector and Services sector also achieved economic growth of 10.88% YoY and 8.63% YoY respectively.

The growth of Information and Communications can also be seen in the Agriculture Sector through the introduction of ICT solutions. Recently, Ministry of Villages, Disadvantaged Regions, and Transmigration of the Republic of Indonesia introduced Smart Farming 4.0 in commemoration of National Farmers' Day on September 24, 2018, at Situbondo, East Java [Direktorat Jenderal Pembangunan Daerah Tertinggal, 2019]. The technologies used include Agri Drone Sprayer (pesticide and liquid fertilizer drones), Drone

Figure 5. 26 PSAUER Programs and Related Ministries



Source: (Deputy Assistant for ICT and Utility)

Surveillance (drones for land mapping), and Soil and Weather Sensors (ground and weather sensors).

These solutions can support an increase in the national economy and therefore should not be underestimated. As one of the largest economies in the world, supported by a large population, Indonesia has become a new economic power at regional and global levels. The ICT sector increasingly plays an important role in economic development and becomes an integral part of the national strategy.

Therefore, in order to improve national economic development, the Action Synergy Program for the People's Economy (PSAUER) was launched on April 11, 2016, by the President of Indonesia supporting the Agribusiness Sub Terminal (STA) of Larangan Village, Brebes Regency, Central Java. PSAUER is a government program that aims to improve the standard of living of farmers, fishermen, SMEs, and alleviate poverty in reducing economic inequalities with the scope of Assets (land), Access to Finance, Production, Marketing, Distribution, and Consumers. This program is also intended to improve ICT literacy to farmers so that in the future digital and economic equality can be realized. This program is a collaboration between Ministries, OJK, BI, Brebes Regional Government, and BUMN. Based on the results of the coordination meeting, held on February 21, 2017, it was agreed that Jagalempeni Village would be a PSAUER pilot project. PSAUER Achievement Summary is described as follows.

Land Asset

1. 1050 land certificate in Brebes has been issued in Brebes district, and in Jagalempeni 210 certificates.
2. The utilization of land certificates for capital is not considered to be the maximum, so it needs further coordination with the banks.

Financial Access

1. Bank of Indonesia (BI) operate Onion Training Center, for learning onions farming: land preparation, processing, seeding, maintenance, harvesting, storage (fumigation, mini cold storage, CAS, Instore drying, oven, product / processed diversification.
2. BI Tegal plan to distribute onions produced in Brebes to Pasar Jaya Jakarta.
3. The farmers have also cooperated with PT. Pura Barutama, Kudus, to find a new way of storage (up to 6 months).
4. BI also has 9 other farmer clusters and now doing testing the solar cell-based pest control and organic fertilizer for the use of 5 tons.
5. A proposal that the reference letter based on a Family Registers Letter (KK) integrated with the Single Identity Number (NIK) can be used for

Micro-Community Business Loan (KUR) application. Besides that, OJK will maximize the Regional Financial Access Acceleration Team (TPAKD) to improve branchless banking services and access. Lakupandai Program Assesment result shows that financial education program is going well.

6. OJK is also seeking other alternative loan services not only through Micro-Community Business Credit (KUR). OJK is also conducting a study of onion farmer insurance. In addition, a collaboration for collecting and selling the harvest for Jagalempeni village.
7. The Central Java Provincial Government has issued Farmer Cards (Kartu Tani) and distributed them to the 22 Regencies and the rest are targeted by the end of 2017. The implementation is targeted for 2018 so farmers can buy subsidized fertilizer. However, BNI also issued a special card for onion farmers. So, there is a dualism of farmer cards.
8. At present, 4914 Micro Small Enterprises (UMK) permits have been approved and 842 cards have been issued in Kab. Brebes. Besides that, there are also 2 cooperatives in Jagalempeni village. There are approximately 200 products marketed through online media through Nurbaya. The local government is also building e-commerce for SMEs, namely sadewamarket.cyberukm.com.

Production

1. For 2017, there are 6 granted pieces of equipment in Jagalempeni: 2 cultivators, 2 water pumps, and 2 hand spray for onion cultivation.
2. An insurance company makes compensation for crop failure 425 Ha of land.
3. Recommendation to make onion supply chain in Brebes to maintain the onion price stability.

Marketing

1. The onion price in Brebes can be monitored using the SiHati application. BI has made an application so farmers can sell their products freely through the internet.
2. To facilitate the preparation of financial statements reports, BI has made an application SIAPIK (Accounting Information System for Financial Information Reporting) to learn the making of good financial reports. Training has been conducted in Semarang.
3. Communication and Informatics Service of Brebes Regency has installed an internet network in the Jagalempeni village hall so that it is expected to be able to help farmers and residents of Jagalempeni to access internet. Education has also been carried out for farmers using the internet / computer.

Distribution and Logistics

1. National Logistic Agency (Bulog) has a onion warehouse but is still uses traditional method, while at present most onion is stored in Kudus, using a CAS (Controlled Atmosphere Storage System).
2. National Logistics Agency have bought total 45,711 kilograms of red onion. Bulog hopes that PSAUER will not only play a role in the production process but also in the distribution process.

Consumer

Figure 5. 27 Work Visit and Program Coordination Meeting of PSAUER in Brebes, 3 August 2017

Source: (Deputy Assistant for ICT and Utility)

1. Videotron has been installed in Larangan Agribusiness Sub Terminal. It shows contains information about commodity prices throughout Indonesia only. In the future, the videotron will be connected to the Farmer Information System so farmers can check the price at any time.
2. BI has provided onion slicing machines.

As the coordinator, the team of CMEA has conducted regular meetings with stakeholders especially with regent of Brebes Mrs. Idza Priyanti and Jagalempeni Village Official like Mrs. Maimunah, as shown in Figure 5.27. The team of CMEA also held several meetings in Padang. One of the meetings is attended by Professor Helmi from the University of Andalas, Mr. Masril Koto, the founder of Agri Bank in Agam, West Sumatera, an official from MCIT, and Agricultural and Fishing Solutions startup CEO (Figure 5.28).

AGRICULTURE DIGITIZATION

Agricultural Information System

The agriculture Information System is a centralized digital platform containing information about all aspects of agriculture e.g. Pests, Crop Information, Trade Prices, Farming Practices, Machinery Information, etc.

Agriculture e-Commerce Platforms

Digitalization of price information and online platform trading are set to play a growing role by enabling scattered producers to become organized for exporting. Farmers in lower-income developing economies are likely to be successfully integrated when online platforms are available locally and allow farmers to interact more directly, rather than having to trade through intermediaries. Platforms in agriculture also tend to be more successful when they provide a range of agriculture support services and systems (such as logistics, finance, insurance and provision of seeds and fertilizers) in addition to price information (Burrell and Oreglia, 2013). These platforms help producers bring products to market in smarter ways and connect directly with the end customers, allow producers to trade and track their stock and products.

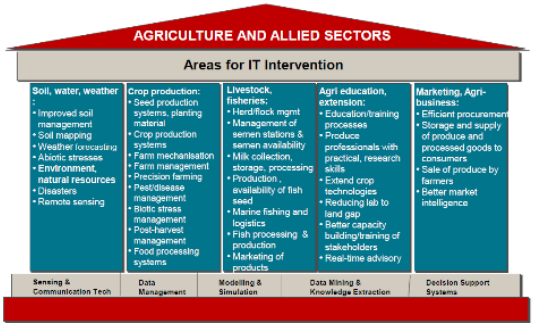
Precision agriculture has transformed farming thanks to big data analytics and IoT

Precision agriculture entails the use of digital technologies to optimize plant farming operation and boost production yield. Big data analytics and IoT have enabled precision agriculture, which provides productivity gains by optimizing the use of agriculture-related resources including; savings on seed, fertilizer and irrigation, as well as farmers' time.

Figure 5. 28 Meeting on Utilization of Information and Communication Technology (ICT) in Agriculture for Increasing Productivity in Padang, 15 June 2017

Source: (Deputy Assistant for ICT and Utility)

Figure 5. 29 Example: ICT in Precision Agriculture



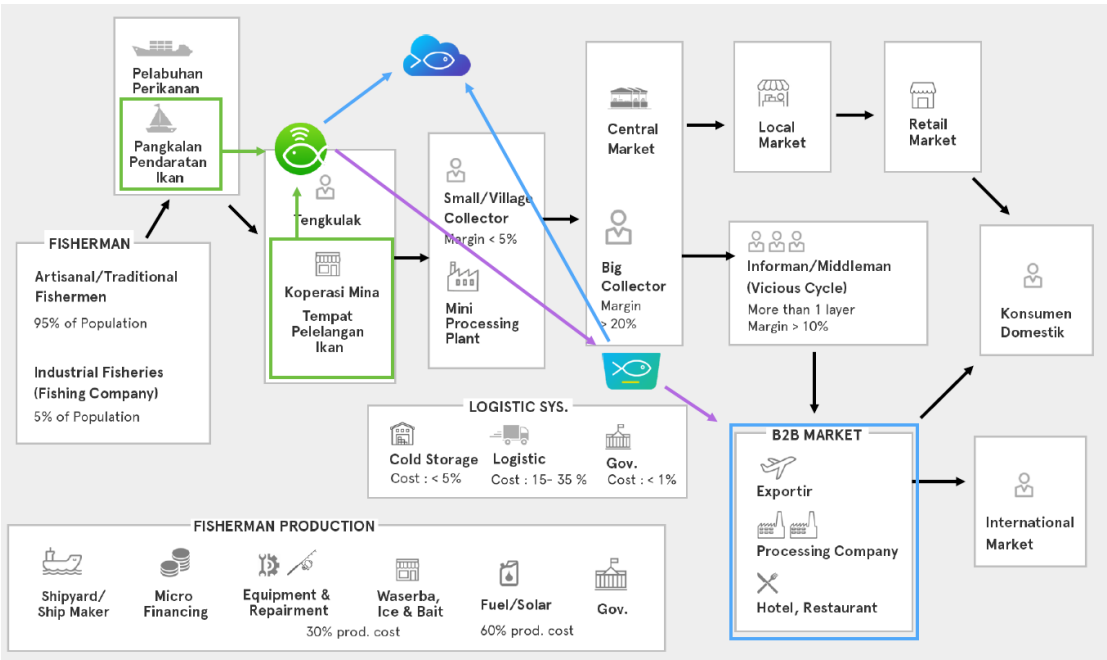
Source: (Deputy Assistant for ICT and Utility)

FISHING DIGITIZATION

In April 2019, through the Maritime Affairs and Fisheries Ministry, the government has introduced a program that includes training and workshops for at least 1 million fishermen in 300 coastal areas or cities around Indonesia [MCIT, 2019]. The program is supported by mobile phone-based application FishOn, offers useful features for fishermen, including Fish Finder, which helps them locate their catch easily; Panic Button to send an emergency signal to nearby fishermen for help, and Chat Messenger to send messages to friends or relatives while they are out at sea. The government plans to train at least 300,000 people through the program by the end of 2019. FishOn also collaborates with charitable institutions to help give fishermen access to capital and give them productive loans from state-owned companies through the microcredit program (KUR). State-owned companies will help ensure that the fishermen would be able to repay their loans. Through a marketplace called FishMart.id, the start-up company also enables fishermen to sell their catch at a better market rate than at traditional fish auctions.

Same with the Agriculture Sectors in PSAUER, the technology of ICT and applications also can be utilized for other sectors like fishing. One of the startups introduced by Deputy Assistant for ICT and Utility is ARUNA which has data management of fish prices and buyers, fisheries data intelligent system, and integrated online e-commerce for fisheries. ARUNA CEO Farid Naufal Aslam makes a presentation about the supply chain created by ARUNA as shown in Figure 5.30.

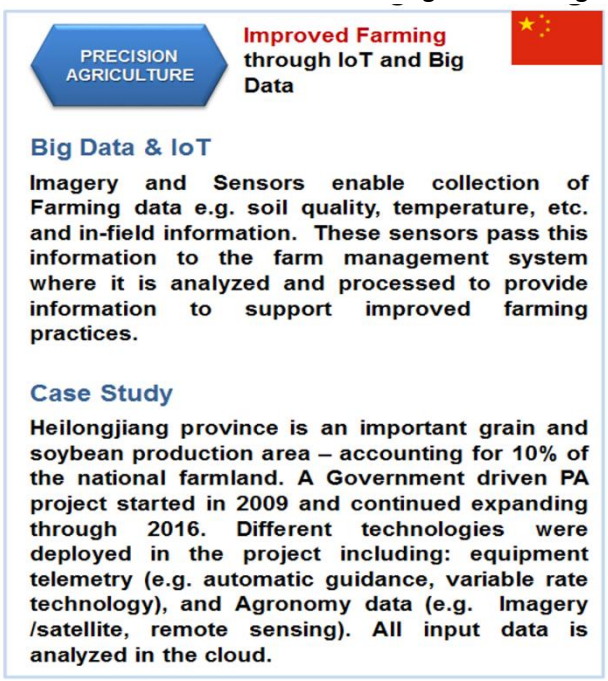
Figure 5. 30 Indonesia Fishery Supply Chains



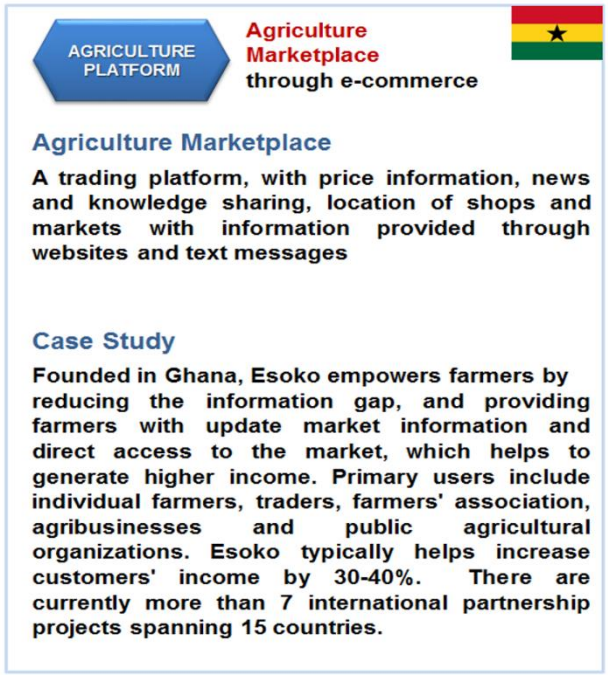
Source: ARUNA as presented on June 2017

E-AGRICULTURE CASE STUDIES

Figure 5. 31 E-Agriculture Case Studies



Source: (Asian Development Bank, n.d.)



Source: (Accenture)

AGRICULTURE DIGITAL MATURITY

Digital Maturity is based on the degree of digitization of an Industry. The core elements of digitization are Broadband, Big Data, IoT, Cloud, and Data Center. The below represents the digital goals for the Agricultural Sector

Figure 5. 32 Agriculture Digital Maturity

AGRICULTURE SECTOR DIGITAL GOALS	CONNECTED *Broadband, IoT*	INFORMATION ACCESS *Big Data, IoT, Cloud, Data Center*	APPLICATIONS & PROCESSES *IoT, Cloud, Data Center*
AGRICULTURE INFORMATION	Farms & Fisheries have access to smart devices that are connected to the Internet	All Agriculture Data (Pests, Marketing Pricing, Farming Methods, Weather) is digitized and available online	Business & Farm Management Apps are available online as a services through Cloud SaaS
AGRICULTURE E-COMMERCE PLATFORMS	Farms and Fisheries are connected and have access to e-Commerce Platforms	Farms & Fisheries have Online Web Presence/Site connected to e-Commerce Marketplace. Access to Information about Transport Schedules	Digital Marketing Tools E-Commerce Marketplace Logistics & Support Systems
PRECISION AGRICULTURE	Smart Sensors (Environmental, Livestock, Geographic) and Machinery are connected to IoT Network	Sensor and Machinery Information is captured and analyzed through Big Data Cloud based PaaS Platform	SaaS Cloud based Farming Applications associated with the data collected from sensors e.g. Soil Sensors provide Information to Soil Salinity App

Source: (Deputy Assistant for ICT and Utility)

TOURISM DIGITIZATION

Tourism is one of the most prominent and fastest-growing industries in the world. Travel and Tourism is one of the world's largest economic sectors. It creates jobs, drives exports, and generates prosperity across the world. This sector is shown to account for 10.4% of global GDP and 313 million jobs, or 9.9% of total employment, in 2017.

"Inclusive growth and ensuring a future with quality jobs are the concerns of governments everywhere. Travel and Tourism, which already supports one in every ten jobs on the planet, is a dynamic engine of employment opportunity."

Gloria Guevara Manzo, President & CEO

World Travel and Tourism Council

2017 was one of the strongest years of GDP growth in a decade. This global growth transferred again into Travel and Tourism with the sector's direct growth of 4.6% outpacing the global economy for the seventh successive year with a string performance across Asia recover strongly.

INDONESIA TRAVEL AND TOURISM

As reported on the World Travel and Tourism Council (WTTC) Power and Performance Ranking 2018, Indonesia is ranked in 9 of the top ten countries. Indonesia is also in the top 20 fastest-growing travel destinations globally. Travel and Tourism is one of the priority sectors for development in 2018 Government annual work plan.

"I declare tourism as the leading sector. Tourism as a leading sector is good news, and all other Ministries must support tourism development". - President Joko Widodo -

In Indonesia, this sector is experiencing significant growth and in 2017 the industry grew by 22% against an average growth rate of 7% in ASEAN and 6.4% globally. The growth was a result of a 32% growth in sector investment during 2017; Foreign Direct Investment of USD 1,326.56 million and Domestic Direct Investment of USD 461.49 million.

The Ministry of Tourism has announced 10 new tourist destinations and branded theses to support the Wonderful Indonesia campaign, receiving 23 awards in 4 countries. The World Economic Forum ranked Indonesia 47th in brand performance ahead of Thailand 68th and Malaysia 85th. The objective is to attract 20 million visitors in 2019. In the long run, the destinations are expected to become alternatives for tourists, who today mainly visit only Bali. These 10 destinations need to be equipped with appropriate infrastructure; transportation links, accommodation, restaurants, tours, and smart destination/city services.

"Tourism is a new road, the fastest and easiest to break the chains of poverty, unemployment, and inequality that we faced for 71 years" - *Dr. Ir. Arief Yahya, Minister of Tourism* -

Figure 5. 33 2017 Indonesia Travel and Tourism

Source: (www.wttc.org)

Based on the World Travel and Tourism Council's assessment of Indonesia, in 2017 Indonesia Travel and Tourism's direct contribution to GDP was IDR259,583.0bn (1.9% of GDP). This is forecast to rise by 5.2% to IDR273, 159.0bn in 2018.

Travel and Tourism generated 4,585,000 jobs directly in 2017 (3.7% of total employment) and this is forecast to grow by 1.8% in 2018 to 4,668,000.

Travel and Tourism in Indonesia grew by 7.8% in 2018 – double the global growth average of 3.9. In 2018, Travel and Tourism contributed IDR 890,428 billion (USD $62.6 billion) and created nearly 13 million jobs [WTTC, 2019]. In total, international tourists spent nearly IDR 221,000 billion (USD $15.5 billion) in Indonesia last year, accounting for 6.8% of total exports. Combined with domestic spending, Travel and Tourism supported 6.0% of the nation's GDP in 2018.

Priority Programs for 2018

Digital Tourism

- 63% of all travels, searched, booked, purchased and sold online
- 50% of all online travel sales involve more than 1 device
- More than 200 reviews per minute posted on TripAdvisor

Homestay:

- Ministry of Tourism contributes to the development of 100 thousand homestays as part of the 1 million home program
- President Widodo plans to develop a rural tourism concept

Air Accessibility:

- Air Connectivity is the success factor to push international visitor growth because 75% - 80% of international tourists arrive with air transportation.

TOURISM DIGITIZATION

As destinations and nations compete to attract tourists and travelers, they are turning to e-Tourism Information and Communications Technologies to provide a high-quality customized tourist experience and deliver competitive differentiation over other destinations.

For Tourism Businesses, the Internet offers the potential to make information and booking facilities available to large numbers of tourists at relatively low costs.

It also provides a tool for communication between tourism distributors and suppliers, as well as end consumers. The advent of Internet-based electronic commerce offers considerable opportunities for firms to expand their customer base, enter new product markets and rationalize their business.

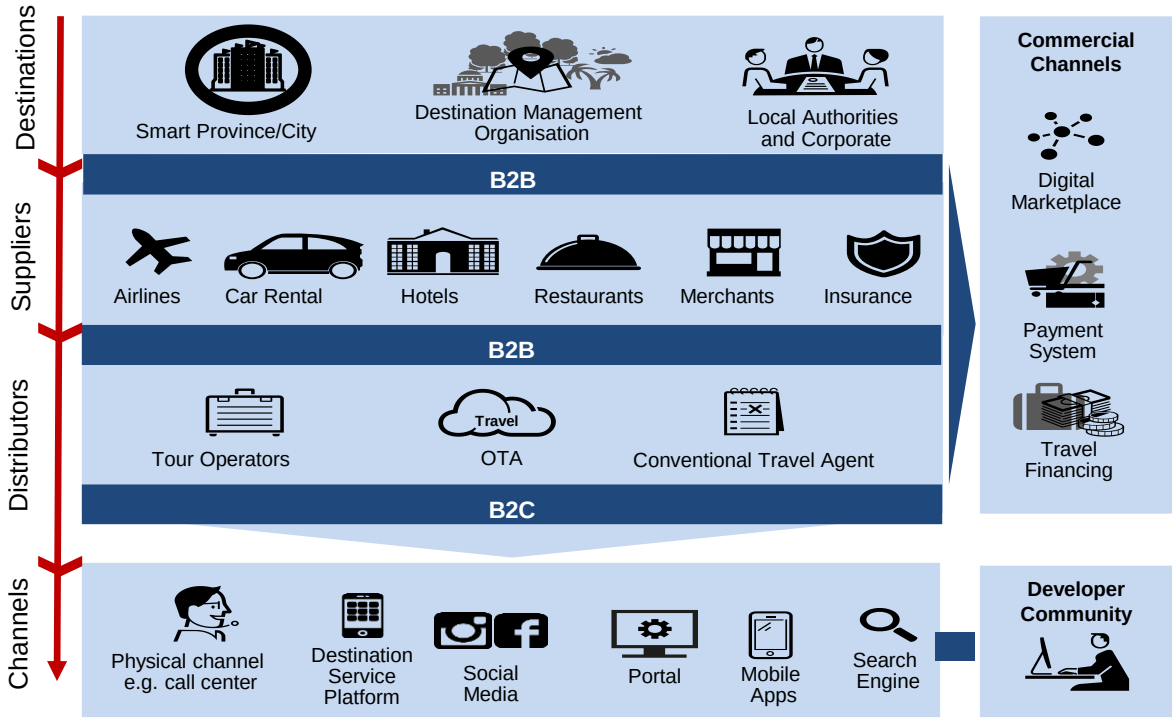
With the expansion of the Internet and Smart Devices, the Digital Online Travel Industry has flourished and today most tourists and travelers choose to utilize this online channel to arrange their travel and activities both before and during their visit.

However, the SME Tourism Businesses are facing challenges in the adoption of new information technology, particularly in areas of ICT affordability and skills relating to Digital Marketing and the use of ICT tools.

According to the United Nations “It is not the cost of being there, on the online market place, which must be reckoned with, but the cost of not being there.” It is certain that embracing digital communication and information technology is no longer an option, but a necessity. Thus, one of the most important characteristics of electronic commerce is the opportunity and promise it holds for SME Tourism Businesses to extend their capabilities and grow.

The Indonesian government was an early adopter of digital information systems to promote tourism. The Ministry of Tourism dedicated 30% of its 2016 budget to digital promotion with an objective of reaching 50% [Haxton, 2019]. The Ministry has developed a digital dashboard to monitor Indonesia's tourism reputation on social media on a daily basis (at national and destination levels). The system compares the country with its nearby competitors to assess its relative performance. In addition, mobile positioning systems are utilized to monitor the number and distribution of tourists. This information allows decision-makers to better understand visitor flows and perceptions, respond to issues as they arise and make better-informed marketing decisions.

In 2016 the Ministry launched Indonesia Travel X-Change (ITX), a digital platform as one-stop service for both trade and consumers to see, compare and book tourism products and packages covering the entire archipelago. It would also help opening international markets to local tour operators as they will be able to also sell online. The system also provides a booking and online payment system plus analytical tools and eases communication between sellers and buyers. However, it is still being developed and should be finalized quickly and advertised more widely.



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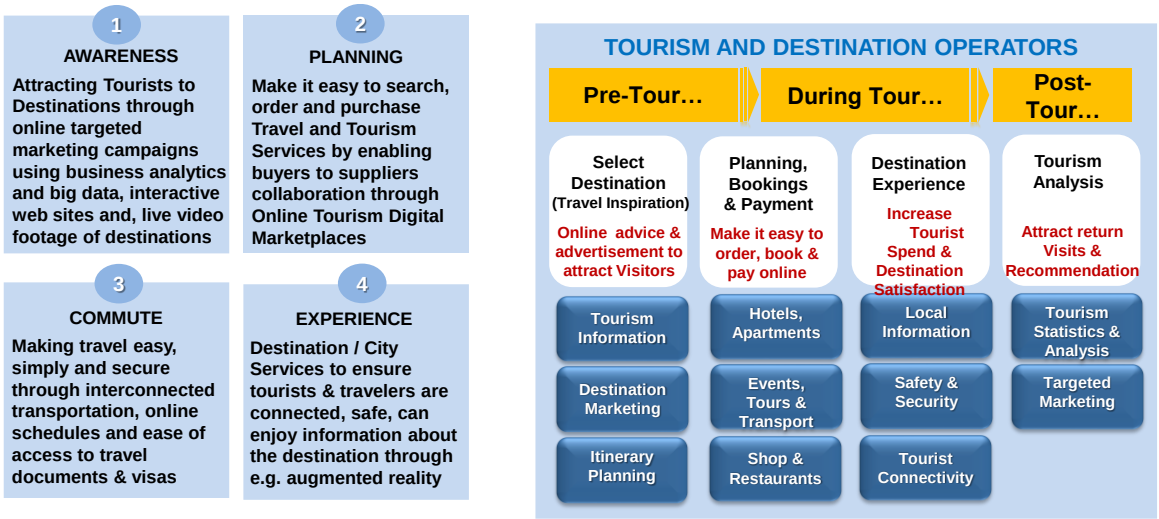
SERVICES TO ENABLE DIGITAL TOURISM

Services to enable e-Tourism are based on; Creating Awareness, supporting the Tourist or Traveler to plan their journey, ensuring the journey is easy to make and provide a superior experience while at the destination.



These services need to be offered in collaboration between National and Local Tourism Operators and the Destination City or Location to be visited. The core of e-Tourism, being e-Commerce, is specific to the Industry however the City Services may need to be aligned to Smart City Plans.

E-TOURISM CASE STUDIES

Figure 5. 34 E-Tourism Case Studies

Source: (https://atdw.com.au/)

TOURISM DIGITAL MATURITY

Digital Maturity is based on the degree of digitization of an Industry. The core elements of digitization are Broadband, Big Data, IoT, Cloud, and Data Center. The below represents the digital goals for the Tourism Sector.

Figure 5. 35 Digital Goals for Tourism Sector

TOURISM SECTOR DIGITAL GOALS	CONNECTED *Broadband, IoT*	INFORMATION ACCESS *Big Data, IoT, Cloud, Data Center*	APPS & PROCESS AUTOMATION *IoT, Cloud, Data Center*
DESTINATION AWARENESS	Tourism Operators & Local Government Officials have access to smart devices that are connected to the Internet	Destination Information (Travel, Sites, Tours) is digitized & online. Cloud Stored Real Time Information about locations (Live Video). Information on previous Visitors and their likes/dislikes.	Marketing Program Tools to generate online marketing campaigns Tour Operator Business Management Apps available online as a services / Cloud SaaS
TOUR PLANNING	Tourism Operators and Local Government Officials are connected and have access to Tourism Exchange / e-Commerce Platform	Tourism Operators have Online Web Presence/Site and Live Booking Information. This is connected to the Tourism Exchange to enable live Online Bookings and Payments by travelers & tourists	Apps associated with Destination and Trip Planning Tourism Exchange (Marketplace & Payment System)
DESTINATION COMMUTE		Travel Information is available Online e.g. Travel Documents/Visas, Transport and Transport Schedules	Online Visa Applications Destination Transportation Scheduling Applications
DESTINATION EXPERIENCE	Travelers & Tourists have access to local Information and the Internet while visiting the destination e.g. Local WiFi Access Destination Sensors / CCTV are connected to e.g. measure tourist activities & to provide security	Local Detailed Destination Information available online through Augmented Reality Tools e.g. Tourist Site Info. General Local Information available Online e.g. local restaurants, discount shopping, weather etc. Collection CCTV & Sensor data	Safe City Application Augmented Realty App Destination Apps

Source: (Deputy Assistant for ICT and Utility)

TRANSPORTS AND LOGISTICS DIGITIZATION

Like most industries, transportation and logistics are currently undergoing significant change predominantly through; globalization, new technologies, new market entrants, increased customer expectations, and new business models.

Customer expectations are increasing greatly, with individuals and businesses expecting to get goods delivered faster, more flexible, and at a reduced cost. This can only be achieved through the use of technologies that enable supply chain process automation. Digital enablement is a challenge for this sector which is generally lagging another sector. Increased competition from new entrants who are finding ways to carve out the more lucrative areas of the supply chain, is making it hard for traditional players to innovate. These new entrants are exploiting digital technologies and new sharing business models e.g. Uber-style approach without the legacy of the traditional transport and logistics operators.

Globalization and the proliferation of e-Commerce have without a doubt placed significant pressures of Transportation and Logistics Industries to standardize and innovate.

Image Source: JOC

INDONESIA TRANSPORT AND LOGISTICS

Roads, Seaports, Airports, and Rail upgrades are a critical priority for the government of Indonesia. The main aim is to lower transportation costs across the board, which are the highest in South East Asia, reduce congestion, and improve the sector's business and investment climate. Transportation is key to facilitating the smooth distribution of goods, enhancing economic linkages between the various islands and connecting the country to global value chains. Progress is being made on all fronts as infrastructure spend reaches an all-time high. There are numerous examples of infrastructure projects; Trans island toll road projects, upgrading of ports, completion of the new international airport terminal, regional airports to support tourism, bonded logistics centers, and high speed and commuter rail lines. These projects should support international and intra island connectivity as well as rising trade and growth in tourism.

But the harsh fact is that sea transportation has long been among the most inefficient industries in Indonesia, as most ports are poorly equipped and managed, and port handling is in shambles, making the country's logistics costs the highest in the ASEAN region. Almost 72 percent of logistic costs went to transportation. Logistics costs are a massive focal point as approximately 24% of Indonesia's GDP is spent on logistics. The government (CMEA) issued 13 logistics policy packages since November 2015. Featuring massive de-regulation policy, simplification of licensing procedures and cancellation of thousands of regional regulations impacting development, these plans are aimed at dropping logistics costs more in line with regional norms.

All these policies and investments have resulted in Indonesia's transport and logistics sector experiencing double-digit growth. Indonesia managed to rise sharply in the ranks of the World Bank's latest Logistics Performance Index (LPI). In the 2018 edition, Indonesia ranked 46th, up from 63rd in the preceding edition (in 2016), due to the massive construction in infrastructure, roads, and ports. A compound annual growth rate of 15.4% until 2020 has been predicted. However, Indonesia stills ranks below Malaysia, Thailand, India, and Vietnam, and it means that Indonesian products and services are not as competitive against their regional counterparts.

The Government is committed to making Indonesia into a regional "maritime axis" power in the Indo-Pacific region, reflecting the country's archipelagic identity; the need to develop marine resources, fisheries, ports, and other maritime infrastructure; and boost maritime defense of its territorial waters, outer islands and EEZs to address illegal, unreported and unregulated (IUU) fishing, piracy and other threats.

One of the key elements of the 2018 Strategic Plan is the Integration of Marine and Fisheries Center Program that is particularly focused on Transportation and Seaports

- Seaports (50)
- Fishery Ports (850+)
- Special Economic Zones
- Priority Industrial Areas – (8) Building new regional-based industries in the outer islands, closer to the export gateway

Key Challenges facing Maritime

- Unable To Track and Monitor Inventory
- Lost Revenue due to illegal tactics and Poor licensing Infrastructure
- Insufficient Port Facilities
- Lack of Data Sharing among Ports, Agencies, Fisherman
- Multiple Adhoc Systems

Upgrades needed to satisfy Major Projects (BRI and Sea Toll Road).

TRANSPORT AND LOGISTICS DIGITIZATION

In transport, digitalization can significantly improve traffic and transport management through more

accurate information on traffic and infrastructure conditions and on the location of transportation vehicles and/or goods. Better access to and sharing of digital transport (traffic, travel, vehicle, cargo, etc.) data for both public and private stakeholders along the supply chain can foster seamless information flows, and provide efficient delivery of goods.

- Shippers would benefit from better information on available transport services.
- Factories would have information on goods arrival time to optimize their inventory management and production.
- Logistics service providers would be able to optimize transport operations in real-time and to react to unexpected events
- Public authorities could benefit from more accurate and reliable information on infrastructure use and cargo, thereby contributing to better efficiency and operational safety of networks

To achieve an integrated logistics/supply chain will require collaboration between key industry players, policies and standards to enable online document exchange and exchange of data, as well as core digital solutions.

Key Digital Solutions

Port Management

- Port Management and Control
- Security - Vehicle ID, Video Surveillance
- Environment monitoring
- Port Communications - Voice, Video and Data

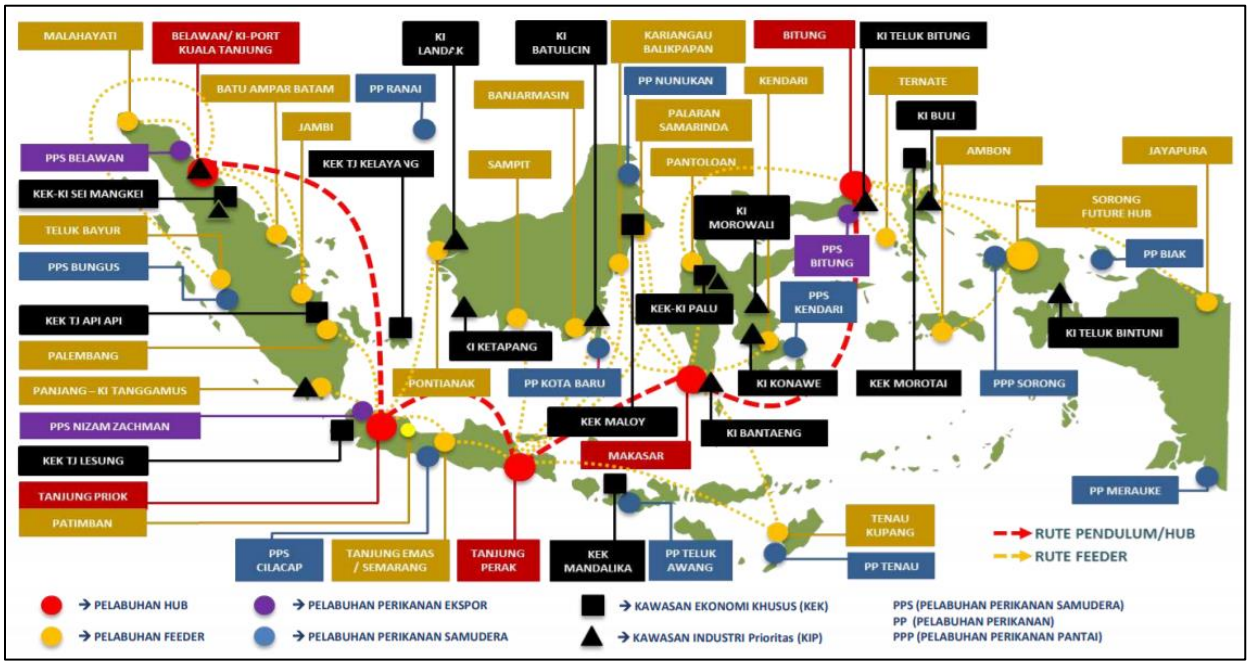
Customs

- Clearance Management
- Tariff Management
- Bonded Warehousing
- Anti-Theft and Smuggling

Integrated Logistics

- Inventory Management – Monitoring, Warehousing, Spoilage, Tracking, Theft
- Distribution Management
- Transportation Management and Automated Scheduling
- Transportation and Goods Tracking Logistics Planning

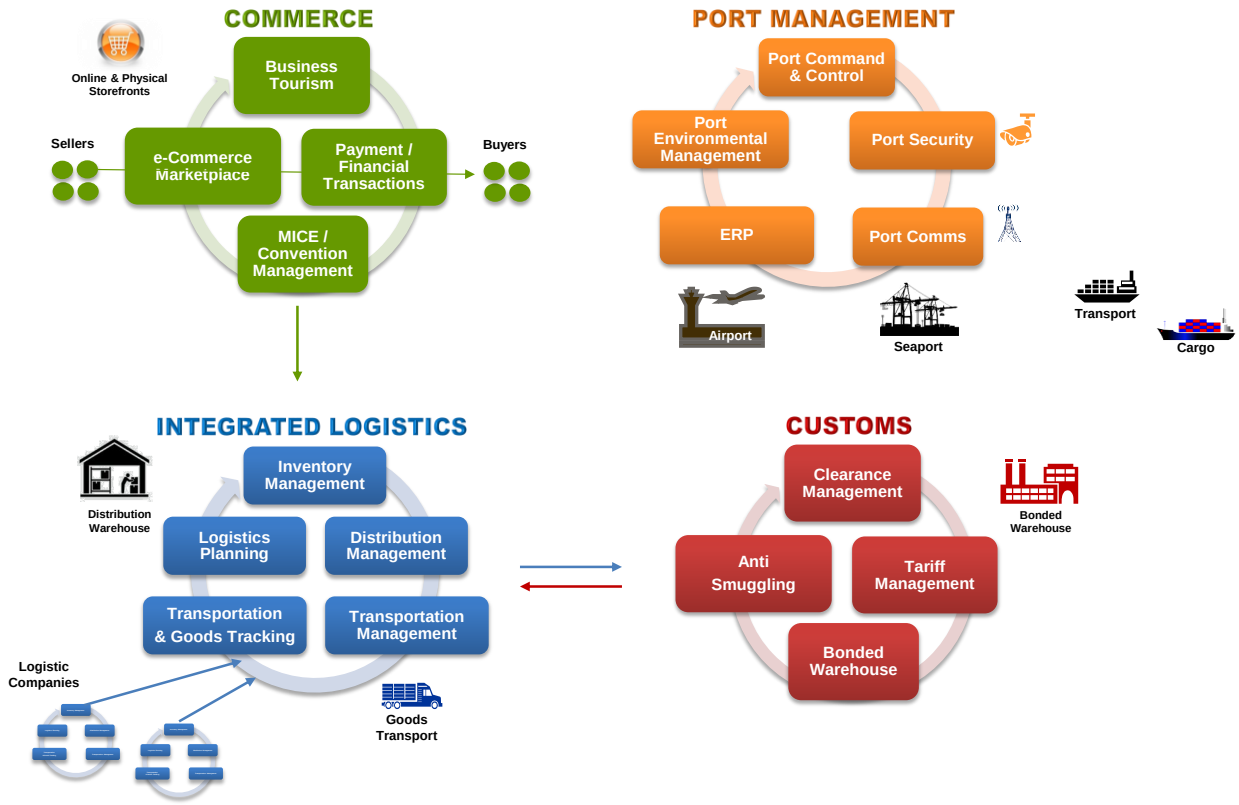
Figure 5. 36 Maritime Policy Development, Government Work Plan 2018

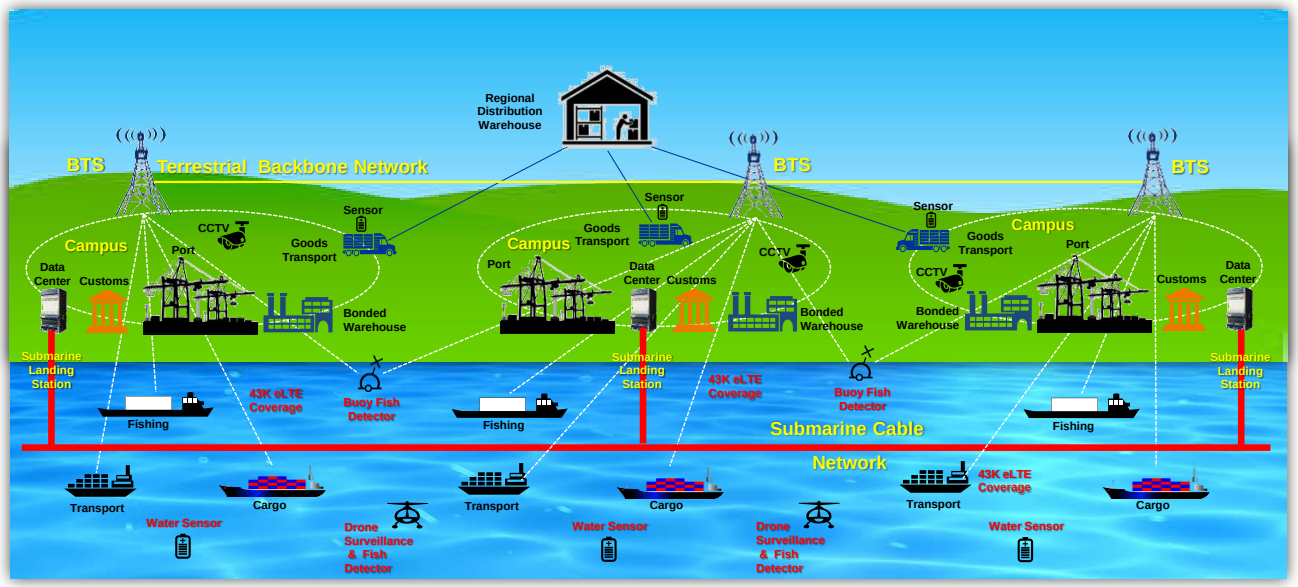


Source: (Bappenas)

Commerce

- e-Commerce Marketplace
- Payment and Financial Transactions and Settlement
- Business Tourism and MICE – provides a location for Indonesia SMEs to wholesale products to international and domestic buyers
- Additionally, the expansion of Sea Toll Roads is needed. Current Sea Toll Roads connect five major ports and 6 Economic Zones and numerous smaller ports
  - Belawan in North Sumatra
  - Tanjung Priok in Jakarta
  - Tanjung Perak, Surabaya in East Java
  - Makassar in South Sulawesi
  - Sorong in Papua
  - Economic Zones (8)





Source: (Huawei Maritime Solution)

TRANSPORT AND LOGISTICS CASE STUDIES

Figure 5. 37 Transport and Logistic Case Study

INTEGRATED LOGISTICS

Warehousing and delivery of goods through Supply Chain Systems

Integrated logistics / Supply Chain

Integrated Logistics are the process and digital tools to enable seamless management of goods from the warehouse to the end customer and includes; warehousing, tracking and management of goods, and transportation of goods.

Case Study

Starbucks has over 27,000 outlets worldwide. The coffee shop giant has been through its periods of supply chain pain with doubts about the company's ability to supply its outlets. With sales falling and supply chain costs increasing, fewer than 50% of outlet deliveries were arriving on time. After reorganizing their supply chain systems and logistics providers they achieved an annual savings of $500M with goods being delivered on time.

Source: (Morailogistic)

PORT MANAGEMENT

Port Command and Control Enabled through IoT & Command Center

Seaport Management

Command and Control capabilities to better manage incoming vessels and support for ship berthing is needed in a very busy port.

Case Study

The Port of Rotterdam is Europe's largest seaport, handling more than 461 million tons of cargo annually carried by more than 130,000 vessels. The port embarked on a journey to become the Smartest Port made possible by Internet of Things (IoT) which is used to streamline ship berthing operations for greater efficiency and safety. The guidance can reduce wait times, enable faster loading and unloading, and allow ships to come and go more quickly—and shaving an hour from the berthing process can save ship operators USD 80,000.

Source: (portofrotterdam.com)

CUSTOMS

Customs Management through agented reality using mobile devices

Customs Management

Integrated customs management systems are designed to support import and export processes, speed up transactions and reduce the costs involved in international trade. They improve compliance with the legal requirements that govern international trade, and facilitate greater cooperation in "Customs Processing".

Case Study

China's e-Port is a single window into all Custom Services i.e. online import and export declaration, online tariff payment, foreign exchange collection for export and payment for import, electronic account book for bonded logistic & processing, and certificate authority. It serves 472,000 corporations and 13 commercial banks.

Source: (Carecprogram.org)

E-COMMERCE

e-Commerce Platform enables online trading, buying & selling

e-Commerce Platform

e-Commerce Platform is a cloud based system that enables Digital Marketing, Online Selling and Purchasing of Goods through the online Marketplace and financial settlement.

Case Study

China's growth of e-commerce from AliResearch

- e-Commerce is more than 2X of total retail
- 1+ billion products are on sale and 100+ million new products are launched each month on the Alibaba retail platform alone
- 70% of parcels originate from e-commerce
- Express delivery covers 3,000+ counties as well as rural area
- I-consumers send or receive one parcel each week
- The public cloud computing reduces the computing cost by 70% and increases the efficiency by 300%.
- Alibaba retail ecosystem creates 30+ million jobs 316,000 disabled sellers on the Alibaba retail platform

Source: (Godigitalchina)

TRANSPORT AND LOGISTICS DIGITAL MATURITY

Digital Maturity is based on the degree of digitization of an Industry. The core elements of digitization are Broadband, Big Data, IoT, Cloud and Data Center. The below represents the digital goals for the Transport and Logistics Sector.

Figure 5. 38 Digital Goals for Transport and Logistics Sector

TRANSPORT & LOGISTICS SECTOR DIGITAL GOALS	CONNECTED *Broadband, IoT*	INFORMATION ACCESS *Big Data, IoT, Cloud, Data Center*	APPS & PROCESS AUTOMATION *IoT, Cloud, Data Center*
INTEGRATED LOGISTICS	Logistics Operators have access to smart devices that are connected to the Internet in order to provide logistics information to operators as well as employees for purposes of scheduling and tracking. Warehouses & Transport are connected to support IoT applications.	Data Standards and Exchange between logistics operators to enable end to end supply chain management. IoT to support fleet management, cargo tracking, warehouse inventory.	Inventory Management Distribution Management Transportation Management Transportation & Goods Tracking Logistics Planning
PORT MANAGEMENT	All Port staff are equipped with Smart Communications Video supported Devices and connected to the Port Network. CCTV and Sensors are connected to the Port Network to enable surveillance and environmental monitoring.	IoT to support streaming of ship berthing. IoT to support management of Port equipment. IoT supports CCTV footage sensor data collection,	Port Command & Control Port Security ERP Port Environmental Management
CUSTOMS	Customs Intranet supports secure access to Customs Services for Logistics Firms, Banks, Transportation Cos. etc.	Big Data Management of Customs Information.	Clearance Management Tariff Management Bonded Warehouse Anti Smuggling
E-COMMERCE	Internet Access for all e-Commerce Online Buyers and Sellers.	Cloud Services for SME Web Sites Big Data / Analytics for Digital Marketing	Digital Online Marketing Online Marketplace Financial Transactions & Settlements

Source: (Deputy Assistant for ICT and Utility)

SOCIO Development

Healthcare

Education

Financial

HEALTHCARE DIGITIZATION

The healthcare industry is going through a transformation, and to succeed in this increasingly competitive environment, organizations need to make significant investments in processes and technologies to cut down costs, increase access to care delivery, and improve medical care. Driving current healthcare trends are the costs of providing care and the outcome of this care.

KEY TRENDS IN HEALTHCARE DELIVERY

- Appropriate treatments are delivered at the appropriate time and at the right place for a given patient
- The whole of patient view with patient data in one, easily accessible place
- Clinicians use technology to more accurately diagnose and treat illness and deliver care
- All care delivery stakeholders across the ecosystem effectively and efficiently communicate and use information
- New, cost-effective delivery models bring health care to places and people that don't have it through telemedicine
- Efficiencies save money e.g. efficient management of pharmaceuticals

Global health care spending is projected to increase at an annual rate of 4.1% in 2017-2021, up from just 1.3% in 2012-2016. Aging and increasing populations, developing market expansion, advances in medical treatments, and rising labor costs will drive spending.

INDONESIA HEALTHCARE

State-driven developments, as well as activity in the private sector, are triggering impressive growth across the health industry. According to estimates from consultancy Frost and Sullivan, the value of Indonesia's health care market value will reach $21bn in 2019, up from $7bn in 2014.

One of the biggest challenges currently facing Indonesia's health sector is the shortage of doctors, nurses, technicians and other medical professionals available to fill its growing number of hospitals and clinics to support JKN. With demand for care increasing under the expansion of universal coverage, the human resource crisis is becoming more urgent. Technologies associated with telemedicine and personal health sensors can help alleviate issues with medical staff shortages by providing remote healthcare.

For effective diagnosis and treatment of patients, full medical information and historical records on the patients are essential. A National Health Information System NHIS provides the full history of a patient regardless of which hospital or doctor they have seen in the past. Electronic Health Records, which is the heart of the NHIS, can also be used for e.g. schools to understand if their pupils have been vaccinated, provide input to disease surveillance systems to monitor disease outbreaks, input into births and deaths systems as well as e–ID.

Smart Health Experience:

The Presidential Instruction Number 4, made in 2013, concerning the Decade of Road Safety Action Program for the fifth pillar of the Minister of Health which is responsible for improving pre-accident handling including, promotion and improvement of driver health in special situations and post-accident handling with Integrated Emergency Treatment System (SPGDT). The Minister of Health, Nila Djuwita F. Moeloek stated that the majority of regions did not care about handling emergencies within their communities. It was proven that only around 49 of the total 5338 Districts / Cities had established Public Safety Centers (PSCs) meaning only 7.4% of districts/cities in Indonesia which has emergency service facilities.

The Minister of Health stated that the PSC is part of a network of National Command Centers (NCC) that will provide 24-hour service to facilitate cases of emergency services and accelerate the rapid response to handling victims. Both are part of the Integrated Emergency Response System (SPGDT)

issued to reduce high mortality and disability in Indonesia, due to emergency cases.

Medical Emergency is an event that can happen to everyone. It can suddenly endanger lives and requires fast and precise handlers. In an emergency situation, an integrated and reliable information system is needed and should be used as a reference for emergency treatment, then an Integrated Emergency Response System (SPGDT) is developed.

SPGDT is a system for managing emergency patients consisting of elements, pre-hospital services and services in hospitals and between hospitals. Services are guided by rapid responses that emphasize time-saving is life and limb saving, which involves service by general and special lay people, medical staff, emergency ambulance services, and communication systems.

With the Integrated Emergency Response System (SPGDT), the public can call 119 call centers to get information services about which hospitals are best prepared to provide emergency services, advice for first aid and mobilize hospital emergency ambulance transport to pick up patients. Call center officers are doctors and nurses who have emergency competence. The SPGDT 119 aims to provide first aid medical emergency cases, provide referral assistance to available hospitals, co-ordinate medical treatment prior to patients receiving medical services in the Hospital.

Besides SPGDT, the Ministry of Health also has a program, the Puskesmas Information System (SIP). The Puskesmas Information System (SIP) is an order that provides information to assist the decision-making process for implementing Puskesmas management. Each Puskesmas is obliged to carry out the information system of the puskesmas both electronically and non-electronically. In organizing SIP, Puskesmas are required to submit reports on Puskesmas activities, on a regular basis, to the district/city health office. The Puskesmas activity report is a source of data from reporting priority health data held through data communication.

SIP currently accommodates family folders which are family files where data of each family member is recorded. The purpose of the family file is to determine the health condition of the whole family so that things can be easily traced such as diseases that can be genetically inherited or infectious. The Healthy Family Program which is currently being promoted at the Ministry of Health can be included in family files.

HEALTHCARE DIGITIZATION

Healthcare is evolving with the use of electronic health records and mobile healthcare applications. Health sectors across countries are undergoing a profound transformation as they capitalize on the opportunities provided by ICTs. Key objectives shaping this transformation include; improved efficiency, productivity, and quality of care. ICT is also essential to improving access to healthcare services, particularly in rural and remote areas where healthcare resources and expertise are often scarce or even non-existent.

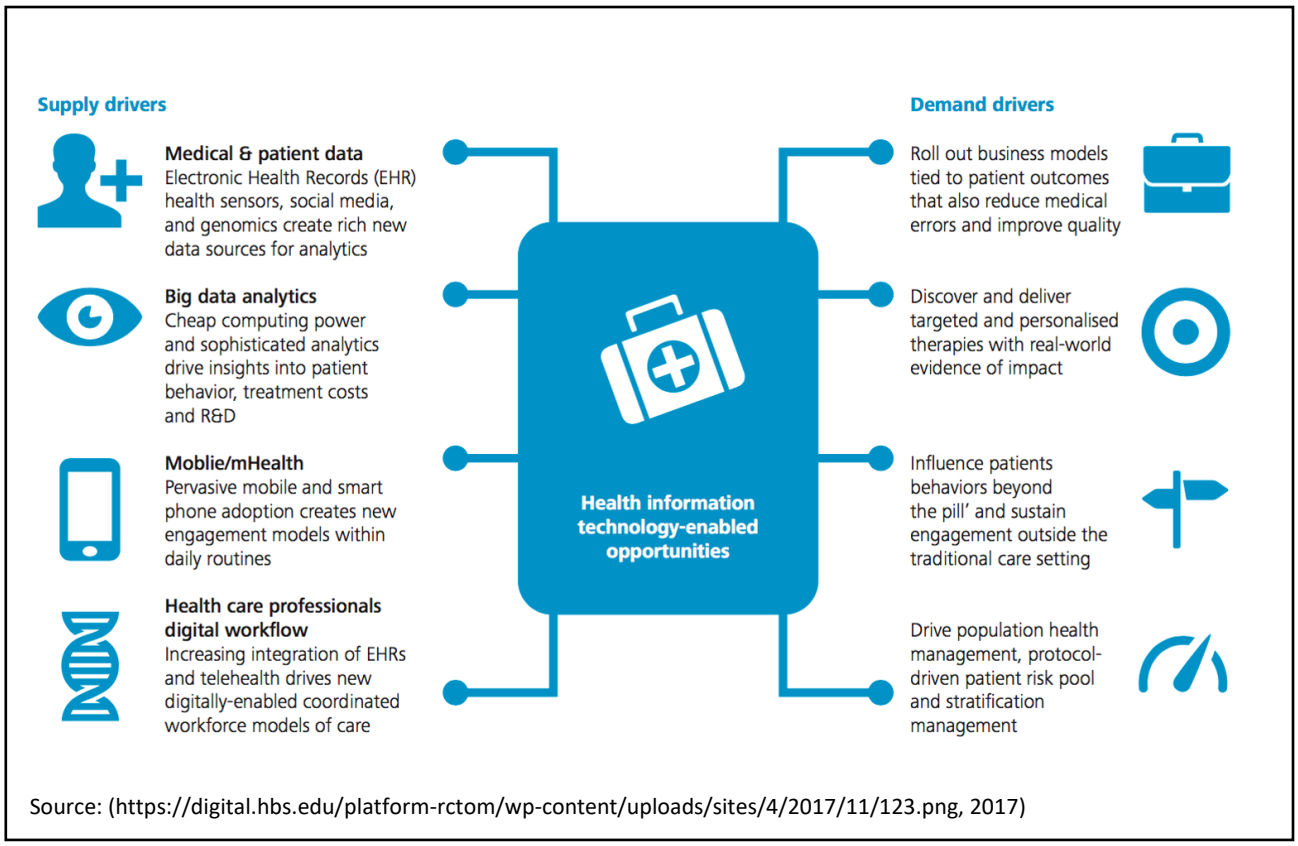
Electronic Health Records

Consolidated electronic health records provide the foundation for improved clinical patient management and disease surveillance.

The objective is to create a national-level EHR system that would allow comprehensive record-sharing within one “countrywide” system. This would be designed to support each patient having only one EHR providing clinical staff with a single view of the patient.

Implementing an EHR is a journey and requires standardization and integration of existing systems and translation of paper-based records into electronic format. Policies and standards need to be put in place today to make this journey much easier.

Figure 5. 39 The Mobile Health Platform



Source: (https://digital.hbs.edu/platform-rctom/wp-content/uploads/sites/4/2017/11/123.png, 2017)

Mobile Health

With an increasing number of individuals using smartphones and mobile devices, mobile health is the fastest-growing segment of ICT-based healthcare delivery systems. Mobile technologies offer a wide range of smart modalities by which patients can interact with health professionals or systems. These technologies provide helpful real-time feedback to support all aspects of healthcare from prevention to diagnosis, treatment, and monitoring. Since m-health services have low marginal costs and high availability, they have the potential to reach large numbers of patients between in-person clinical encounters.

This enables developing economies with geographical challenges to extend access to healthcare by using m-health. In 2015, the World Health Organization surveyed over 125 countries on e-health and m-health activities at the national level. Over 80% of these countries reported government-sponsored m-health programs.

However, the rapid proliferation of m-health pilots and the growth of health and wellness "apps" have emerged as significant challenges for policy makers. Firstly, many m-health projects and pilots were not designed to scale and were instead intended to demonstrate proof of concept leading to implementation issues and secondly, health and wellness apps, unless classified as medical devices, are today largely unregulated, creating concerns about their safety and effectiveness.

Ranking Adoption of m-Health Programs

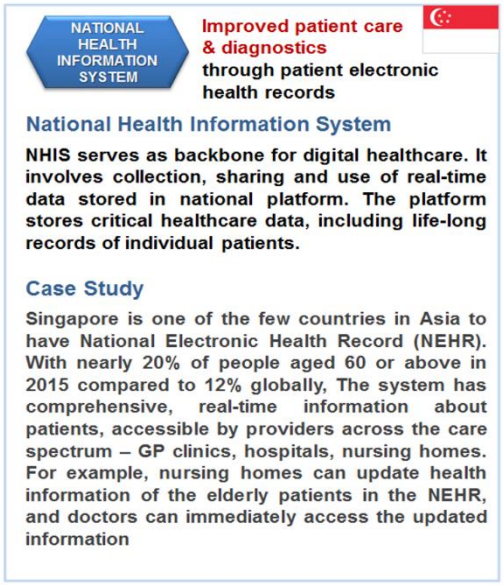
Table 5. 4 Ranking Adoption of m-Health Programs

1. Toll Free Emergency	6. Mobile Telehealth	11. Health Surveys
2. Health Call Centers	7. Emergencies	12. Treatment Adherence
3. Appointment Reminders	8. Patient Records	13. Surveillance/Safety
4. Community Mobilization	9. Machine Learning	14. Decision Support/Big Data
5. Information	10. Patient Monitoring	

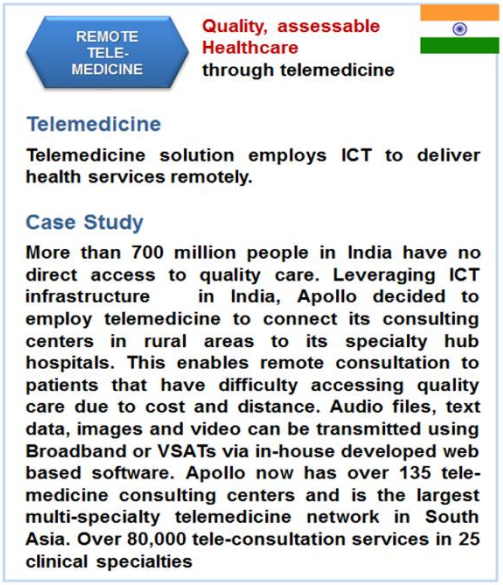
Source: (WHO, 2016)

E-HEALTH CASE STUDIES

Table 5. 5 E-Heath Case Studies



Source: (www.ihis.com.sg)



Source: (www.apollotelehealth.com)

HEALTHCARE DIGITAL MATURITY

Digital Maturity is based on the degree of digitization of an Industry. The core elements of digitization are Broadband, Big Data, IoT, Cloud, and Data Center. The below represents the digital goals for the Healthcare Sector

Figure 5. 40 Digital Goal for Healthcare Sector

HEALTHCARE SECTOR DIGITAL GOALS	CONNECTED *Broadband, IoT*	INFORMATION ACCESS *Big Data, IoT, Cloud, Data Center*	APPS & PROCESS AUTOMATION *IoT, Cloud, Data Center*
NATIONAL HEALTH INFORMATION SYSTEM	Health Professionals have access through the Internet as well as locally within healthcare centers to patient information	Consolidated repository of all patient information/ record e.g. previous illness and treatments, images, drugs etc. Other Hospital Information e.g. pharmacy, outpatients & inpatients	Hospital Applications: HIS, LIS, Pharmacy, Outpatients, Inpatients, Disease Surveillance. Hospital Applications may be linked to other applications to share data e.g. e-ID, Births & Deaths
REMOTE TELEMEDICINE	Remote Patients and Healthcare Professionals are connected to Treatment Centers Connection of Patients Personal sensors/IoT e.g. monitoring of blood sugar levels	Collection of patient information for storage in electronic patient records Collection of personal health data for sensors for analysis by a Healthcare Professional	Telepresence & Video Conference Apps IoT Apps associated with various healthcare sensor devices e.g. Blood Sugar App

Source: (Deputy Assistant for ICT and Utility)

EDUCATION DIGITIZATION

For every country in the world, Education is paramount. Having a skilled labor force directly impacts a nation's GDP and subsequently increases living standards. It is no longer a privilege to be educated it's a requirement to get that job and build a better life.

Student numbers are on the increase. In emerging markets, it is anticipated that the number of students enrolling in higher education with double over the next decade. This will place significant pressure on today's education environment – more teachers, more campus, and better ways of providing education.

Until recent times education has remained largely unchanged since its inception. Traditional schools, libraries, and teachers held the key to all knowledge. Now, knowledge is open to anyone globally with a device and connectivity. Schools and campuses will of course remain, but digital technologies will

transform the way education is delivered and accessed

- Bringing the University to the device — MOOCs (Massive Open Online Courses) and the rise of online learning
- Bringing the device to the university — the use of digital technologies in campus-based learning, Blended learning

Unfortunately, in some of the Asia countries, the education divide has increased significantly as urban centers quickly adopt ICT while it remains out of reach for rural and remote regions. With this in mind, ICT in education in Asia can be viewed from two very different perspectives.

- The role of ICT in eliminating the digital divide by reaching the unreached and providing support to those who cannot access essential infrastructure, trained teachers and quality educational resources.
- e-Learning paradigm where ways of teaching and learning are evolving at a rapid pace to foster learner-centric educational environments, which encourage collaboration, knowledge creation and sharing.

HOW ICT IS EVOLVING EDUCATION

UNESCO defines 4 phases in the evolution of ICT in education. This evolution from traditional teaching approaches to a more student-centric approach.

Every 3 years the OECD releases its Program for International Student Assessment (PISA) Report. The survey covers 15-year olds from 72 countries focusing on mathematics, science reading and problem solving to judge how well the students apply their knowledge. Indonesia ranked below the OECD average for science, mathematics, and reading, and behind many of its neighbors including Malaysia, Thailand and Vietnam. However, Indonesia has

- Teachers and schools using ICT to support their day to day activities – course material, administration activities
- Enhancing traditional learning by adapting the curriculums to incorporate e.g. Online Knowledge Research – using the internet to support project research
- Facilitate Learning by embedding ICT into the curriculum – remote learning
- Open Learning Environment – e-Learning

INDONESIA EDUCATION

Today Indonesia has over 3 million teachers and 50 million students studying at more than 300,000 schools nationwide. Student numbers are on the increase which will place stress on school capacity and teaching staff.

In 2016 private schools accounted for approximately 36% of the student body, an increase from 2000 which was 29%. Demand for private education is mostly prevalent in the tertiary level. Of approximately 4,000 colleges and universities in Indonesia, 70% are private.

Private schools continue to offer a higher level of education and are leading the way with integrating digital technology into the classroom.

To ensure inclusive and quality education for all, as well as promote lifelong learning, investment is needed to improve the quality of education in more affordable public schools.

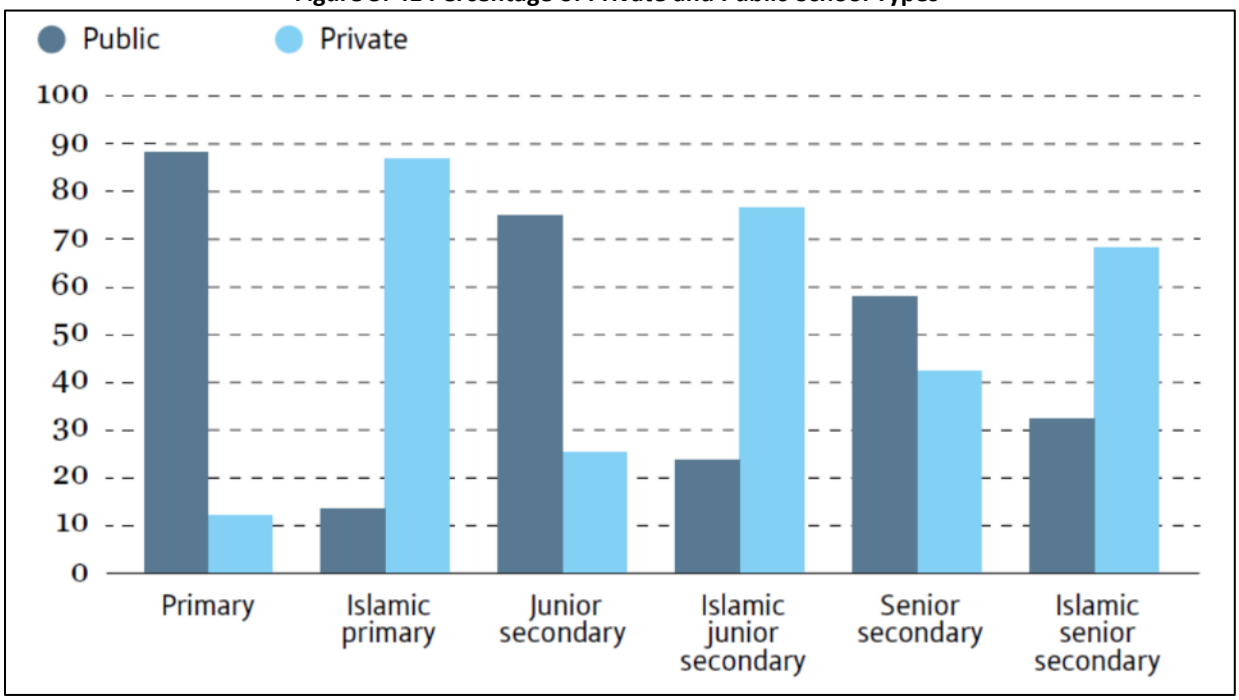
Percentage of Private and Public-School Types

improved over previous years due to improvements in teaching quality and access to technology

Education Technology in Indonesia

While e-Learning is starting to gather pace, however growth slow due to a lack of uncertainty about the national strategy and policy for the use of technology in supporting education.

Figure 5. 41 Percentage of Private and Public-School Types

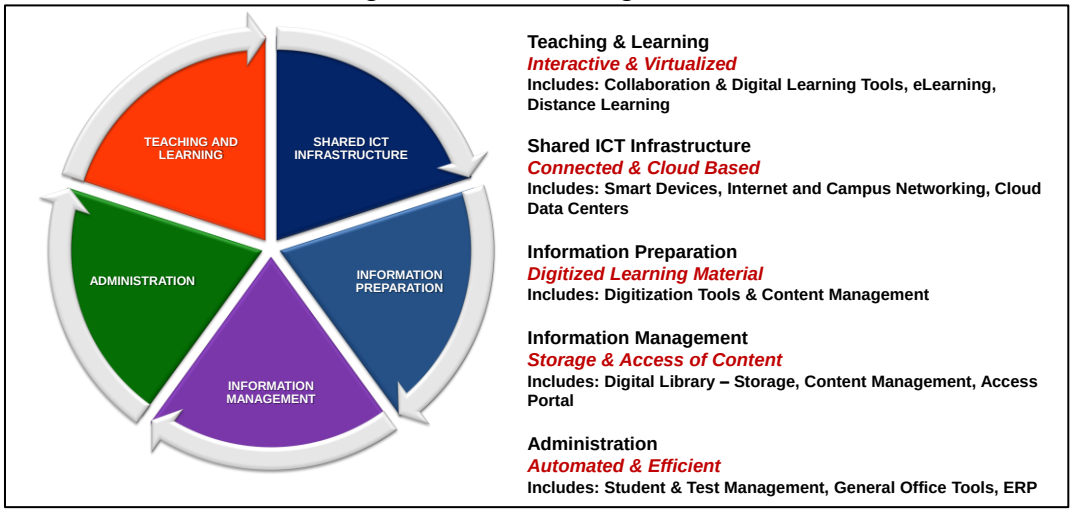


Source: (Center for Educational Data & Statistics & Culture)

EDUCATION DIGITIZATION

There are 5 key areas for ICT investment in the Education Sector

Figure 5. 42 Education Digitization



Source: (EDUCAUSE)

Shared ICT Infrastructure

It starts will providing students and teachers with access to smart devices that are connected to the Internet or a Private Network to enable collaboration and access to information and learning tools. Students and teachers should be able to access these tools regardless of their location; at school, around the campus, or at home. Shared Cloud-based Data Centers should be used to host these tools and information.

Information Preparation

As we move to an online learning environment books and all forms of knowledge information need to be digitized and stored online removing the need for physical books and libraries. This requires tools to enable digitization and a Content Management System to manage and publish the content.

Information Management

Management of this vast amount of Information will require the development of a Digital Library to catalog and store information and provide access through an online secure portal. Generally, Information Digitization and Management is centrally achieved by the bodies that support the curriculum development with access provided to each student, teacher, and school.

Teaching and Learning

Teaching and Learning includes all the tools to enable the new learning experience which would include;

- Remote or Distance learning to support remote students or to provide specialist education to multiple students. Through virtualized classrooms
- Collaboration Tools to enable student to student and student to teach communication. Innovations in wireless projection facilitate the ways learners and instructors exchange information from multiple devices, enhancing collaboration. Emerging commercial products now permit instant translation of writing on physical whiteboards into digital form.
- e-Learning Tools to support Online Learning as part of the delivery of the curriculum
- Artificial Intelligence is also emerging as virtualized teaching assistants

Administration

Administration includes all those activities needed to efficiently and effectively run the learning institution. These include; Management of Student Information and Tests, Financial and Administrative Management of the school, and general office applications.

EXAMPLE OF ICT TRANSFORMING EDUCATION

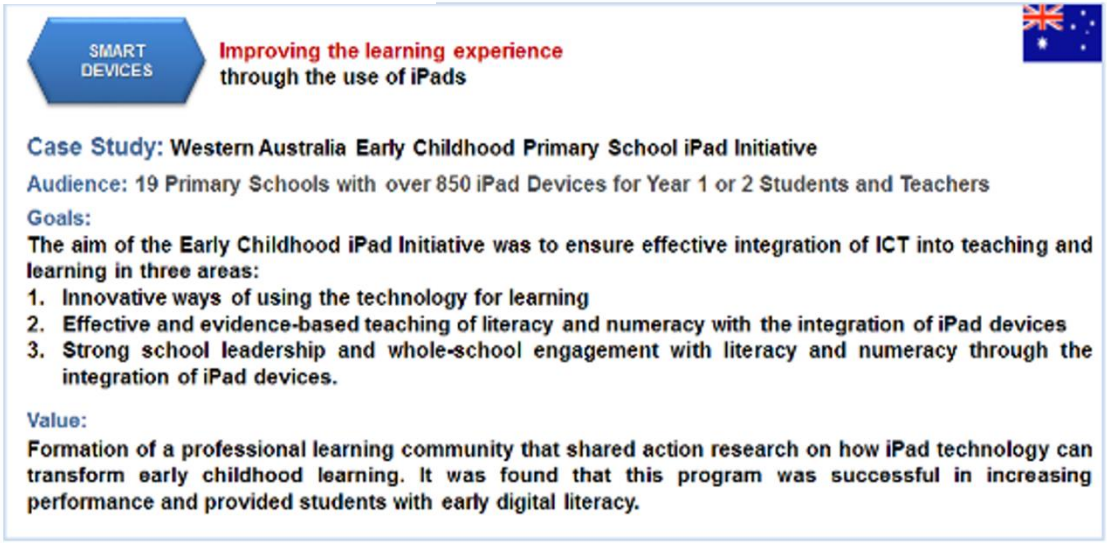
Figure 5. 43 Example of ICT Transformation Education

Source: ouchn.edu.cn

E-EDUCATION CASE STUDIES

Figure 5. 44 E-Education Use Case

Source: ouchn.edu.cn



Source: det.wa.edu.au

EDUCATION DIGITAL MATURITY

Digital Maturity is based on the degree of digitization of an Industry. The core elements of digitization are Broadband, Big Data, IoT, Cloud, and Data Center. The below represents the digital goals for the Education Sector.

Figure 5. 45 Digital goals for the Education Sector

EDUCATION SECTOR DIGITAL GOALS	CONNECTED *Broadband, IoT*	INFORMATION ACCESS *Big Data, IoT, Cloud, Data Center*	APPS & PROCESS AUTOMATION *IoT, Cloud, Data Center*
INFORMATION PREPARATION & MANAGEMENT	Teachers and Course Developers have access to develop Course Information	Information Collection, Digitization, Storage, Publication, Management and Access	Digitization Tools Content Management Digital Libraries Access Portals
TEACHING AND LEARNING	Students and Teachers have Smart Devices that are connected to the Public Internet through Mobile Communications and Private School Networks for the purposes of accessing information and learning tools. Students Teachers and Classrooms are connected to enable Virtual Classrooms through Video based communications for remote/distance learning and open online learning.	Curriculum, Courseware and Student Information	e-Learning Collaboration & Digital Learning Applications Distance Learning Tools e.g. Virtual Reality, Video Conferencing
ADMINISTRATION & SCHOOL MANAGEMENT	Teachers are connected to Administration systems CCTV Campus Monitoring	Curriculum, Courseware and Student Information CCTV Footage	Student Information & Results Testing General Office Apps School Administration/ERP

Source: (Deputy Assistant for ICT and Utility)

FINANCIAL DIGITIZATION

Financial Technology (FinTech) is the new technology and innovation that aims to compete with traditional financial methods in the delivery of financial services and is the digitization of the Financial Sector. The use of smartphones for mobile banking, investment services, and online and mobile payments are examples of technologies aiming to make financial services more accessible to the general public. FinTech companies consist of both startups and established financial and technology companies trying to replace or enhance the usage of financial services provided by existing financial companies. Many existing financial institutions are implementing FinTech solutions and technologies in order to improve and develop their services, as well as gaining an improved competitive advantage.

Global investment in FinTech increased more than 2,200% from $930 million in 2008 to more than $22 billion in 2015

GROWTH OF FINTECH

Europe

$1.5 billion was invested in FinTech companies in 2014, with London-based companies receiving $539 million, Amsterdam-based companies $306 million, and Stockholm-based companies receiving $266 million in investment.

- London has seen rapid growth over the last few years. According to the office of the Mayor of London; 40% of London's workforce is employed in financial and technology services
- Lithuania is starting to become a northern European hub for FinTech companies since Brexit. Lithuania has issued 51 FinTech licenses since 2016.

Asia Pacific

- Australia: FinTech Hub opened in Sydney in April 2015. According to KPMG KPMG, Sydney's financial services sector in 2017 created 9% of National GDP and is bigger than Hong Kong and Singapore
- Hong Kong: FinTech innovation lab was launched in 2015.
- Singapore: Monetary Authority of Singapore launched an initiative named Fintech and Information Group to draw in start-ups from around the world. It pledged to spend $225 million in the FinTech sector over the next five years.

INDONESIA FINTECH

The Indonesia FinTech Industry is fast growing due primarily to; the large population of 260+ million people the majority of which are under the age of 35, the growing of mobile phone and Internet penetration rates, over 50% of the population who do not have traditional bank accounts and credit cards, and a smaller number (17.2% of population) who have borrowed from financial institutions.

In 2016 there were an identified a total of 50 FinTech companies operating in Indonesia. In 2018 this number has greatly expanded to an identified total of 167 FinTech companies.

Status of Indonesia Fintech Market Segments

- The market's largest segment is Digital Payments with a total transaction value of US$22,427m in 2018. Expected annual growth rate (CAGR 2018-2022) of 13.5%.
- Total Transaction Value in the Alternative Financing segment amounts to US$4m in 2018. Expected annual growth rate (CAGR 2018-2022) of 62.8%. The market's largest segment is crowd investing with a total transaction value of US$3.1m in 2018.
- Total Transaction Value in the Alternative Lending segment amounts to US$38m in 2018. Expected annual growth rate (CAGR 2018-2022) of 59.9%. The market's largest segment is crowdlending (Business) with a total transaction value of US$26.4m in 2018.
- Total Transaction Value in the Personal Finance segment amounts to US$810m in 2018. Expected to show an annual growth rate (CAGR 2018-2022) of 33.2%. The market's largest segment is P2P Money Transfers with a total transaction value of US$796m in 2018.

The Indonesia market has also shown a considerable amount of growth with an annual growth rate of 16.3% and the total investment into FinTech companies of USD 176.75 Million in 2017.

Indonesia FinTech sector is primarily regulated by two main entities; 1) Bank Indonesia and 2) Otoritas Jasa Keuangan (OJK), a supervisory arm of the government to regulate the financial services sector. In the FinTech ecosystem, OJK oversees P2P Lending, Crowdfunding, Digital Banking, Insurtech, Fintech in Capital Markets, Online Financing, data security and of course consumer protection.

To develop the FinTech sector Indonesia Regulators have established programs including; setting up of the Fintech Office, the launch of the National Payment Gateway, the establishment of the Fintech Regulatory Sandbox, regulation for P2p lending

services. To date, there is already 40 P2p lending service registered with OJK.

FINTECH TECHNOLOGIES

There are 5 key technologies that will disrupt the financial sector

Blockchain

Blockchain is the underlying technology of digital currencies like Bitcoin that enables a digital ledger in which transactions made in Bitcoin or another cryptocurrency are recorded chronologically and publicly.

Augmented Reality (AR)

Some FinTech products already incorporate AR design features. For instance, The Commonwealth Bank of Australia and Halifax offer an app with features that give users the ability to immediately pull up block information about houses for sale that they see on the street. Other banks are leveraging AR solutions to make it easier for customers to find the nearest branch or ATM.

Artificial intelligence

An example of the use of AI is in Bank of America's Erica. While Erica can only be contacted via text or phone call, for now, the idea is that the chatbot will eventually offer customers 24/7 banking advice via a mobile app.

The objective is to improve and personalize customer service interactions. For example, AI could also be used as part of live transactions, automating payments for customers based on card data. Additionally, AI could also analyze a customer's payment history, automatically suggesting alternatives to improve product and service selling.

Mobile Networks and 5G

5G is set to transform mobile banking with higher data speeds and greater signal efficiency. Payment technology, in particular, could evolve rapidly with 5G, even penetrating the wearable market.

Smart data discovery through Big Data

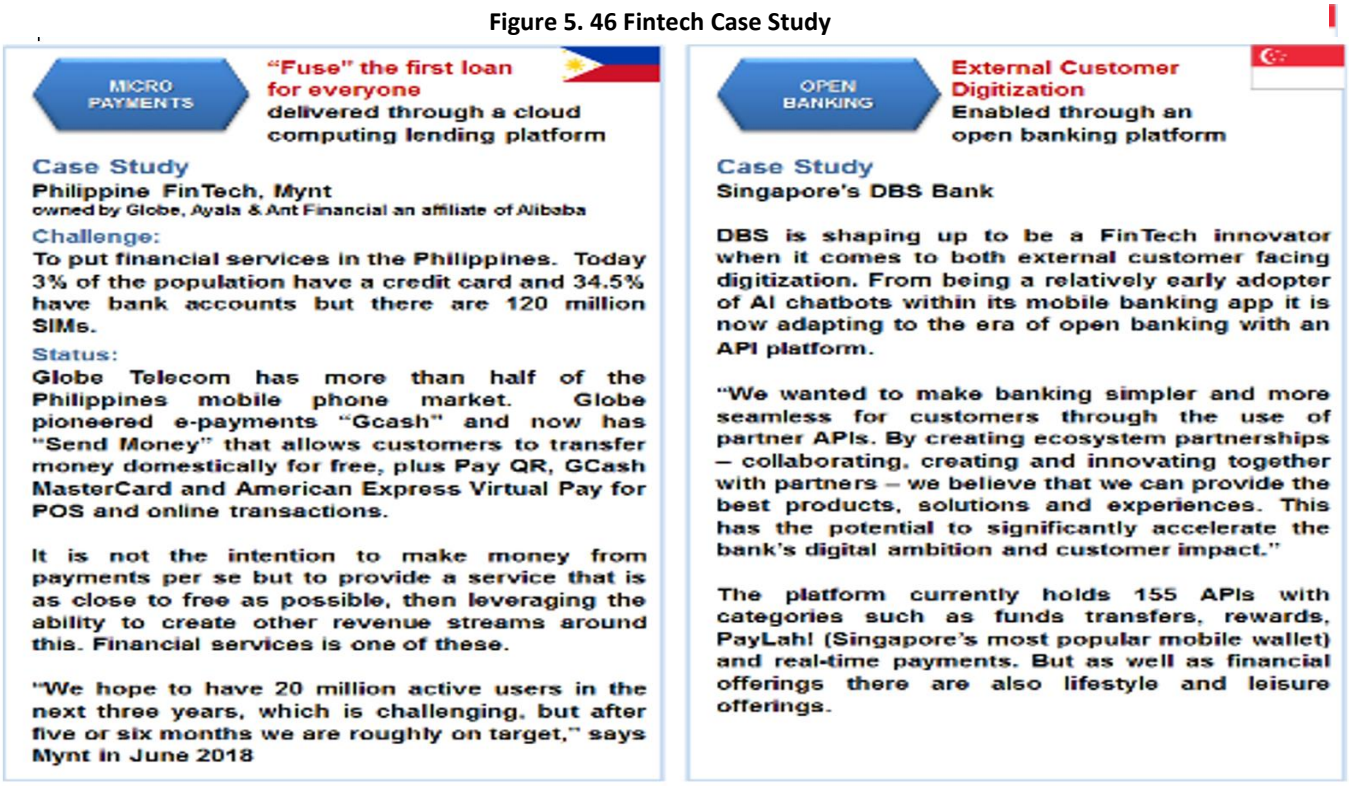
According to research analyst firm Gartner, smart data discovery will accelerate business intelligence capabilities and enable a new generation of data-driven decision making. For banks, this will mean a more accurate understanding of their customers.

FINANCIAL INCLUSION

SNKI or the National Strategy for Financial Inclusion is an advanced level of collaboration between the Government, Bank Indonesia and the Financial Services Authority (OJK) with banks to overcome the problem of a large number of Indonesian citizens who have not been touched by modern financial services. The government is trying to solve minimum banking services in Indonesia with Inclusive Financial Strategy that has been established by President Joko Widodo in a Presidential Regulation Number 82 of 2016 concerning the National Financial Inclusive Strategy. This regulation becomes a guideline strategic steps of ministries/ institutions to enhance economic growth, accelerate poverty reduction program, reduce inequality between individuals and between regions in order to realize the welfare of the Indonesian. National Strategy for Financial Inclusion (SNKI) will focus on six pillars: financial education, public financing facilities, financial information mapping, supportive regulations, distribution networks, and intermediation facilities and consumer protection. For further detail on Financial Inclusive program, please refer to www.snki.go.id

FINTECH CASE STUDIES

Figure 5. 46 Fintech Case Study



Source: www.techinasia.com

Source: www.dbs.com.sg

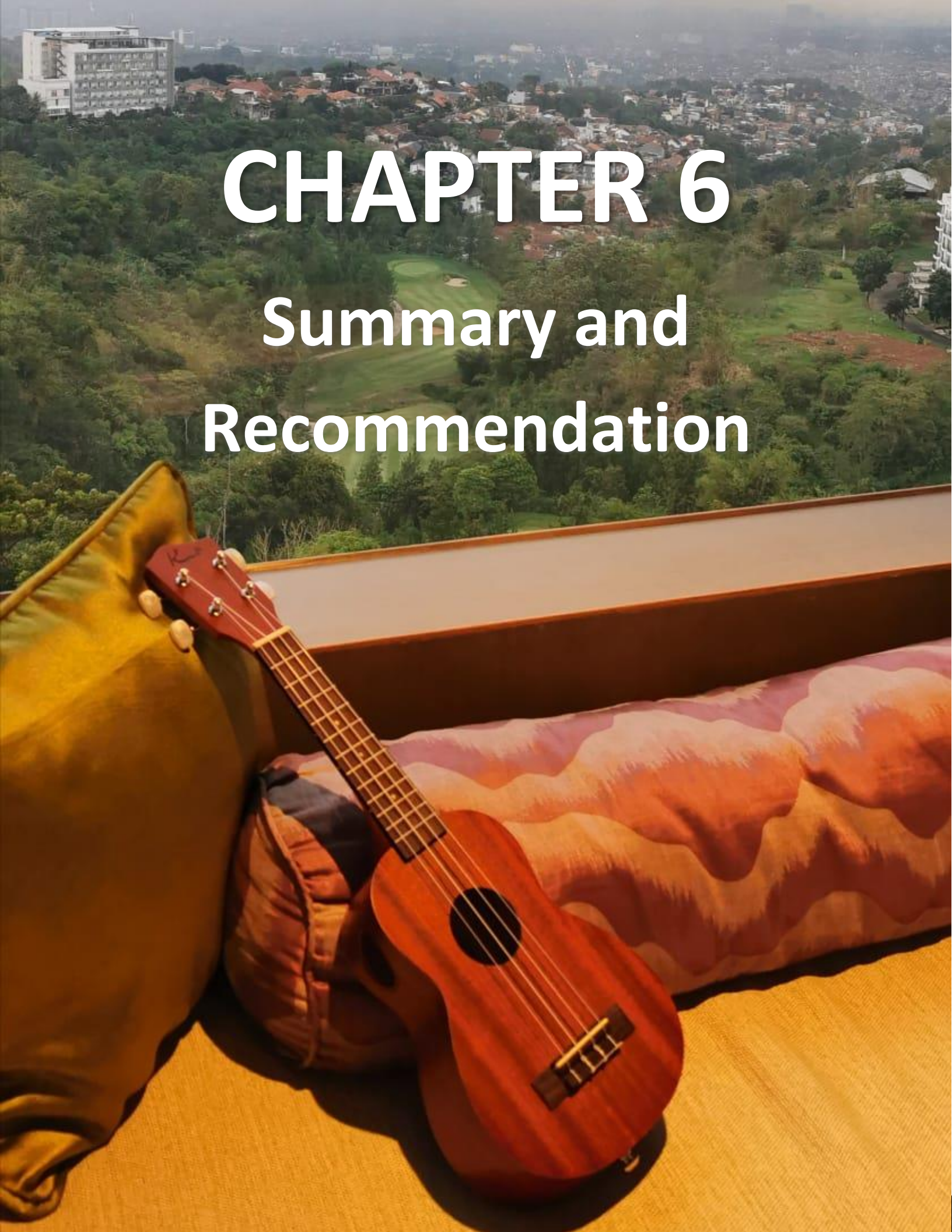
FINANCIAL DIGITAL MATURITY

Digital Maturity is based on the degree of digitization of an Industry. The core elements of digitization are Broadband, Big Data, IoT, Cloud, and Data Center. The figure below represents the digital goals for the FinTech Sector.

Figure 5. 47 Fintech Digital Goals

FINTECH DIGITAL GOALS	CONNECTED *Broadband, IoT*	INFORMATION ACCESS *Big Data, IoT, Cloud, Data Center*	APPS & PROCESS AUTOMATION *IoT, Cloud, Data Center*
DIGITAL PAYMENTS ALTERNATIVE & PERSONAL FINANCING ALTERNATIVE LENDING	Customer have smart devices and are connected to the Internet via Mobile or Fixed Networks to access FinTech Products New Consumer Devices "Wearables" support new FinTech Apps	Data driven decision making to support application of Augmented Reality, Artificial Intelligence, and general customer care and upselling of FinTech products Financial Information to support payments. Loans etc.	Blockchain Cryptocurrency Augmented Reality for e.g. viewing of real estate information Artificial Intelligence to enable improved customer care Financial Platform to enable Payments, Loans & all aspect of Financial Management

Source: (Deputy Assistant for ICT and Utility)



CHAPTER 6

Summary and Recommendation

Mobile Broadband (MBB)

Indonesia owns the largest digital market in ASEAN, the full release of the market vitality and combination of the connectivity, usage and demographic dividend accelerate this country's digitalization process. At the meanwhile, there exist challenges: spectrum shortage, low site density, Low Connectivity Performance, and lack of affordability on terminal devices.

To address these challenges, five readiness is recommended to improve and popularize MBB connectivity and services, and to build a digital society through the digitalization of individual anytime, anywhere.

- **Spectrum Readiness**: accelerate IMT spectrum release by selecting viable spectrum in total around 450MHz and phased operation, fueling digital economy development.
- **Site Readiness**: promote the site density by streamlined planning and administrative processes, Non-discriminatory access to public infrastructure, and open site standard for cross-industry infrastructure sharing, and maximize the spectrum value through encouraging site deployment.
- **Experience Readiness**: enhance the standards and regulations on digital service experience to establish regional leading MBB infrastructure, to encourage digital innovation and to expand digitalization to the whole country by universal service.
- **User Readiness**: encourage the introduction of entry-level LTE terminals cost below 3% of GNI per capita to improve the digitalization adoption and usage.
- **Service Readiness:** lead the provision of public services, which will help the industry to enrich and improve localized services and maximize the value of digital infrastructure.

Digital Indoor System (DIS)

Most of the urban digital activity and applications occur indoors, the quality of services should be maintained as expected level, and however, there are several challenges and strategy for current indoor digitalization in Indonesia for delivering the services:

- **Lack of awareness on building owners**, digital services can generate more value for the building customer's usage. Promoting and educating the value of digital services are required to enhance awareness.
- **Building permit and infrastructure sharing**, the building owner should give it easier for telecommunication operators to deliver indoor services, including infrastructure sharing provided by the indoor provider in order to achieve cost-effectiveness.
- **Policy-Driven for infrastructure permit,** to accelerate indoor coverage deployment, the government can drive policy to the building owner related rental mechanism, with affordable price.
- **5G Spectrum license**, need to be released to serve better experience for indoor services.
- **Technology transformation**, from DAS (Distributed Antenna Systems) conventional indoor infrastructure to DIS (Digital Indoor Systems) for better capacity and quality.

Wireless Broadband (WBB)

Wireless Broadband technology is initiated and become popular to maximize the utilization of Mobile Broadband capacity. Other terms for this also call it WTTX (Wireless To The Home), to penetrate broadband connectivity easier, while there is no fiber connectivity to the home due to difficulty of geographical and could be as first broadband penetration to the home before fiber deployment. Speed experience would be defined based on mobile technology being used, 4G and 5G can help better speed experience to the users.

Fixed Broadband (FBB)

Currently, the National super highway broadband connectivity has been done by Optical Palapa Ring Project. However, it is required to get a connection to the access sites as well. In the year 2019, as per the Ovum analysis and report fiber network penetration reaches 10.54% of the household that is considered still low as compared to other countries such as Malaysia and Vietnam. Malaysia is reached up to 30% penetration and Vietnam has reached 63.31% penetration in the year 2019.

As a matter of fact, High-speed broadband is having a great influence on Indonesian economy in the digital era. Indonesia's geographical situation and permit for laying cables are important constraints and challenges in fix broadband penetration. Fix broadband product packages offering by operators also need to improve in order to get the user's attraction. Aggressive and sustainable strategy approach is imperative In order to accelerate the fixed broadband deployment, adoption, and penetration.

- Some of the quick win strategic directions to pace up the deployments are as follows **Sharing of infrastructures such as poles and highway road construction** for quick fiber deployments.
- **Ease of deployment permit, licensing and Rights of Ways (ROW**) from Government
- **Formulation, the establishment of a steering committee** comprising of all stakeholders such as government, operators, properties players, association and academicians for unified policy and quick agreements
- **Improve fixed broadband product portfolio and affordable attractive package** offerings by bundling new services such as triple or quad-play packages (Video, voice, data, smart home) to attract more users.

Disaster Management

Between 2005 to 2015, Indonesia has experienced more than 15,000 natural disasters, whereby the total economic losses exceeded Rp235,26 Trillion, as well as a huge impact in terms of a number of victims. Some of the more notable challenges related to disaster management are ineffectiveness of the existing centrally managed disaster management system, further optimization of the Early Warning System (EWS) is required, more inter-agency integration and collaboration, need for well-planned contingency plans between both government and NGOs, as well as the current state of high level of vulnerability of existing buildings. To continue to build upon the good work done by the respective departments, some of the following mitigation measures are recommended:

- Non-technological:
  - Increase of pervasiveness of the **socialization and building code application** for key infrastructure;
  - Prepare detailed and practical **business continuity plans**;
  - Improve the **Disaster Funding Mechanism**;
  - **Accelerate post-disaster economic recovery** through the implementation of the business continuity plan;
- Technological:
  - Ensure **connectivity infrastructure readiness**;
  - **Upgrade the digital infrastructure** and building of common digital and data platforms;
  - Put in place **more sensors** in the high-risk areas;
  - Develop a **disaster management system** that focuses on the operational readiness capability, as well as intelligence to enable smart prediction and analysis of disasters.

Smart City

The Indonesian government understands the need for digital transformation and has been pushing for smart city initiatives. Besides launching the IoT Roadmap Draft that focuses on connectivity, other initiatives included the Venture Capital Policy to provide incentives to fintech start-ups, sustainable smart city for a green city and smart housing for low-income people, an intelligent transport system, and more. An initiative for 100 smart cities movement was also launched, which was well-received with

several cities pushing ahead on the smart city front, namely Jakarta, Denpasar, Bandung, Surabaya, Makassar, and Medan, to name a few. Moving forward, the Indonesian government can consider:

- Develop a **national level smart city master plan** and accompanying policies that lay down a strong foundation and allows the individual cities to flourish with their local smart city agenda;
- **Ensure better connectivity** to the remote and rural parts of the country, through the use of new ICT technologies such as 5G and NB-IoT, so as to narrow the digital divide;
- Build a **national level common digital and data platform** that will allow the various government agencies to share data and collaborate together;
- Through citizenry **e-Participation**, involve more citizens and businesses in the smart city initiatives, allowing them to contribute data, as well as make use of open data provided by the government;
- Push for the **digital transformation of the individual domains** (such as transport, security, etc.) so as to transform these domains to reap the benefits of the digital economy for the country.

E-Government

Since 2015, the government has been on a journey to improve and implement digital technologies, whereby essential eGovernment infrastructure targets have been identified for core infrastructure budgets, procurement, etc. Cities also began to develop electronic-based government systems for service efficiency and to reduce data redundancy. Presidential Regulation No. 95 of 2018 concerning Electronic Based Service Systems (SPBE) was made to realize clean, effective, transparent and accountable governance and quality, and reliable public services, all delivered by an electronically based national government system. Other regulations have also been enacted to support the push for eGovernment in Indonesia, resulting in many implementations of eGovernment applications within the government and for the citizens and businesses. The government should continue to:

- Display **strong leadership** in pushing the eGovernment agenda and maintain the reform process;
- Enable **better participation of local governments and communities**, thereby synchronizing the collaboration effort between people and government;
- Support with an **investment strategy** that is sustainable.

From a technological perspective, several infrastructure foundations are needed that will maximize the application of eGovernment:

- Connect the country with **optical fiber + satellite**;
- Better **cellular services**;
- Provision of **Wifi**, especially in the area of government offices and business districts;
- The **best policies** about OTT, cloud services, the Internet and Service Providers, RFID, and Blockchain;
- **Reliable electricity** source;
- **Guaranteed** infrastructure and networks.

Multi-Sectors Digitalization

Toward making Industry 4.0, the digitalization era has been reached to multisector industries. Integrated ICT Infrastructure, application, and digital transformation on operational will accelerate the maturity of digital ecosystems.

E-Agriculture, E-Education, E-Logistic, E-Finance, E-Health are sectors that currently and, in the future, keep moving forward on digital transformation. Integrated all stakeholder contribution is required to establish proper policy, planning, and implementation.

- **Broadband connectivity** to reach the public enterprise, government and other institutions is a basic requirement.
- **Policy, regulation** for protecting strategic data, data users, is important to manage security and maximize the benefit to the people.
- **Integrated Planning and Implementation**, for all stakeholders, to penetrate and accelerate digital transformation.

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Indonesia's digital economy is demonstrating its world-leading capability, attracting billions of Rupiahs in investments for digital business. Indonesia also has recorded a 90 percent growth in its digital economy in 2015-2017, the highest among ASEAN member countries. It is critical that Indonesia is at the forefront of spectrum policy and allocation to ensure the digital economy continues to grow and achieve its potential for financial inclusion, economic contribution, digital citizenship and social equality.

Prepared by Deputy Assistant for ICT and Utility, Deputy Ministry for Coordination of Infrastructure and Regional Development Acceleration, Coordinating Ministry for Economic Affairs (CMEA), this document highlights Indonesia current conditions and explains the huge digital economy potential to accelerate the economic growth and Indonesia prosperity. This document is to be used as a "White Book" to drive the need for a National Digital Master Plan.

OBJECTIVE OF THIS BOOK

- Proposing the importance of ICT to the Nation and the need for a consolidated and integrated National Digital Master Plan
- Create a National Digital Vision and Blueprint and how this Blueprint can be delivered.
- Spread out the optimal use of ICT into various development sector such as: agriculture, logistics and transportations, governance, tourism, health sciences, disaster management, financial technology, commerce and industry, education, and others.

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