Working Group on the Digitalization Scorecard:

Which policies and regulations can help advance digitalization

June 2017

BROADBAND COMMISSION
FOR SUSTAINABLE DEVELOPMENT

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Chaired by:

NOKIA

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The Broadband Commission Working Group on Digitalization Scorecard is chaired by Mr Rajeev Suri, CEO of Nokia. Nokia has coordinated the process of drafting the document with special acknowledgement to Mr Barry French, Mr Marc Vancoppenolle, and Ms Julia Jasinska from Nokia. The approach, analysis, research and report formatting were provided by PwC led by Mr Mohammad Chowdhury. Support of the Working Group was given by Ms Phillippa Biggs and Ms Anna Polomska of the Broadband Commission Secretariat at ITU.

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FOREWORDS

Houlin Zhao
Secretary-General of the International Telecommunication Union (ITU), The Co-Vice Chair of the Broadband Commission

Connectivity lies at the heart of digitalization. To benefit from the wealth of content and services available online, people everywhere have to have access to information and communication technologies. This is the core mission of the Broadband Commission, which has been calling for affordable and equitable access to ICTs for all people since its inception in 2010. Yet despite progress, much of the world's population still lacks access, thereby holding back progress towards the 2030 Agenda for Sustainable Development. To that end, the conclusions of this Working Group study are a valuable tool for showing how specific digital interventions may contribute to achieving the Sustainable Development Goals.

While increasing connectivity is essential, it is not enough. Not in today's world, where developments in automation, the Internet of Things and artificial intelligence, to name a few, have brought about new opportunities but also new challenges with which to contend. This rapid digital transformation must be accompanied by an equally fast and appropriate regulatory response. The different actors of the ICT ecosystem need to engage in a meaningful discussion, within and across sectors. Because ICTs underpin vital achievements and modern services in many sectors, governments and industry must increasingly work together to create the conditions needed to facilitate the growth of broadband for sustainable development. ITU has been advocating for this multi-stakeholder approach, working extensively with its Members States from developing and developed countries alike to provide the tools for an effective policy, legal and regulatory environment for the ICT sector.

As Co-Vice Chair of the Broadband Commission for Sustainable Development, I warmly welcome this Working Group report as an important contribution to the ongoing work programme of the Commission. At a time when we are entering a digital revolution, policy makers and regulators everywhere are grappling with common and unfamiliar questions about how to balance and guide the path to digitalization. This study provides lessons learned from six pilot countries and draws on these examples with a set of recommendations calling for the strong digital foundation to support the digitalization in the sectorial initiatives. Moreover it builds on the Commission's call for further cross-sectorial cooperation in implementing inclusive and forward-looking ICT regulations for a world of digital opportunities for all.

Rajeev Suri
President and Chief Executive Officer of Nokia
The Chair of the Broadband Commision's
Working Group on the Digitalization Scorecard

The world is changing at an unprecedented rate. Demographic and economic power shifts, significant technological breakthroughs, rapidly accelerating urbanization, and even climate change all stand to benefit from digital technologies that are changing the way we live, work, and play.

Digitalization – the conversion from the analog world into one of digital communications and its multiple applications across the many domains of our society – is the foundation for creating a connected world that makes us safer, healthier, smarter, and more productive.

Just imagine a world where access to educational resources is equal, no longer affected by geographic location, income, and other factors. Or, a world where digitalization opens up new agricultural opportunities through automation and better decision-making as a result of powerful data analytics. Or, a world that provides more accessible, affordable, and higher-quality health care for all.

These are some of the benefits digitalization can provide when societies embrace the connected world. Yet, in some areas, these benefits are delayed or unavailable simply because current regulations and policies are not keeping up with the pace of innovation.

That is why I was honored to introduce the 'Digitalization Scorecard' project in March of 2016 to the Broadband Commission. It is an effort focused on helping governments assess their policy framework across multiple priority sectors, such as e-learning or the adoption of the Internet of Things (IoT) for health care. I am very grateful for the strong support of the Digitalization Scorecard Working Group, which also includes fellow Broadband Commission members. They have been instrumental in developing this report.

With a focus on helping to unleash the economic and societal benefits of digitalization, the Working Group's report presents key recommendations and best practices that enable governments to learn how to create adequate policy frameworks. It addresses both the obstacles and enablers to digitalization (such as digital literacy, security, and cloud policy frameworks) that are common across sectors, as well as sector-specific frameworks. Six countries have been assessed. While some are more advanced than others in taking important steps toward policies and regulations that enable digitalization, more work still needs to be done.

I am convinced that policy frameworks which incorporate digitalization will make a meaningful impact toward meeting the UN Sustainable Development Goals more quickly. I hope that this report will bring useful insights to governments and policymakers as they embark on their journey, to realize the full benefits of a connected world and improve the lives of all their citizens.

INTRODUCTION

We are in a digital revolution which touches almost every community in the world

Digital technology is today touching the lives of individuals and businesses across the world. A social and economic revolution is enabled by digital technology, often underlined by the power of the Internet. The revolution is rapidly extending beyond people to objects, illustrated by the new-found potential of the Internet of Things (IoT). The emergence and accelerated adoption of technologies including cloud computing, artificial intelligence, connected and autonomous cars, smart cities, big data analytics, digital commerce, virtual and augmented reality and smart manufacturing is promising social and economic transformation, positive impacts on education, health and wellbeing. But as digitalization unfolds, policy makers and regulators are faced with an unfamiliar challenge: how can they capture the benefits of digitalization by removing blockages and introducing initiatives that enable the pace and scale of digital change.

Digitalization is a phenomenon of integrating digital technologies and ICT solutions into businesses and society; it is a conversion from the analogue world into one of digital communications and its multiple applications across the many domains of our society.

Digitalization is scaling quickly in some countries, yet more slowly in others

Policy makers all over the world are grappling with common questions around how to balance and guide the path to digitalization. From a global perspective, digitalization is scaling quickly in some countries, yet moving more slowly and unevenly in others. Some countries are successfully defining country visions premised on digital technology and knowledge-based economic advancement and translating these into reality through the development of national ICT transformation programs and policies, the rollout of infrastructure, the adoption of new digital services and creating the appropriate awareness of the use of these services amongst the populace. In a world where the experience of digitalization is new and as yet untested in many fields, there is scope for all countries to observe what is happening to their peers and exemplars, to implement good practice and to learn from each other. An assessment how well countries are developing policies, adopting the digital revolution and connecting the un-connected allows for the immediate identification of some of the best global examples to follow and best practices to adopt.

The digitalization scorecard explores the digitalization readiness from a policy and regulatory perspective

With this context in mind, the Broadband Commission's Working Group on Digitalization Scorecard, with the chairmanship of Nokia and research support from PwC, has prepared this scorecard to evaluate the policy and regulatory readiness for digitalization identifying specific enablers and bottlenecks. The scorecard presents a first assessment of policy and regulatory frameworks which encourage digitalization on an economy-wide basis. It takes into account relevant legislations, but also their implementation and more generally governmental interventions.

The purpose of this study is to encourage a critical revision of policy and regulatory frameworks, to map where regulations may create obstacles to the digitalization of a country's priority

sectors – or where necessary policies and regulations are missing. The Working Group has undertaken this project to support countries in introducing enabling policies sooner.

It is worth emphasizing that a good policy is one which is 'fit for purpose', introduced timely, implemented and enforceable. The absence of an enabling policy and/or regulation is crucial to address in order to allow for digitalization of a given sector. This report is not intended to encourage regulation per se, but to point out where regulation is currently helpful (enabling) or unhelpful (blocking) for digitalization. In addition, the report aims to present concrete examples of policy actions taken by some countries that have succeeded in digitalization, so that those can be replicated by other countries where appropriate.

The scorecard explores six countries, five sectors and foundation elements

The scorecard covers six countries, focusing on five sectors in each as well as common digital foundations. Together, the analysis sets out how each country is performing when it comes to policies and regulations to foster or limit digitalization. The six countries covered in this scorecard represent high, middle and low income nations as well as a spread by geography and size of population:

- High income: Finland, Singapore
- Middle income: Colombia, Indonesia
- Low income: Kenya, Pakistan

Every country covered in the scorecard shows a strong ambition in digitalization, a desire to succeed, and specific policy and regulatory initiatives.

Each scorecard reviews five sectors, selected because of their high socio-economic impact: Agriculture, Education, Healthcare, Government and Transportation.

Each scorecard also assesses the digital foundation elements of digital leadership, digital literacy, cybersecurity, data protection, e-payment, and cloud services, which are all horizontal enablers of digitalization.

The pace and impact of digitalization is subject to wider factors than purely the policy and regulatory environment, for instance by political structure or general legal, economic and investment environments – these factors are beyond the scope of this study.

Good connectivity through appropriate infrastructure is a precondition for digitalization

The availability of an ICT infrastructure that would provide reliable and affordable connectivity is a first step on every country's road to digitalization. Telecom and ICT infrastructure is digitalization's basics – in fact it can be seen as the global nervous system of a modern world that underpins our digital lives. However, in many countries, universal access to broadband has not been yet achieved. There the expansion of ICT infrastructure has to be fostered as a matter of priority. For those looking for advice on how to effectively develop and deploy ICT infrastructure with supportive regulations, multiple excellent publications are already available, such as Global ICT Regulatory Outlook[1] and Trends in Telecommunication Reform Series[2].

Given a wealth of good quality literature on this topic, it was a choice of the Working Group not to duplicate the efforts but instead to move beyond pure connectivity-related aspects of policies and regulations. To achieve a successful digitalization of the economy, that would best serve the society, governments need to sequence their priorities and efforts, focusing first on the necessary connectivity, then securing that a digitalization foundation is established with appropriate frameworks for privacy and cybersecurity and etc. Digitalization of verticals should be built on top of that. This sequencing however does not preclude early considerations of sector-specific policies and regulations on a journey to digitalization. On the contrary, those governments that ensure digitalization-readiness of sectorial policies early on would gain an advantage and foster their countries' digitalization.

The scorecard is targeted at those with an interest in digital as well as in vertical policies and regulations

Our investigation results in a series of sector-specific recommendations what governments should do to remove blockages and encourage enablers to digitalization. Some of those should be taken into consideration in legislative activities; others focus more on implementation, and should be driven by the executive branch of the government and its implementing agencies. Many of those require a collaboration of the ministry responsible for ICT with departments/regulators responsible for sector-specific policies.

[1] https://www.itu.int/pub/D-PREF-BB.REG_OUT01-2017
[2] http://www.itu.int/pub/D-PREF-TTR/en

Digitalization may contribute to achieving the UN Sustainable Development Goals

In 2015, the UN launched its Sustainable Development Goals (SDGs). The 17 SDGs are designed to end poverty, protect the planet and ensure that all people enjoy peace and prosperity. There is broad agreement in the international community about the positive relationship between ICT and connectivity and economic and social wellbeing, provided that appropriate safeguards are introduced to mitigate related challenges such as the digital divide.

To fully harness the potential benefits of digitalization, a thoughtful approach and carefully drafted policies are needed. This study seeks to advance the understanding what this approach could be, with adequate policy frameworks that would unleash societal gains from digitalization. The conclusions of this study show how specific digital policy interventions may contribute to achieving the SDGs; these are discussed further in the recommendations section. At the same time, there are ongoing debates about the societal impact of digitalization; this is beyond the scope of this study and would hopefully be given appropriate consideration in future projects of the Broadband Commission.

EXECUTIVE SUMMARY

Most countries will benefit from a clear designation of a body responsible for digitalization through interdepartmental collaboration

Our study indicates that governments should create a mechanism to establish cooperation across existing institutions. We also recommend identifying which are the best positioned entities (government departments or agencies) to champion digitalization that will lead the way to the future with a holistic vision, and large-scale digital transformation projects. It must be clear which ministry or agency, or possibly an inter-departmental collegial body, has the mandate and the competence to drive digital initiatives across multiple sectors. Many of the activities required will be beyond the telecom/ICT space, and so it is not necessarily the case that a ministry of ICT is the only option for such a championing role. The establishment of an adequately resourced and empowered (collegial) body dedicated to driving digitalization would greatly contribute to accelerating the progress of digitalization. Such a body, given its horizontal role across the sectors, should have an easy access to appropriate departments responsible for sector specific initiatives and a clear mandate to consult with all relevant stakeholders to create an inclusive strategy. It should also be the task of a central body to coordinate implementation of this holistic strategy, and to assure its coherent translation into different sector-specific activities. Setting up a new entity might be an attractive solution, but it is costly and not always efficient to guarantee the successful implementation of the digitalization principles.

Other than collaboration with other ministries and government department or agencies, it would also be beneficial if private sector stakeholders are involved, including corporations, operators, and universities to work towards developing a coherent narrative around the key enablers which will result in a win-win proposition. It will help to achieve a country's vision; it will help regulators and ICT ministers to introduce appropriate pro-investment and forward-looking policies; and it will enable private sector stakeholders to deploy best-in-class infrastructure and innovative services.

Responsible data sharing should be enabled by adequate policy frameworks

As we move towards the Internet of Things, a wealth of data will be unlocked and with it new horizons of opportunity for socio-economic advancement. Big data will help us find new cures, optimize business processes, and be better stewards of scarce resources. There is one precondition for this: moving from sensing, collecting and monitoring raw data, to using analytics to create valuable insights and knowledge. For example, in agriculture, policy makers should support development of standardized frameworks to provide transparency of supply and demand information to farmers (in line with data sharing protocols). In healthcare, regulators should establish standards and guidelines which support interoperability of health management systems and devices, and encourage standards for sharing of electronic healthcare data (EHR, EMR) as well as enable healthcare institutions to access national health data to conduct research into improving health outcomes across society. In transportation, regulators should ensure that data collection is allowed to enable real-time traffic management for cities and other transportation authorities, taking into account data privacy and anonymization requirements. This recommendation comes with a strong call for appropriate regulation guaranteeing data privacy.

Public funding can accelerate kick-starting digitalization

Our study reveals the need in some cases for an initial amount of governmental funding to kick-start the digitalization progress, be it in a particular sector or location (such as a city). Government budget allocations to drive strategic digitalization initiatives may be merited to advance ambitious goals, for example in areas such as R&D for the use of digitalization in addressing societal challenges. An initial public funding for digitalization projects should act as seed money and further mobilize private sector investments. Moreover governmental funding would steer the development of innovations into areas with most societal benefits.

National strategies provide clarity of vision on digitalization's critical elements

Whilst digitalization in general enables a variety of socio-economic impacts across a country, the availability of an underlying and modern ICT infrastructure remains key. Governments usually address this through pursuing National Broadband Plans, setting targets and supportive actions for improving connectivity. Sometimes more direct interventions are needed which are targeted at public service institutions, such as schools and hospitals. To enable this, we recommend governments continue to evaluate the need to upgrade government institutions' access, site by site, to higher quality broadband connectivity to enable digitalized services and speed up the implementation of e-Government. Even though it is important to have an established broadband infrastructure, it is worth emphasizing that strategies, such as National Digital Economy Strategy, National Cyber-security Strategy, and National Smart Cities policy, are equally important for a country so that they are able to provide clarity of vision and scope on critical elements of digitalization.

Education and awareness raising are critical to effectively implement digitalization policies

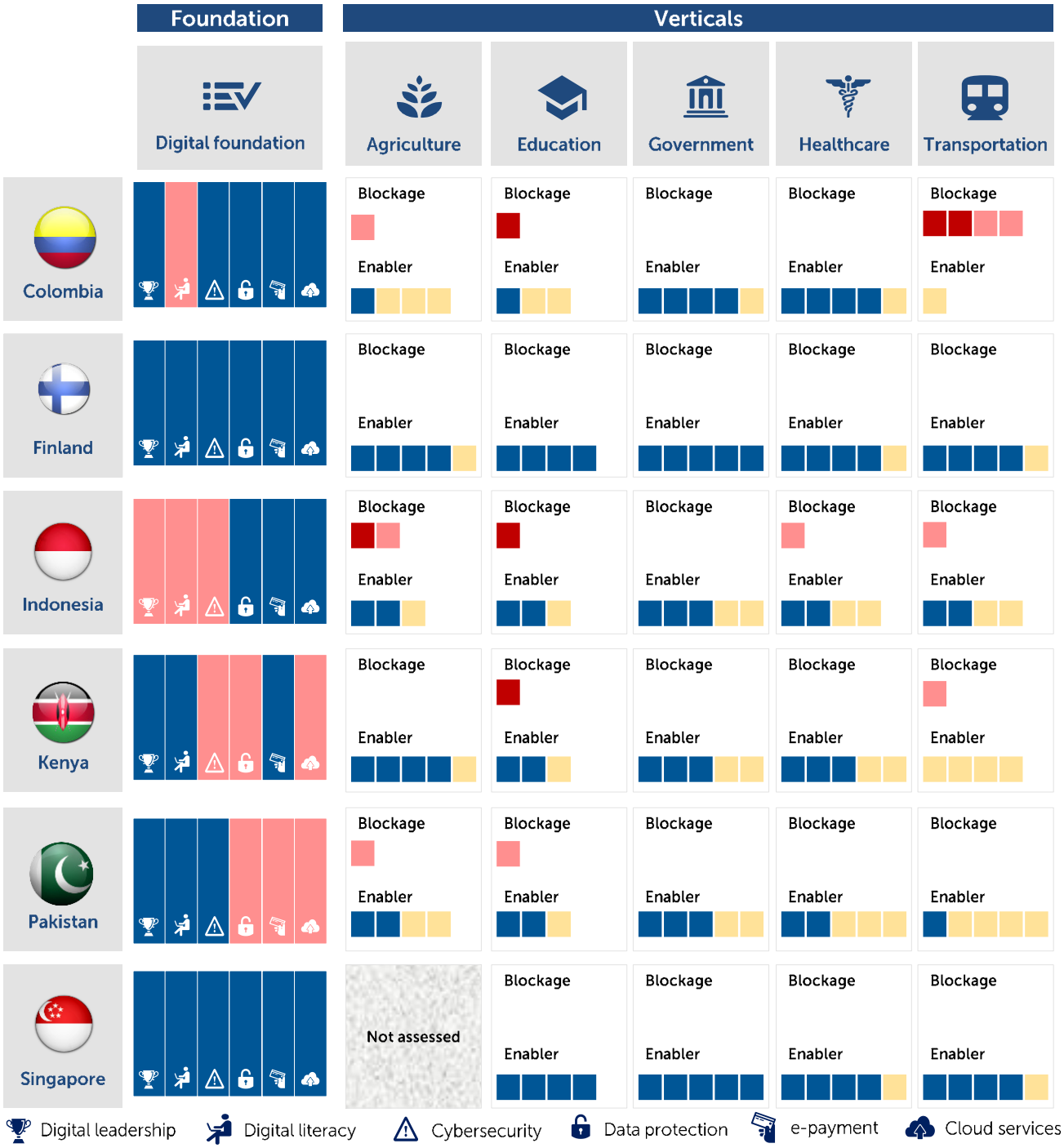
Beyond society-wide actions and campaigns aiming at spreading e-skills and improving digital literacy in society, it is important that governments — at different levels, central and/or regional — consider dedicated initiatives to address sector-specific needs (for example, raising the awareness of farmers on the benefits of digital solutions for agriculture, or targeted education and awareness building for healthcare ecosystem players, such as community health workers, physicians and pharmacists). Such campaigns will more effectively help raise awareness about opportunities brought by digitalization, as well as encourage greater acceptance of digital solutions among stakeholders.

There is no room for complacency in driving digitalization

Our assessment shows that regardless of whether a country is of high, middle or low income, there is no room for complacency. Some countries are more mature in their approach to digitalization, and have already done well to establish policies and regulations for digitalization. Yet even in those countries high on the digitalization adoption curve (e.g. Finland), continued action is required to encourage digitalization initiatives to thrive and scale, to improve digital literacy in some sectors, and to foster innovation. For all countries, as the technological possibilities evolve, so must the digital foundations in order that innovation can continue to develop. For those countries lower on the adoption curve, focus on more constructive policy and regulatory frameworks and appropriate governmental interventions presents an opportunity to unleash digitalization at a faster pace, and leapfrog. It is important to stress that enabling policies are desired and achievable in all countries, regardless of their economic performance. As such the recommendations of this study are not dependent on the income group categorization.

Digitalization Scorecard

SUMMARY SCORECARD



Legend:

Digital foundation

- Policy and regulatory framework is implemented
- Policy and regulatory framework is in planning phase
- No sufficient framework /No visible plan

Action required

Verticals

- Enabling policy and/or regulation is in place
- Enabling policy and/or regulation is planned
- Blocking policy and/or regulation is planned OR supportive policy and/or regulation is missing
- Blocking policy and/or regulation is in place OR necessary policy and/or regulation is missing

Action required

COLOMBIA

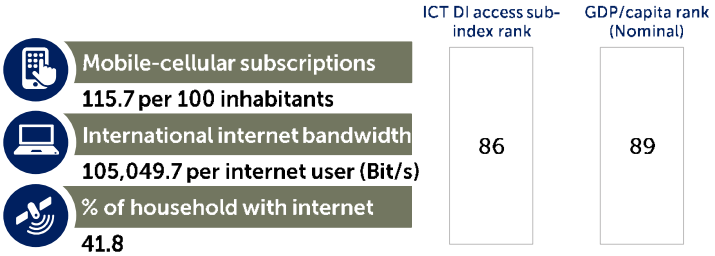
Digital foundation

Key facts

Population
48 million
Annual GDP growth
4.7%
GDP per capita
USD 7,831
Life expectancy at birth
74 years
Adult literacy rate
91.4%
Mobile broadband penetration
37%
Average age of population
28 years

ICT Infrastructure

Colombia is aware of the importance of ICT to the economy. The Government is continuously increasing the number of internet connections by expanding its infrastructure and lowering service costs. Colombia has experienced rapid growth in internet users from 7% to 60% between 2010 and 2014. The ITU's ICT Development Index (ICT DI) ranked Colombia 86th.



The data for infrastructure readiness is based on ITU ICT Development Index 2016 (For the purpose of this report, only the relevant measurements of the access sub-index is shown: Mobile-cellular subscriptions, International internet bandwidth, and % of household with internet); GDP/capita rank is based International Monetary Fund assessment 2016.

Assessment summary

Digital leadership

Colombia aims to establish itself as a digital nation by creating and implementing various digital initiatives, referred to in the Live Digital Plan developed under the Ministry of Information Technologies and Communications (MinITC). MinITC is responsible for the coordination of digital initiatives. Colombia is making a continuous effort to strengthen its readiness to implement digitalization across sectors.

Digital literacy

Various ICT development plans and programs, such as the ICT Strategic Education Plan, have been introduced in order to develop the national ICT infrastructure and programs to enhance digital skills. In addition, ICT integration into its educational curriculum (as early as primary and secondary levels) is also underway. The Government is working on further ways to enhance the digital literacy of its population.

Cybersecurity, data protection, e-payment, and cloud services

Colombia is relatively well equipped to secure the country from cyber attacks. This is evidenced by the presence of national planning policy guidelines for cybersecurity and defence, national and sector-specific computer incident response teams and national cybersecurity framework. In addition, the Financial Inclusion Bill exists to regulate and encourage the entry of new players into the financial services and payments markets to increase the usage of e-payments across the country. However, there is no regulation that governs the utilization of cloud services, it is currently indirectly addressed in the Electronic Information and Transaction Law.

Digitalization scorecard on foundation topics

COLOMBIA

Policy and regulatory framework

Assessment summary

Agriculture

Colombia's agriculture sector is a key contributor to its economy. However, the Government does not have policies to encourage connection and access to digital market platforms for both farmers and buyers, as well as supply and demand data. In collaboration with the private sector and other Government bodies, Colombia has started to adopt digital technologies to help the agriculture sector move forward. For example, an online trade platform has been developed in partnership with various private organizations to provide farmers with free access to marketplaces and agricultural information. As digitalization advances, there is a need for digital literacy programs specifically targeted at farmers.

Education

In collaboration with the private sector and international organizations, Colombia is in the process of digitalizing its education sector. Colombia's educational program, A Que te Cojo Ratón, encourages the use of digital content to raise the country's education level. In addition, there is legislation that supports the improvement of education delivery through infrastructure development and ICT standardization for educational purposes. Colombia would benefit from policy/regulation to create a secure and reliable e-education environment.

Government

In 2016, the UN e-Government index ranked Colombia 57th out of 193 countries. The Government has shown a clear intent to digitalize Government services. The strategic plan supports the digitalization of Government mechanisms and public services in information, citizen interaction, transactions, transformation and democracy. Sharing of data in open format and interoperable system platforms are also promoted to enhance the quality of public services. Furthermore, an e-Government office has been formed to monitor and evaluate the progress of e-Government implementation.

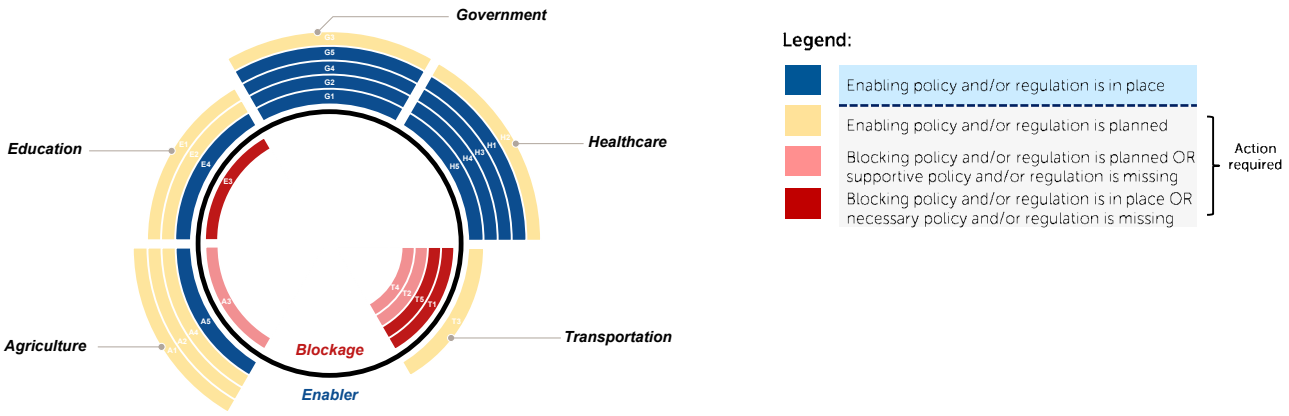
Healthcare

Digitalizing healthcare is a Government priority, as the country recognizes that healthcare services provided through digital means are more cost efficient and accessible. Regulations have been established to govern the use of e-health, including Electronic Health Records (EHR), e-prescriptions and telemedicine. In addition, system interoperability and the digital literacy of healthcare personnel are encouraged under the Strategy and Plan of Action on e-health. Colombia is promoting online systems to enable the accessibility of health-related information among patients, medical practitioners and institutions.

Transportation

Colombia's transportation plans are geared towards improving transportation infrastructure. Even though the Ministry of Transport has launched a National Urban Transit Program to build efficient urban transportation systems in the country, there is currently limited evidence of policies to support adoption of ICT technologies in the sector. For example, policy coverage does not extend to the sharing economy business model in transportation or the use of digital data to improve infrastructure planning.

Digitalization scorecard on policy and regulatory framework



FINLAND

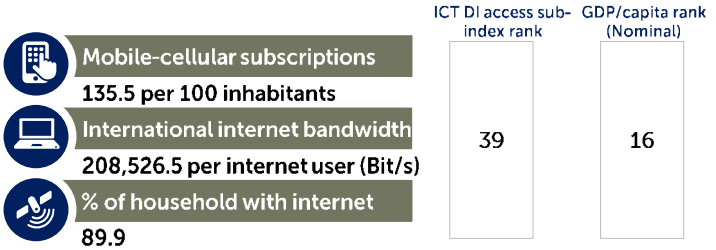
Digital foundation

Key facts

Population
5.5 million
Annual GDP growth
0.2%
GDP per capita
USD 42,654
Life expectancy at birth
81 years
Adult literacy rate
100%
Mobile broadband penetration
77%
Average age of population
42 years

ICT Infrastructure

With almost 90% of households connected to the internet, Finland is a leading nation in promoting digitalization across sectors. Despite having a relatively small population and market, the success of Finland's digitalization initiatives, enabled by robust ICT infrastructure, has made it one of the ICT leaders in the world today. The ITU's ICT Development Index (ICT DI) ranks Finland 39th for accessibility to ICT.



The data for infrastructure readiness is based on ITU ICT Development Index 2016 (For the purpose of this report, only the relevant measurements of the access sub-index is shown: Mobile-cellular subscriptions, International internet bandwidth, and % of household with internet); GDP/capita rank is based International Monetary Fund assessment 2016.

Assessment summary

Digital leadership

A strong focus on digitalizing multiple sectors of its economy makes Finland one of the most advanced digitalized countries today. The Government's plan to utilize ICT to improve national competitiveness is a coherent effort across ministries. This inter-ministerial partnership, with active involvement from the private sector, has contributed to the success of digitalization in Finland.

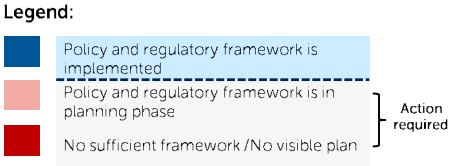
Digital literacy

Digital literacy is a critical contributing factor to a country's level of digital readiness. Finland has developed an equitable and inclusive information society, and was one of the first countries in the world to ensure, through its Digital Agenda for 2011-2021, that citizens have the opportunity to use digital services regardless of their place of residence or income level. In addition, Finland's education curriculum has established ICT as a core competency, providing a platform for students to develop digital skills.

Cybersecurity, data protection, e-payment, and cloud services

Finland has an established cybersecurity strategy and an officially recognized national computer incident response team. Finland has prioritized the development of cybersecurity standards, accredited inspection bodies and appropriate data protection laws. Digital payments as an alternative to traditional forms of payment have emerged from changing consumer habits and developments in technology, and are unconstrained by regulatory obstacles. While there are no specific regulations governing the use of a cloud network, Finland follows European Cloud Computing Strategy and mark the highest take-up of cloud services among European Union countries.

Digitalization scorecard on foundation topics



FINLAND

Policy and regulatory framework

Assessment summary

Agriculture

Although it accounts for only 3% of GDP, Finland treats agriculture as a priority for digitalization. To drive digitalization in agriculture, Tekes, a Government agency, has invested in the distribution of digital devices to farmers to provide them with access to market demand and supply data generated by the Department for Agricultural Scientific Research. The Ministry of Agriculture and Forestry has increased its focus on the adoption of technological solutions for improving production practices. However, whilst digital literacy is a national priority, there is no specific digital literacy program for stakeholders in the agricultural sector.

Education

The Government encourages ICT skills development across the population through the New National Core Curriculum. Government actively promotes the incorporation of digital content into all subjects across all academic levels. Individuals are able to obtain university level degrees online through the Finland Virtual University (FVU). Finland focuses on enhancing the quality and attractiveness of digital learning through the provision of innovative programs to teachers and students.

Government

Finland's Government is one of the highest-ranked in terms of its e-Government and e-Services provision. Through successful implementation of several e-Government strategies, such as the EU e-Government Action Plan 2016-2020 and e-Services and the e-Democracy Acceleration (SADe) Programme, Finland is accelerating the development of an information society and the growth of electronically-accessible public services. The involvement of committed stakeholders and availability of sufficient funding to drive the strategy are key ingredients of success.

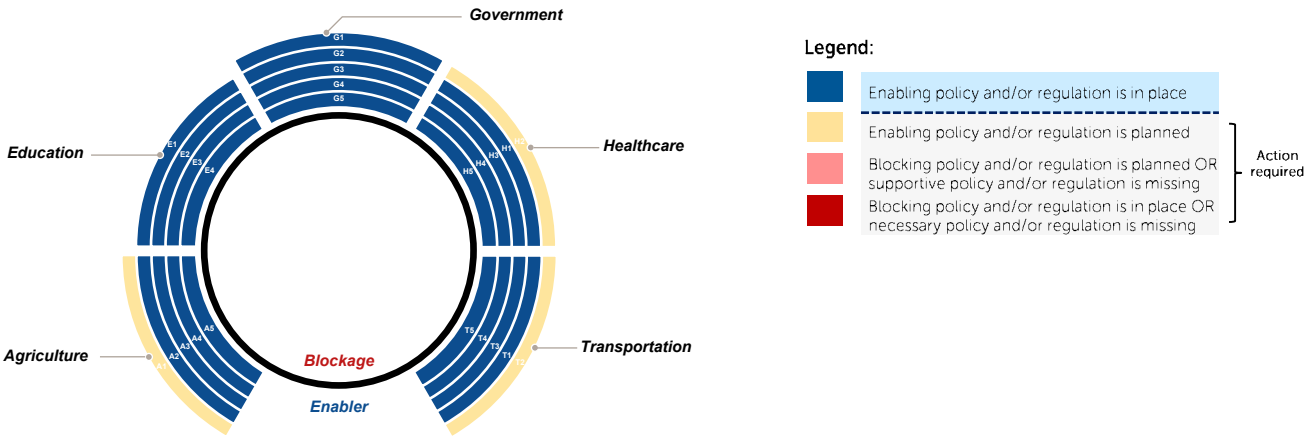
Healthcare

With 100% adoption of Electronic Healthcare Records (EHR) achieved in national hospitals, digitalization of the healthcare sector in Finland is considered to be at an advanced stage. There are well established public policies that support provision of digital healthcare services, such as e-prescription and telemedicine. The use of Internet of Things (IoT) in healthcare is actively encouraged, and the accessibility and processing of electronic health data are regulated. Work is currently underway to enhance interoperability standards to enhance the efficiency and performance of health management systems.

Transportation

Despite having a relatively low population density (17 inhabitants per sq. km.), the Government invests heavily in transportation infrastructure. The Finnish Transport Agency is actively addressing new digitally-enabled business models in transportation such as ride sharing, autonomous vehicles, and interoperable payment systems for the use of national public transport facilities. Supporting policies for digital innovation in transport are currently under preparation. In addition, an Intelligent Transportation System (ITS) strategy has been established to encourage the use of real-time information to enhance the transportation experience for commuters.

Digitalization scorecard on policy and regulatory framework



INDONESIA

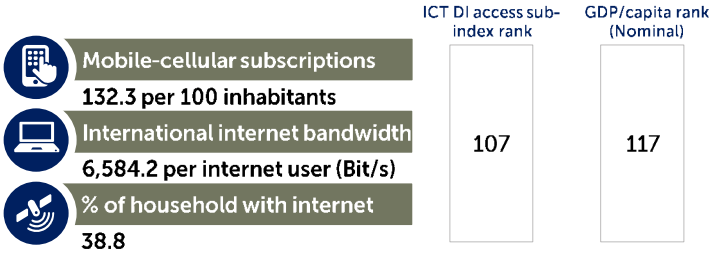
Digital foundation

Key facts

Population
260 million
Annual GDP growth
4.8%
GDP per capita
USD 3,350
Life expectancy at birth
68 years
Adult literacy rate
95.4%
Mobile broadband penetration
37%
Average age of population
28 years

ICT infrastructure

Whilst Indonesia has a large and rapidly growing number of internet users, only 22% of the population is connected to the internet. However, current infrastructure projects, such as the Palapa Ring project, are expected to significantly increase internet coverage. The ITU's ICT Development Index (ICT DI) ranked Indonesia 107th.



The data for infrastructure readiness is based on ITU ICT Development Index 2016 (For the purpose of this report, only the relevant measurements of the access sub-index is shown: Mobile-cellular subscriptions, International internet bandwidth, and % of household with internet); GDP/capita rank is based International Monetary Fund assessment 2016.

Assessment summary

Digital leadership

Indonesia has ambitious plans to digitalize key areas in multiple sectors and harmonize them into a coherent set of digital initiatives across the economy. While Indonesia does not currently have a central agency focused on driving the implementation of digital initiatives, the Ministry of Communications and Informatics is taking the lead for a number of initiatives on ICT infrastructure improvement, and supports programs such as smart cities, e-Government, and the development of cybersecurity in selected sectors.

Digital literacy

Improving digital literacy is a significant challenge for a developing country with a population of 260 million. Nevertheless, enhancing citizens' digital literacy is a national priority and is embedded within the national ICT plan, which addresses the early adoption of e-learning at all levels of education. As an effort to increase digital literacy in general society, the Government is creating shared working spaces in various cities to provide access to computers and the internet.

Cybersecurity, data protection, e-payment and cloud services

Indonesia is in the process of adopting and refining foundational enablers of digitalization, such as cybersecurity, data protection, e-payment and cloud services. While copyright protection laws and data protection provisions exist, they are sector-specific at present. In addition, the Indonesian Financial Services Authority (OJK) is improving financial inclusion and access to financial services for unbanked citizens by putting in place regulations and policies to ensure that such activities are secure and reliable.

Digitalization scorecard on foundation topics

INDONESIA

Policy and regulatory framework

Assessment summary

Agriculture

Agriculture is a key sector in Indonesia, accounting for more than 10% of GDP. To help the agriculture sector remain competitive in the domestic and international market, the Ministry of Agriculture is undertaking initiatives to promote digital innovation and adoption of ICT in the sector. For example, access to production and pricing data and farmers' capacity to make digital payments is being promoted through mobile applications. The adoption of ICT in agriculture is still at an early stage.

Education

With over 50 million students and two million teachers spread across a large archipelago, Indonesia's education system is broad and diverse. The country has recognized that ICT adoption could give students greater access to better education. The Government has distributed devices to students and teachers and made educational content accessible online, such as through the provision of tablets to K-12 students. However, more can be done in e-education through collaborating with non-governmental organizations to develop content.

Government

The UN e-Government index ranked Indonesia 116th out of 193 countries. e-Government implementation takes place in each province with coordination from the national Government. Indonesia has begun to scale up e-Government services to improve the value and ease of interactions between the Government, citizens and businesses. However, the e-Government strategy is fragmented among agencies and lacks important centralized programs at the national level, such as universal citizen ID. Furthermore, there is no policy to equip Government personnel with digital skills to fully utilize e-Government services.

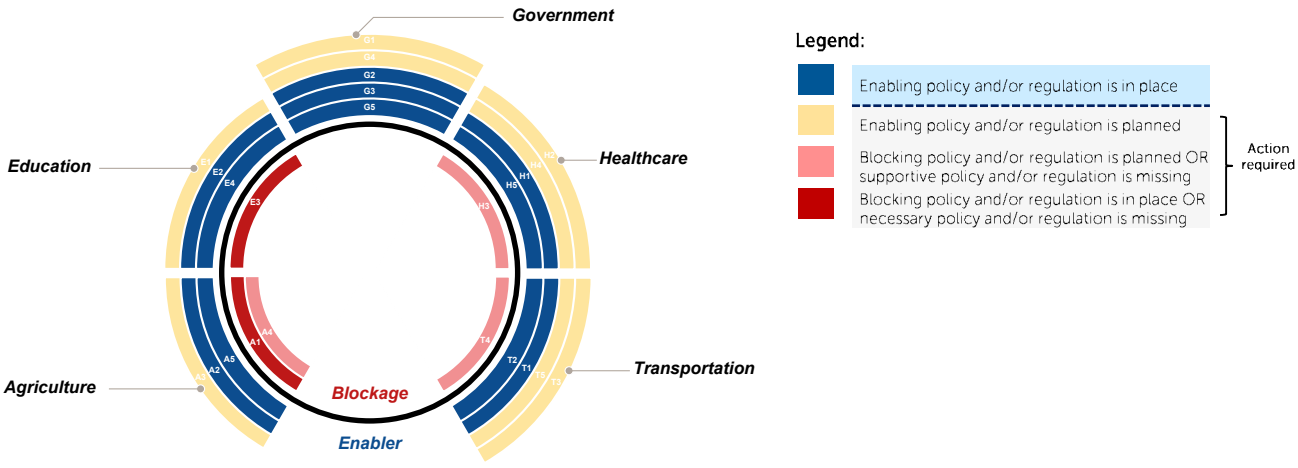
Healthcare

With 1,700 hospitals and 1.6 doctors per 10,000 population and in Indonesia, healthcare resources and facilities are not equally accessible to all citizens. This has led the Government to support ICT technologies to deliver e-health services to citizens across the country. However, current e-health regulations are not sufficient to support the use of digitally-enabled services, such as telemedicine and Electronic Health Record (EHR). In addition, a low level of socialization and regulatory enablement of e-health services hinder the sector from achieving the full benefits of e-health services.

Transportation

Indonesia has been focusing on infrastructure development and building an integrated transportation system, enabled by digitalization initiatives such as the implementation of smart travel cards and automated toll gates. The Government is actively engaged in formulating regulations that address the emergence of new technologies in the transportation sector, such as sharing economy business models, transportation data collection, and traffic management.

Digitalization scorecard on policy and regulatory framework



KENYA

Digital foundation

Key facts

Population
47 million
Annual GDP growth
5.7%
GDP per capita
USD 3,304
Life expectancy at birth
61 years
Adult literacy rate
72.2%
Mobile broadband penetration
19%
Average age of population
18 years

ICT infrastructure

Kenya is considered to be advanced in terms of ICT infrastructure compared to other East African countries, since the Government supports available technologies for the dissemination of information, enhancement of service delivery and improving internet connectivity. The ITU's ICT Development Index (ICT DI) ranked Kenya 133rd for accessibility of ICT.

Mobile-cellular subscriptions
80.6 per 100 inhabitants
International internet bandwidth
40,067.0 per internet user (Bit/s)
% of household with internet
19.6

ICT DI access sub-index rank	GDP/capita rank (Nominal)
133	147

The data for infrastructure readiness is based on ITU ICT Development Index 2016 (For the purpose of this report, only the relevant measurements of the access sub-index is shown: Mobile-cellular subscriptions, International internet bandwidth, and % of household with internet); GDP/capita rank is based International Monetary Fund assessment 2016.

Assessment summary

Digital leadership

Digital leadership in Kenya is exercised through the ICT Authority, an autonomous state-owned corporation under the management of the Ministry of Information, Communication and Technology. The aim of this ministry is to lead Kenya's Government transformation into an ICT hub in East Africa and to promote ICT literacy, capacity, innovation and enterprise in line with the Kenya National ICT Master Plan 2017. Another agency, the Kenya Innovation Agency (KENIA), is being launched to manage the national innovation framework, including innovation in ICT.

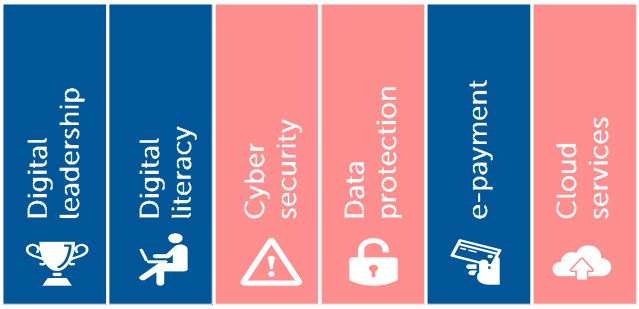
Digital literacy

Kenya's Government seeks to increase the level of digital literacy in educational institutions and society as a whole. For example, innovation centres of excellence (CoEs) and science and technology (S&T) parks have been established for research and development purposes. These hubs provide a supporting environment for innovators to develop digital products and services. Initiatives are also being implemented in educational institutions, such as programs that provide teaching and learning tools for primary school students, as well as the automation of academic and administrative processes at all levels of education.

Cybersecurity, data protection, e-payment, and cloud services

Enablers of digitalization, such as cybersecurity, data protection, e-payment, and cloud services have been promoted in Kenya. Although the Kenyan Government has recognized the importance of cybersecurity, data protection and cloud services as enablers of digitalization, the promulgation of these regulations is still in progress. A privately operated and closed mobile payment platform has successfully given the majority of Kenyans access to formal financial systems through their mobile phones.

Digitalization scorecard on foundation topics



KENYA

Policy and regulatory framework

Assessment summary

Agriculture

Agriculture is a critical sector, representing 24% of Kenya's GDP. The country has begun to develop ICT-based innovations to facilitate farmers' activities through IoT adoption, access to online agriculture-related data, and connection to online market platforms. Currently, Kenya is developing a central database to support the development of agriculture technology. The Government realizes that technological progress is a major challenge in the sector and has begun to formulate initiatives to address this.

Education

The Government is actively engaged in developing and implementing initiatives to improve the quality of and access to Kenya's educational system. For example, the ICT Authority created DigiSchool, a learning program in all public primary schools that aims to integrate digital technologies into the learning experience of students. Kenya is currently working on ways to increase awareness of fraud management among investors, universities, research institutes and the general public to provide students with secure and reliable e-education.

Government

There is a wide range of ongoing ICT initiatives and projects to provide e-Government services to citizens. For example, the e-Citizen website enables citizens to access immigration services and license application without paperwork and queueing. The Government has also created one-stop service points across the country, known as Huduma Centres, to enable citizens without home internet to access e-Citizen. Kenya's ICT Master Plan aims to increase the digital literacy of citizens and the workforce to exploit digital technologies, including e-Government services.

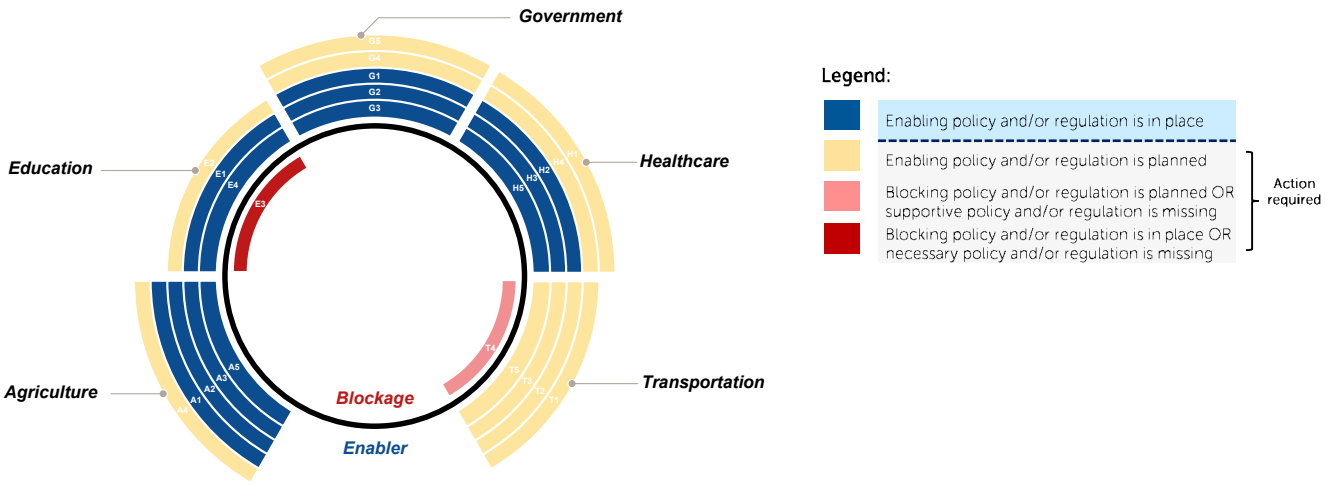
Healthcare

Kenya's Government has realized the benefit of ICT technologies in providing patients with greater access to healthcare services through digital technologies. The Government has enabled access to smart health solutions for its citizens as well as collection and sharing of personal health data. To further accelerate e-health adoption, the Government is working on standards for provider accreditation and digital literacy for healthcare personnel and consumers.

Transportation

Kenya's public transportation system is under strain, with unreliable service operations, long waiting times and a relatively high incidence of accidents. While the Government has started leveraging ICT to improve access to traffic data and integrated transport management, regulation of digitally-enabled transportation is still under development. Kenya is conducting a pilot project for online vehicle registration, cashless payments for public transportation, and fleet management to enable the authorities to track vehicle speed and location.

Digitalization scorecard on policy and regulatory framework



PAKISTAN

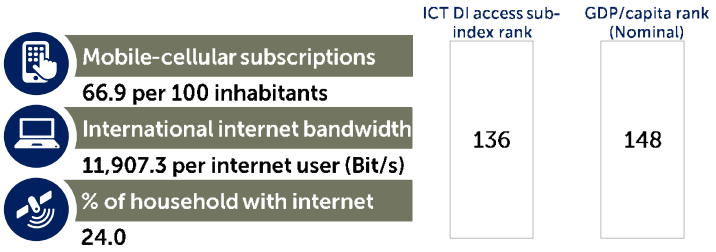
Digital foundation

Key facts

Population
192 million
Annual GDP growth
4.2%
GDP per capita
USD 1,132
Life expectancy at birth
66 years
Adult literacy rate
56.4%
Mobile broadband penetration
19%
Average age of population
23 years

ICT Infrastructure

Pakistan is using its Universal Access and Service Fund (UASF) to expand rural network coverage and reduce the development gap between metropolitan and provincial areas, and to provide incentives for fibre optic investment and the expansion of broadband access. The ITU's ICT Development Index (ICT DI) ranked Pakistan 136th for accessibility of ICT.



The data for infrastructure readiness is based on ITU ICT Development Index 2016 (For the purpose of this report, only the relevant measurements of the access sub-index is shown: Mobile-cellular subscriptions, International internet bandwidth, and % of household with internet); GDP/capita rank is based International Monetary Fund assessment 2016.

Assessment summary

Digital leadership

The Ministry of Information Technology and Telecom (MoITT) is the governing body that oversees the development of the existing digital ecosystem at the national level. The MoITT is committed to providing guidance and support to stakeholders involved in ICT implementation. Under the umbrella of MoITT, there are agencies that govern digitalization at the provincial and sector-specific levels. For example, the Technical Implementation Unit (TIU) assists the execution of digital-related policies in the education sector and the Punjab IT Board facilitates digital initiatives in the province of Punjab.

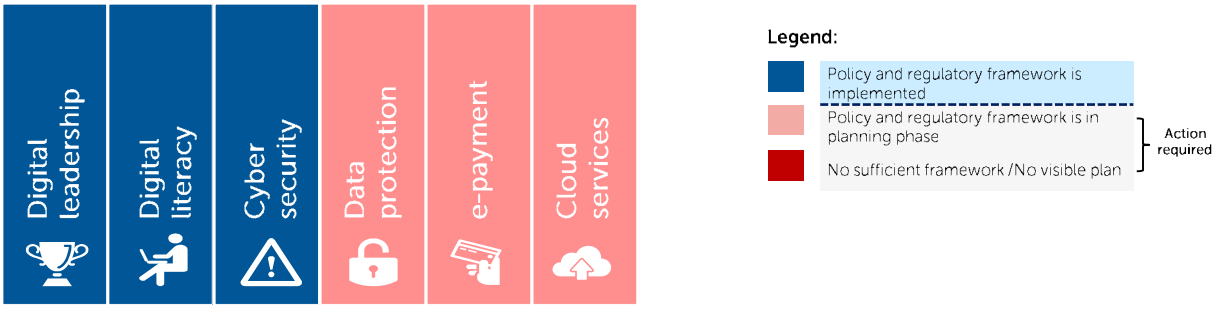
Digital literacy

In order to drive economic growth through the mass adoption of ICT, the Government has put in place initiatives to improve digital literacy of its citizens under the draft Digital Pakistan (2017). Although internet penetration throughout Pakistan remains low at 20%, the Government has initiated policies to increase the incorporation of ICT into the educational curriculum at all levels as well as established technical training programs to equip young people with ICT skills necessary for employment. With a large young population, digital literacy is important to unleash society's potential.

Cybersecurity, data protection, e-payment, and cloud services

Security measures have not been fully addressed in Pakistan's digital environment. Although cyber security is governed by the Prevention of Electronic Crime Act (2016), there is still no direct legislation to regulate the use of personal data. Cloud services in Pakistan have grown in the last few years; however, regulatory intervention to formalize national cloud strategy could further enhance cloud uptake in Pakistan. Pakistan has established mobile-money service and is looking for ways to scale up e-payment activities through several initiatives such as the establishment of a national e-payment gateway and state bank law.

Digitalization scorecard on foundation topics



PAKISTAN

Policy and regulatory framework

Assessment summary

Agriculture

The agriculture sector makes up a quarter of Pakistan's GDP. Initiatives to digitalize the agriculture sector by improving literacy of farmers and establishing a computerized agriculture databank have been included in the draft Digital Pakistan (2017). Even though numerous mobile applications have been launched to improve farmers' connectivity to online marketplaces and improve the accuracy of information relating to weather, cropping and cultivation, more could be done to enhance the quality of agricultural produce through the use of digital technologies.

Education

Pakistan's Government is committed to building a stronger education system. The National Information and Communications Technology Strategy for Education in Pakistan (NICTE) was developed to extend the reach of educational opportunity through ICT adoption. The UASF has successfully contributed to the establishment of 1,328 educational broadband centers in different areas of Pakistan. However, more could be done to enhance the quality of e-education.

Government

Pakistan has started to scale up the quality of public sector services through the implementation of e-Government services, enabled by the introduction of a Smart National ID Card (SNIC). Systems integration and compatibility to improve performance and streamline workflows in e-Government services are being encouraged. The Government plans to provide training for basic IT literacy and specific software operations for Government personnel to ensure that the delivery of e-Government services is improved further.

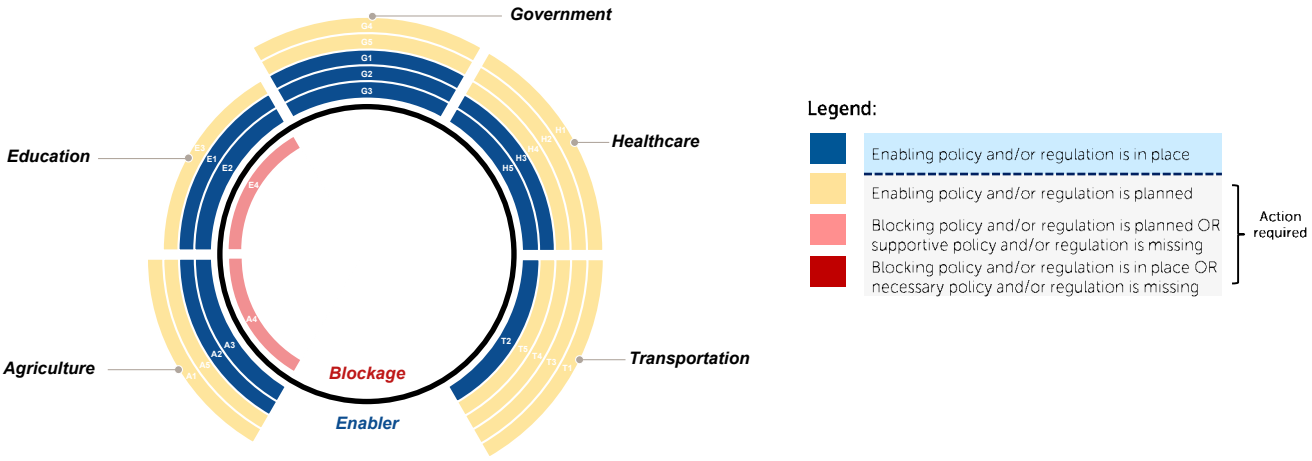
Healthcare

Pakistan has supported the development of e-health in the draft Digital Pakistan (2017), including collection and sharing of health data and IoT adoption. These plans, if well implemented, will address challenges in the healthcare sector, such as lack of access to basic healthcare and insufficient qualified medical personnel. Private organizations have also launched mobile applications for telemedicine, online pharmacy, and a healthcare online hub. However, some of these innovations are hindered by existing regulations that hinder wider adoption of digitalization in the sector, for example, telemedicine is only valid for radiological reporting.

Transportation

Transportation policy in Pakistan is largely directed at the provincial level, and therefore the extent of digitalization progress varies. The Government of Sindh (one of Pakistan's four provinces) has developed a Sustainable Urban Transportation Policy setting out goals to utilize technological development through specific initiatives such as traffic data collection and new business models to promote ride-sharing. The Government is currently in the process of formulating a comprehensive national transport policy and master plan. However, the implications of the use of digital technologies in the sector have not yet been fully articulated.

Digitalization scorecard on policy and regulatory framework



SINGAPORE

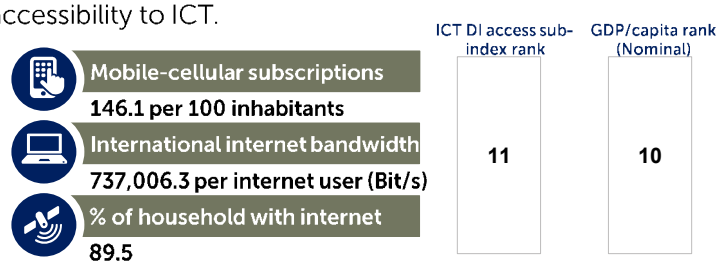
Digital foundation

Key facts

Population
6.8 million
Annual GDP growth
1.8%
GDP per capita
USD 51,855
Life expectancy at birth
82 years
Adult literacy rate
96.8%
Mobile broadband penetration
98%
Average age of population
34 years

ICT infrastructure

Singapore has an advanced and reliable ICT infrastructure. Singapore's Government has made significant efforts to bring fibre broadband to lower-income households through its Home Access program, which provides 100mbps fibre broadband connectivity and tablet at subsidized rates. The ITU's ICT Development Index (ICT DI) ranks Singapore 11th for accessibility to ICT.



The data for infrastructure readiness is based on ITU ICT Development Index 2016 (For the purpose of this report, only the relevant measurements of the access sub-index is shown; Mobile-cellular subscriptions, International internet bandwidth, and % of household with internet). GDP/capita rank is based International Monetary Fund assessment 2016.

Assessment summary

Digital leadership

To drive digital innovation, Singapore's Infocomm Media Development Authority (IMDA) leads the digital transformation of Singapore to promote the development and delivery of secure and reliable digital services to individuals and businesses. As Singapore strives to become a "Smart Nation," IMDA aims to build a digitally inclusive society, encouraging the adoption and usage of ICT across sectors. This includes providing assistance to senior citizens and people with disabilities to leverage available digital technologies.

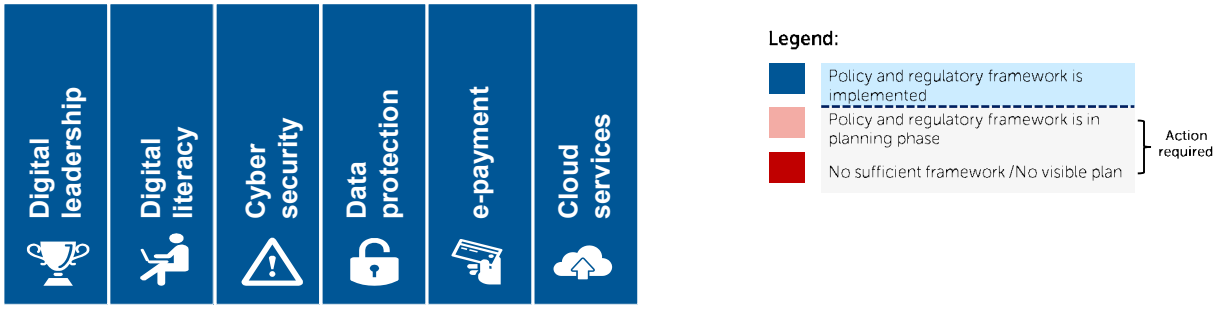
Digital literacy

The importance of digital literacy has been emphasized in Government publications such as the ICT Master Plan and policy framework. The Government has recognized that the workforce must be equipped with the right digital skills to increase productivity and innovation. For example, Code@SG is a program to establish coding and computational thinking as a national capability. The program aims to realize the potential of younger generations to transform Singapore into a Smart Nation.

Cybersecurity, data protection, e-payments and cloud services

To fulfil Singapore's Smart Nation program, the country is creating a robust and reliable digitalization environment spanning cybersecurity, data protection, e-payments and cloud services for stakeholders such as program developers, industry organizations, enterprises and users. Singapore has a comprehensive and internationally recognized cybersecurity framework, and policies governing national personal data protection, making it an attractive destination for companies and individuals engaged in digital innovation.

Digitalization scorecard on foundation topics



SINGAPORE

Policy and regulatory framework

Assessment summary

Agriculture

Singapore does not have a significant agricultural sector, making up less than 0.5% of GDP. This digitalization scorecard does not include a formal assessment of agriculture in Singapore. There are, however, innovative companies in Singapore which provide agricultural research and services for this sector in other countries.

Education

Singapore's education system is a leader among countries in Southeast Asia, providing easy access to both traditional and online education. Singapore has been implementing ICT innovation in the education system since 1997 and its success has been driven by the Government's continuous efforts in infrastructure improvement, curriculum integration and enabling learning environments. E-education is encouraged through the PC Bundles Scheme, a subsidy program that enables students in Singapore to access digital content remotely.

Government

Singapore's rank of 4th in the UN e-Government global index has been achieved through the continuous implementation of improvement initiatives for Government services to meet the needs of its citizens and businesses. ICT technologies have been used to provide citizens and businesses with fast, secure and accessible services. To ensure that e-Government services are up to date with latest technology advancements, the Government regularly renews its e-Government Master Plan. Singapore has also established Government Technology Agency of Singapore (GovTech), which is dedicated to managing and overseeing the development of ICT solutions in the Government sector.

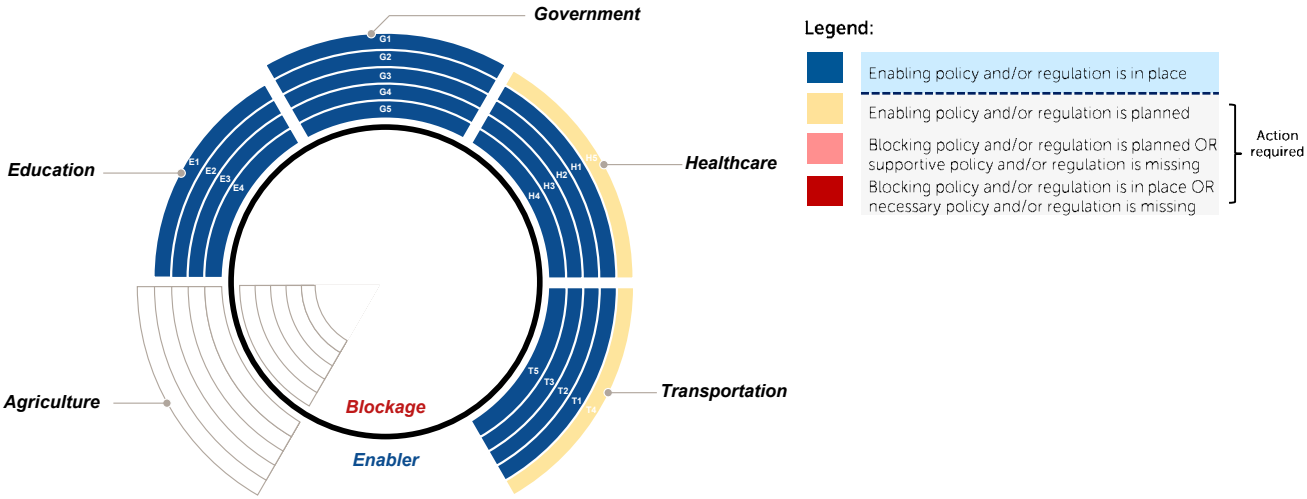
Healthcare

Through collaboration among Government agencies and private organizations, Singapore has successfully leveraged ICT technologies to accelerate the healthcare sector's transformation to achieve high quality clinical care, service excellence and cost-effectiveness. Innovations such as e-prescriptions have been put in place with regulations to maintain quality through licensing to provide positive results for both health practitioners and patients.

Transportation

Singapore's Government bodies and industry organizations are continuously making efforts to introduce the benefit of digitalization across multiple modes of transportation through supporting policies and regulations. For example, the Land Transport Authority (LTA) has regulations that address ride-sharing services to protect public safety and create fair competition through registration and licensing. Singapore generates and uses high quality transportation data to improve the efficiency of commuting around the island. Further challenges lie ahead, including developing a policy framework for autonomous vehicles.

Digitalization scorecard on policy and regulatory framework



Recommendations

The scorecard shows that there is more to be done by policy makers and regulators to realize the significant benefits of digitalization in terms of its positive economic and societal impact.

Our analysis identifies the following recommendations for policy makers and regulators with respect to each sector, and these apply equally across all countries.

Digital foundation

Strong digital foundations are essential to supporting digitalization. Getting digital foundations right will be critical to progress any sectorial initiative, to improve inclusion across sectors and countries, and will impact multiple SDGs.

Recommendations for policymakers and regulators in the area of ICT	Selected good practice
1. Establish digital leadership in the country through mandating a ministry, an agency or an inter-departmental collegial body to drive digitalization agenda in collaboration with other relevant departments.	Singapore established Infocomm Media Development Authority (IMDA) to drive innovation in the digital initiatives. In Finland digitalization is a collegial responsibility of a group of ministries. Both models, albeit different, are note-worthy.
2. Investigate how to encourage digital literacy and digital innovation through initiatives such as interactive training programs in community centres, and encourage the involvement of private organizations to accelerate digital literacy	Pakistan established National Technical Training Program to develop ICT skills through communities. In addition, government of Pakistan supports digital innovations created by private organizations, such as the Girl Effect mobile app, a global digital platform to empower young girls in more than 60 countries.
3. Establish up-to-date cybersecurity strategy that includes incident response, mitigation measures and preventative controls for cyber-attack/crime.	Finland established goals and guidelines to respond to threats to ensure that cyber activities are secure.
4. Establish national and/or sector-specific data protection laws that prohibit harmful uses of personal information that could erode trust in digital services.	Singapore created Personal Data Protection Act that governs the collection, use, and disclosure of personal data.
5. Collaboratively with different stakeholders develop cloud policy framework that provides transparency and facilitation for: • Data disclosures and supporting protocols • Regulations associated with data rights • Liability issues, especially for data misuse or loss. This does not mean a dedicated cloud regulation; rather checking whether the three aspects above are addressed in horizontal regulations.	Finland follows the European Cloud Computing Strategy that addresses ownership, access, portability of data and switching of cloud service providers.
6. Encourage digital financial inclusion, including through-e-payment innovations facilitated by secure and reliable e-payment platforms and by adjusting current regulations that may hinder its development, such as requiring a high minimum level of capital investment.	Indonesia's Financial Services Authority (OJK) issued consumer protection regulations governing electronic payment processing to provide security for consumers. As a result, the use of e-payments has significantly increased. This situation triggered many FinTech players in the country to create more e-payment innovations.

Table 1: Recommendations for digital foundation

Agriculture

Digitalization in agriculture opens up new potential through automation, and better decision making through access to better information and the power of data analytics. Based on the scorecard findings, following recommendations for policy makers and regulators can be distillated:

Recommendations for policymakers and regulators in the area of ICT	Selected good practice	Impacted SDGs (direct)
1. Develop training and awareness building programs to educate farmers on available digital technologies and their potential benefits.	Kenya provided training through training institutions to improve farmers' knowledge of production technologies and how this technology can improve productivity and profitability of agricultural businesses.	
2. Establish a mechanism to support (conduct and sponsor) R&D activities for e-agriculture innovation and services.	Finland established the Department of Agricultural Sciences to perform scientific research in the agriculture sector and technologies pertaining to it.	
3. Develop standardized frameworks to provide transparency of real-time product supply and demand information to farmers online.	Central Bank of Indonesia publishes online real-time prices of staple foods such as rice, chili, meat, onion, and certain types of fish.	
4. Introduce regulations to enhance food quality through the use of digital technologies (digital tracking, smart labeling).	Finland adopted Food Law Regulation EC1978/2002 to follow food safety legislation, including but not limited to management systems, irradiation and labelling, for example, smart labelling that provides information about fresh produce and food through mobile phones and PCs.	

Table 2: Recommendations for agriculture

Education

Access to educational opportunities in many countries is unequal, affected by geographic location, socio-economic status, and other factors; for example, remote areas are often underserved due to a lack of teachers and/or teaching facilities. In addition, the quality of education provided to students may not be adequate. Based on the scorecard findings, we have the following recommendations for policy makers and regulators to ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

Recommendations for policymakers and regulators in the area of ICT	Selected good practice	Impacted SDGs (direct)
1. Create an education sector digitalization master plan, with supporting budget, for deploying e-learning as well as supporting training and awareness building initiatives.	Singapore created a master plan for education; which states that the country's objective is to continue developing the ICT infrastructure to support the ICT programs in schools, to integrate ICT into curricula and to digitalize the students' learning environment. It also includes initiatives that would equip teachers and students with the knowledge to teach and learn in a digitalized education environment.	
2. Digitalize educational content from primary, secondary and tertiary curricula to increase education accessibility and affordability.	Finland digitized educational content of all subjects and integrated it across all grade levels.	
3. Support broadband connectivity for all educational institutions and community learning centres across the country.	Indonesia provided devices and ICT infrastructure to students and teachers and makes educational content accessible online.	
4. Establish a clear responsibility to accredit digital delivery of education to protect students from fraud.	Singapore established the Learning Standards Technical Committee (LSTC) for tracking, developing and promoting specifications for e-learning competencies.	

Table 3: Recommendations for education

Government

Increasing Internet penetration is changing citizen expectations about how – and how fast – they can interact with government. Additionally, the emergence and ubiquity of social media empowers citizens by giving them real-time platforms for communicating opinions and airing grievances. Government has the opportunity to leverage technological advancements and digital innovation to operate more efficiently and effectively. As an initial step, every country should introduce an e-Government strategy which will set out how the government will expand the reach of government services to the public. Based on the scorecard findings, we have the following recommendations for policy makers and regulators for e-government.

Recommendations for policymakers and regulators in the area of ICT	Selected good practice	Impacted SDGs (direct)
1. Provide capacity building activities/ support for public service personnel to build their capability and confidence to use digital technologies.	Colombia created a dedicated team to develop a program that support digital literacy for government personnel.	
2. Establish a function mandated and accountable for establishing e-government operations (including integration, coordination, implementation, monitoring and evaluation).	Singapore established GovTech to deploy a wide range of ICT solutions in the public sector, growing new capabilities and talent to support digital service delivery.	
3. Improve service delivery to citizens (G2C) for commonly provided government services (including Tax, Licensing, Immigration and Passports, ID, Social Security), and create policies/ regulations to facilitate: • Acceptance protocols for e-signatures • Creation of portals and online platforms that improves ease of access to government services • Public education campaigns to promote G2C e-services • e-payments (G2C and C2G), targeting the unbanked • e-Government procedures/portals on establishment of companies/ legal entities • Procedures/portals for humanitarian crises management • Information search portal	Finland digitized educational content of all subjects and integrated it across all grade levels.	
4. Establish a policy framework for the development of e-procurement activities for government.	Singapore established e-procurement portal, GeBIZ, where suppliers can search for government procurement opportunities, download tender documents, and submit their bids online.	
5. Upgrade government institutions' access, site by site, to broadband connectivity to enhance ability to deliver e-services and operate cloud services.	Singapore developed a private government cloud system and provides secure access to broadband connection that would resulting in a secure and resilient ICT environment for public services.	

Table 4: Recommendations for government

Healthcare

The emergence of digital technology offers tremendous opportunities for the healthcare sector to bring more accessible, affordable, and higher quality healthcare for all. Based on the scorecard findings, we have the following recommendations for policy makers and regulators with respect to the healthcare sector.

Recommendations for policymakers and regulators in the area of ICT	Selected good practice	Impacted SDGs (direct)
1. Establish and implement an e-health master plan that includes an objective to design a comprehensive ICT education, training, and development program for registered healthcare practitioners (doctors, nurses) to increase their level of digital skill in adopting digital methods in the healthcare sector.	N/A	
2. Design and deploy targeted education and awareness building for healthcare ecosystem players, such as community health workers and pharmacists, to utilize digital technologies.	N/A	
3. Establish a mechanism to encourage the development of new healthcare e-services, and localized (including language) content through: • Clearly mandated responsibility to best positioned governmental entity • Monetisation of available healthcare e-services supported by private sector or government entity	N/A	
4. Continuously update the policy and regulatory framework for healthcare to allow for and encourage innovative e-health services and protocols, including new business models and seed-funding and/or public-private partnership arrangements to encourage health care digitalization initiatives in the public or private sector.	Singapore's Health Sciences Authority is the government agency responsible for regulating health products in Singapore to meet the standards of safety, quality and efficacy. Their regulatory activities supports development in the biomedical sector and includes licensing in selective health related products.	
5. Establish e-health data governance regulatory framework that covers privacy, security, interoperability for patient data stored electronically. (EHR, EMR)	Finland established the Archive of Health Information (KanTa) and National Electronic Archive of Patient Health (eArchive) to allow every citizen to access his or her medical records, as well as prescription services.	
6. Enable government and its agencies to access national health data to conduct research into improving health outcomes across society, taking account of data privacy and anonymization requirements.	N/A	

Table 5: Recommendations for Healthcare

Transportation

Limited transportation solutions can adversely impact the economy by reducing productivity (e.g. slowing down the transfer of goods or increase commute time). The scorecard findings with respect to the transportation sector show importance of access to data:

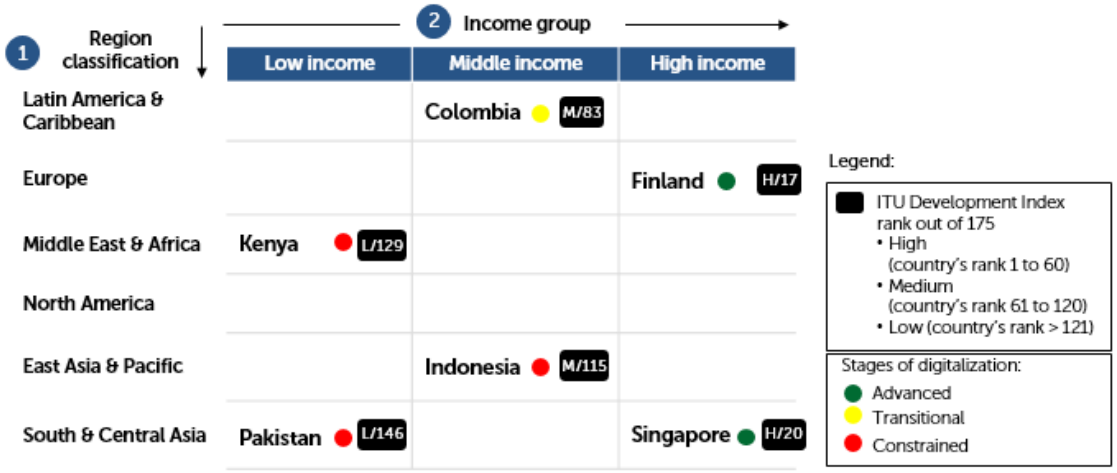
Recommendations for policymakers and regulators in the area of ICT	Selected good practice	Impacted SDGs (direct)
1. Prioritize the implementation of integrated, interoperable e-payment systems for transportation services (especially in cities).	Singapore launched interoperable national e-purse standards that incorporate banking e-purse, transit and electronic road pricing requirements.	
2. Improve citizens' mobility through collecting, analyzing and making available transportation data to users in real-time, with appropriate safeguards regarding data privacy and anonymization requirements.	Finland launched an Intelligent Transport System Strategy to embed digital tools and technologies to support transportation infrastructure planning and construction.	
3. Ensure that data collection and big data analytics is permitted (e.g., data from sensors, CCTVs, drones and other devices used to monitor traffic/movement, and data made available in a digital form to providers of transportation services (both public and private) to enable real-time traffic management for cities and other transportation authorities, with appropriate safeguards regarding data privacy and anonymization. requirements.	Finland allows real-time transportation data to be used and transmitted to service producers, with consideration of citizens' right to privacy and data security.	
4. Enable government and multilateral agencies to access transportation-related data to conduct research into improving ways of commuting, taking account of data privacy and anonymization requirements.	Kenya and Indonesia partnered with private organizations to use anonymized consumer transportation data in studies to improve public transportation systems.	

Table 6: Recommendations for Transportation

Approach and Methodology

We have adopted an approach and methodology for this study that enables us to identify an appropriate sample of countries and sectors for our research, and to develop a framework with which to assess the policy and regulatory environment across these countries and sectors. Two criteria were used to select the countries:

Selection of countries



1. Regional classification

Countries were selected to represent different regions of the world (Latin America & Caribbean, Europe, Middle East & Africa, North America, East Asia & Pacific, South & Central Asia), to provide a broadly representative geographical spread for this study.

2. Income group

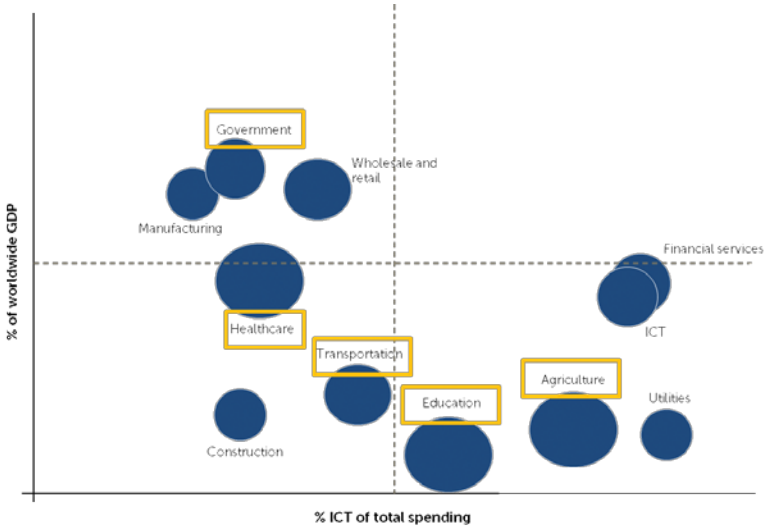
Two countries were selected from each of three income groups based on Gross National Income (GNI) per capita:

- Low income group represents countries with GNI per capita of less than USD 4,035;
- Middle income group represents countries with GNI per capita between USD 4,036 and USD 12,475; and
- High income group represents countries with GNI per capita of more than USD 12,475.

In addition, reference to ITU Development Index (IDI) scores was incorporated in the selection process to understand the level of digitalization maturity in each country and ascertain whether sufficient data was available for this study.

Selection of industries

We selected sectors for this study based on two criteria:



1. Significance to the economy (% of worldwide GDP) and digital spending (Spend on ICT as a % of total spending in a sector)

Sectors were selected for this study based on the percentage of worldwide GDP and percentage ICT of total spending that they represent. The intention was to pick sectors across the segments that will benefit most from digitalization.

2. Level of social impact

In addition, we conducted a qualitative assessment of how the sectors contribute to the achievement of the United Nations Sustainable Development Goals (SDGs), to ascertain social impact made by each sector.

Based on these criteria, we have selected a set of sectors to be assessed in this study and defined the scope of each sector:

Agriculture – Farming activities that include production and distribution processes of agricultural commodities, the raising of livestock or poultry, fishery and any practices performed by farmers in conjunction with farming operations and product sales. Excludes food processing and manufacturing.

Education – Services provided by educational institutions (primary, secondary, tertiary), content development, including educational content development as well as delivery through classes, e-learning, and other channels. Educational institutions exclude training and assessment centres.

Government – Services provided by government at national, regional and local levels, including tax returns, obtaining licenses, driving, death, birth and marriage certificates; immigration and passport services. For the purposes of this report, excludes sector-level services, such as transportation, healthcare, defence, education and utilities.

Healthcare – Health and wellness services provided by healthcare institutions (including hospitals, laboratories and pharmacies, both in the public and private sectors).

Transportation – Provision of terrestrial transportation, including cargo and public transportation services and its supporting infrastructure in all forms. This covers intelligent transportation systems (ITS) that provides innovative services that enable users to make 'smarter' use of transportation networks.

Identification of policy and regulatory blockages/enablers

To provide a consistent method of identifying and evaluating blockages and enablers in the policy and regulatory environment for all five sectors, we developed an assessment framework based on the concept of a high level value chain, as shown below.

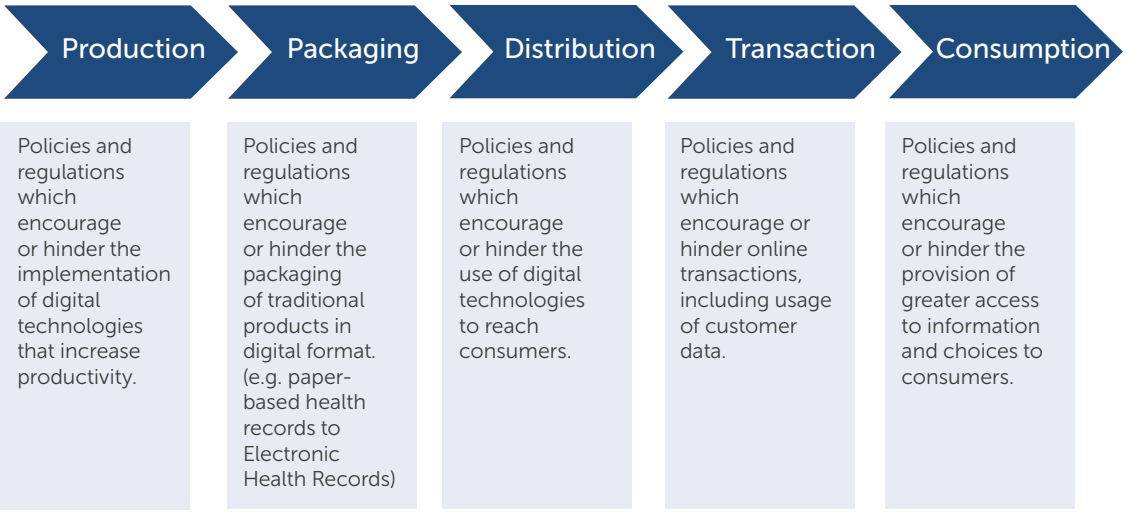


Figure 1: Generic Value Chain

Using the concept of the value chain, we identified the types of blockages and enablers present in the policy and regulatory framework for each of the five sectors as well as the types of blockages and enablers that are common across all sectors, which we termed "digital foundation". The six elements of digital foundation are: digital leadership, digital literacy, cybersecurity, data protection, e-payments, and cloud services. We then defined assessment criteria for each type of blockage/enabler, to enable us to evaluate the degree to which they helped or hindered digitalization.

All information and data reflected in this report, including articles, policies and regulations, and other reports, was gathered between December 2016 and March 2017.

Digital foundation

Blockage / Enabler	Assessment criteria

Digital leadership	• Articulation of digital ambitions supported by institutional frameworks that encourage digitalization across the economy. This may be illustrated by the following examples:
	  • National CIO (likely to be more appropriate for a smaller nation or city state)
	  • Establishment of a national digital agency
	  • Adoption of policies that encourage digitalisation across multiple sectors

Digital literacy	• Promotion of benefit of digital technologies and how to utilize them in daily life, such as sending emails and making online reservation
Cybersecurity	• Establishment of cybersecurity standards and guidelines
Data protection	• Existence of regulations that deal with data privacy, and possible restrictions on the usage of personal data
e-payment	• Existence of regulations addressing transactions made through online platforms using digital financial instruments, such as credit card, mobile money, and electronic cheques.
Cloud services	• Existence of regulations facilitating cloud services

Table 7: Digital Foundation blockages/enablers assessment criteria

Agriculture

Blockage / Enabler		Assessment criteria
A1	Adoption of Internet of Things (IoT) in agriculture	• Promotion of digital literacy and its application in agriculture • Funding of digital innovations in agriculture sector
A2	Improved supply and demand planning using digital technologies	• Policies that enable the capture of accurate agriculture-related information • Policies aiming to provide free access to supply and pricing data through digital platforms
A3	Transparent and direct market access to stakeholders	• Policies that support and enable access to online market platform • e-payment facilitation by the government
A4	Food quality enhancement through the use of digital technology	• Regulations enabling the use of technology to trace the origins, ingredients, and nutrition of food
A5	Scientific research for agricultural development	• Regulations enabling the use of technology to improve the quality of agricultural produce

Table 8: Agriculture blockages/enablers assessment criteria

Education

	Blockage / Enabler	Assessment criteria
E1	Policies supporting e-learning creation and building digital literacy	• Policies supporting creation of robust e-learning content to attract students, including promoting partnerships between government and non-government entities to develop and deliver e-learning content • Policies aiming to building digital literacy
E2	Access to e-learning content	• Funding for Internet connection and technology devices for teachers and students of educational institutions
E3	e-learning content provision	• Open source, Internet freedom, and fraud management for e-learning content
E4	e-learning quality and accreditation	• Minimum standards for e-learning • Standards for accreditation of online courses/studies

Table 9: Education blockages/enablers assessment criteria

Government

	Blockage / Enabler	Assessment criteria
G1	Basis for e-government	• Elements that enhance institutional capacity of public sector to deliver e-government, such as establishment of a function/agency that drives and enables e-government, and policies supporting electronic transactions, universal citizen ID, government cloud, and e-procurement
G2	Budget for digital initiatives and/or attracting third party funding	• Public budget allocation for digitalization (e-government/e-service) initiatives • Enabling private sector investment in e-government/e-service projects • Implementation of e-government and e-service to citizens and businesses
G3	Implementation of e-government/e-service	• Implementation of e-government and e-service to citizens and businesses
G4	Adoption of IoT and access to e-service	• Activities developing digital literacy of government personnel and citizens through promotion and socialization of e-service • Interoperability standards between government agencies and institutions
G5	Collection and sharing of data and information among citizens and government institutions	• Policies/regulations governing the collection of citizens' data and sharing of collected data for non-Governmental purposes (e.g. commercial purposes)

Table 10: Government blockages/enablers assessment criteria

Healthcare

	Blockage / Enabler	Assessment criteria
H1	Adoption of IoT in healthcare	• Policies aiming at improving digital literacy of health sector personnel and health/wellness consumers
H2	Collection and sharing of personal health data	• Interoperability standards for health systems that share patient data • Regulations on electronic data sharing/data protection/ privacy
H3	Access to smart health solutions	• Policies supporting connection/access to e-health services for medical consultation, diagnosis and/or treatment
H4	Legal basis for providing e-health services, acknowledgment of e-health providers by insurance companies	• Making EHR/EMR, e-prescription, telemedicine legally possible • Governmental initiatives to establish protocol and/or standards for providers' accreditation
H5	Use of anonymized health data for scientific purposes or international health initiatives	• Regulation on electronic data sharing/data protection/ privacy across borders • Data format standardization

Table 11: Healthcare blockages/enablers assessment criteria

Transportation

	Blockage / Enabler	Assessment criteria
T1	Adoption of digitally-enabled transportation	• Policy allowing sharing economy business model and other emerging digitally-enabled transportation modes
T2	Collection and sharing of transportation related data	• Public initiatives for traffic management, travel optimization, routing and pricing
T3	Introduction and usage of smart cards/e-payment in transportation systems	• Interoperability standards for cards used by commuters to pay across multiple modes of public transportation
T4	Legal basis for innovative transportation services	• Regulatory framework allowing operation of autonomous vehicles that are capable of sensing their environment and navigating without human input
T5	Access to and use of anonymized consumer transportation data	• Regulatory framework allowing operation of autonomous vehicles that are capable of sensing their environment and navigating without human input

Table 12: Transportation blockages/enablers assessment criteria

Assessment of policy and regulatory framework

We have used different colors to indicate the level of readiness of a country's policy and regulatory framework to support digitalization across digital foundation elements and sectors.

1. Digital foundation – assessment color scheme

The level of readiness of a country's policy and regulatory framework in supporting digitalization with regard to the digital foundation elements (digital leadership, digital literacy, cybersecurity, data protection, e-payment and cloud services) is categorized into three stages:

Policy and regulatory framework is implemented

This indicates that a country has implemented a policy and regulatory framework that governs digitalization, and has successfully incorporated a digitalization agenda into the digital foundation elements. Policy makers should regularly review the policy and regulatory framework to evaluate its relevance in supporting digitalization in the country.

Policy and regulatory framework is in planning phase

This indicates that a country is planning to develop, or is already in the process of implementing a policy and regulatory framework that governs digitalization. Policy makers should pay special attention to digital foundation elements that fall into this category, to ensure that the policy and regulatory framework becomes fully implemented and effectively supports digitalization.

No sufficient framework or no visible plan

This indicates that policy makers of a country do not acknowledge the importance of, or do not yet have, a policy and regulatory framework that governs digitalization. Policy makers should pay special attention to digital foundation elements that fall into this category as there is a high risk that the benefits of digitalization to its sectors will be unrealized or blocked.

2. Sectors – assessment color scheme

The level of readiness of a country's policy and regulatory framework in supporting digitalization with regard to the five sectors selected for this study (agriculture, education, government, healthcare, transportation) is categorized into four stages:

Enabling policy and/or regulation is in place

This indicates that a country has established enabling policies and/or regulations to support digitalization for a specific sector. Policy makers should regularly review the policy and regulatory framework to evaluate its relevance in supporting digitalization in the sector.

Enabling policy and/or regulation is planned

This indicates that a country is planning to develop, or is already in the process of implementing, enabling policies and/or regulations to support digitalization for a specific sector. Policy makers should accelerate the development of such policies and/or regulations to drive the successful development of the sector.

Blocking policy and/or regulation is planned or supportive policy and/or regulation is missing

This indicates that a country either is developing policies and/or regulations that block digitalization or is missing policies and/or regulations that support digitalization for a specific sector. Policy makers should remove or adjust existing policies and/or regulations that block digitalization, and develop policies and/or regulations to support it.

Blocking policy and/or regulation is in place or necessary policy and/or regulation is missing

This indicates that policies and/or regulations already exist that block digitalization or necessary policies and/or regulations for digitalization for a specific sector are missing. Policy makers should take immediate actions to remove or adjust existing policies and/or regulations that block digitalization and establish necessary policies and/or regulations that support digitalization.

Notes to the color scheme

1. In assessing the above issues, a decision has been made in each case of whether a policy or regulation is "in place or implemented," "planned" or deemed "missing." The classification in each case is determined following a reasonable amount of research and consultation to investigate the existence of policies and regulations. It should be noted that the assessment does not include an in-depth review of the quality of policies and regulations or of potential outcomes.

2. In addition, there is an element of judgement involved in determining whether a policy or regulatory measure is "supportive" or "necessary". This has been done by assessing whether a policy intervention is required to enable a specific aspect of digitalization, or whether it could be achieved otherwise, for instance through private sector initiative.

Reference table for digital foundation per country

Digital leadership	Articulation of digital ambitions supported by institutional frameworks that encourage digitalization across the economy. This may be illustrated by the following examples: ▪ National CIO (likely to be more appropriate for a smaller nation or city state) ▪ Establishment of a national digital agency ▪ Adoption of policies that encourage digitalization across multiple sectors		Currently, the Ministry of Information Technologies and Communications is responsible for leading and coordinating the digitalization efforts across various sectors, and implementing the Live Digital Plan, which outlines the national digital agenda for Colombia. Colombia aims for widespread Internet usage through increasing the number of Internet connections and extending the ICT infrastructure to connect the nation through an expanded fibre broadband network. Colombia's Internet connectivity (based on population) increased rapidly from 7% in 2010 to 60% in 2014.
Digital literacy	Promotion of knowledge and skills how to utilize digital technologies in society as an enabler for digitalization		Colombia developed six action plans, which are intended to promote digital literacy in society: • Live Digital Plan • ICT Appropriation Route • PET21 • ICT Strategic Education Plan • Educational Revolution • Decennial Development Plan However, these plans are not yet fully implemented.
Cybersecurity	Establishment of cybersecurity standards and guidelines		In 2011, Colombia implemented the National Planning Policy Guidelines for Cybersecurity and Defence, supplementing existing national and sector-specific cybersecurity frameworks for the implementation of international cybersecurity standards. Colombia also has a national and sector-specific Computer Incident Response Team (CIRT).
Data protection	Existence of regulations that deal with data privacy, and possible restrictions, on the usage of personal data		Law 1581 of 2012 governs the protection of personal data and safeguards the constitutional right to individual privacy, and Decree 1377 of 2013 sets out enforcement guidelines and sanctions for noncompliance with Law 1581. There are also sector-specific data protection laws. Colombia scored 0.588 on the Global Cybersecurity Index in 2014, ranked at 9 out of 29 in the world in terms of its preparedness for cyber-attacks/crimes.

e-payment	Existence of regulations addressing transactions made through online platforms using digital financial instruments, such as credit card, mobile money, and electronic cheques.		The Financial Inclusion Bill, which was approved by the Congress in 2014, created a licence to allow new players, including non-banks such as mobile operators, to enter the low-cost electronic deposits market. Colombia aims to expand the use of digital financial services and electronic payments throughout the country.
Cloud services	Existence of regulations addressing cloud services		Currently, data processing in cloud services is allowed as long as it complies with the applicable data protection provisions under the Electronic Information and Transactions (EIT) law, including Law 1581 of 2012 and Decree 1377 of 2013.

Finland

Blockage/Enabler	Assessment criteria	Result	Explanation
Digital leadership	Articulation of digital ambitions supported by institutional frameworks that encourage digitalization across the economy. This may be illustrated by the following examples: ▪ National CIO (likely to be more appropriate for a smaller nation or city state) ▪ Establishment of a national digital agency ▪ Adoption of policies that encourage digitalization across multiple sectors		Digitalization in Finland is a joint effort across Ministries. While there is no official central agency responsible for facilitating digitalization, the ministries continuously prioritize the development and implementation of digitalization initiatives throughout the country, making Finland one of the most digitally advanced countries in the world. This is evidenced from its 17th rank in ICT Development Index (IDI) 2016 by ITU.
Digital literacy	Promotion of knowledge and skills how to utilize digital technologies in society as an enabler for digitalization		Finland's Digital Agenda for 2011–2020 introduces policy aimed at improving digital skills and Internet access, based on the principle that everyone should have the skills and opportunity to use digital services in Finland. The Digital Agenda also mandates the integration of ICT content into the curriculum for basic education. This includes developing ICT skills of students and teachers. From Q3 2016 onward, basic education will include the teaching of programming skills in each age group.
Cybersecurity	Establishment of cybersecurity standards and guidelines		Finland's Cybersecurity Strategy (2013) defines the key goals and guidelines to respond to threats in the cyber domain and to ensure that cyber activities are secure Finland's information security follows international accreditation standards including ISO 17021 and ISO 27006, with sector-specific regulations. Finland also has a national Computer Incident Response Team (CIRT) The European Centre of Excellence for Countering Hybrid Threats will start its operation in Helsinki in the beginning of 2018.

Data protection	Existence of regulations that deal with data privacy, and possible restrictions, on the usage of personal data		Personal data in Finland is governed by several laws and regulations: • The Constitution of Finland governs general rights to privacy. • The Personal Data Act (523/1999) (PDA), which incorporates the European Union (EU) Data Protection Regulation, governs consent, responsibility for compliance and usage restrictions. • The Information Society Act governs data protection and communications. The Data Protection Ombudsman (DPO) handles questions/complaints from the public regarding data protection.
e-payment	Existence of regulations addressing transactions made through online platforms using digital financial instruments, such as credit card, mobile money, and electronic cheques.		The regulatory framework supports the development and usage of e-payment methods. For example, the Second Payment Services Directive (PSD2) is a piece of legislation in the EU which aims to promote a more integrated and efficient European electronic payments market.
Cloud services	Existence of regulations addressing cloud services		While Finland has not published national guidelines for cloud computing, the European Commission has established the European Cloud Computing Strategy to address ownership, access, portability of data and switching of cloud service providers. • There are no restrictions on processing data in the cloud. Cloud services are allowed as long as they comply with the applicable laws in Finland.

Indonesia

Blockage/Enabler	Assessment criteria	Result	Explanation
Digital leadership	Articulation of digital ambitions supported by institutional frameworks that encourage digitalization across the economy. This may be illustrated by the following examples: ▪ National CIO (likely to be more appropriate for a smaller nation or city state) ▪ Establishment of a national digital agency ▪ Adoption of policies that encourage digitalization across multiple sectors		There is a plan to digitalize some sectors including government, education, health, agriculture and transportation. However, there is currently no central agency responsible for leading and/or coordinating all digital initiatives in Indonesia. For some sectors where digitalization is taking place, continuous performance monitoring and evaluation is managed by the Ministry of Communication and Informatics.
Digital literacy	Promotion of knowledge and skills how to utilize digital technologies in society as an enabler for digitalization		The government has recently created a shared working space in Jakarta open to the public and plans to create more in other areas, to provide access to computers and the Internet, in order to foster digital innovation.
Cybersecurity	Establishment of cybersecurity standards and guidelines		While Indonesia does not yet have a national cybersecurity strategy, it does have regulations governing cybersecurity: • Government Regulation of the Republic of Indonesia Number 82 of 2012 concerning the Implementation of Electronic Systems and Transactions • SNI/ISO/EIC 27001: 2013, Information Security Management Systems • National Information Security Index (Index KAMI) Indonesia also has a national and sector-specific Computer Emergency Response Team (ID-CERT). Indonesia scored 0.471 on the Global cybersecurity Index in 2014, ranked at 13 out of 29 in the world.
Data protection	Existence of regulations that deal with data privacy, and possible restrictions, on the usage of personal data		Data protection and privacy are managed by sector-specific regulators. For example, the Indonesian Financial Services Authority (Otoritas Jasa Keuangan, OJK) has the authority to act as the regulator of data privacy in the capital markets and in relation to banks' consumer data privacy issues. At the national level, both the Electronic Information and Transactions (EIT) Law and Reg. 82 require consent to be obtained from the owner of personal data for the collection, use and processing of such data.

e-payment	Existence of regulations addressing transactions made through online platforms using digital financial instruments, such as credit card, mobile money, and electronic cheques.		Indonesia promotes e-payment innovations and improvements to provide financial access for unbanked citizens by implementing regulations and policies to govern such transactions. There is no regulation that significantly constrains e-payments or online financial services. Indonesia's Financial Services Authority (OJK) has also issued consumer protection regulations regarding electronic payment processing.
Cloud services	Existence of regulations addressing cloud services		Cloud services are currently governed under cybercrime provisions and copyright protection laws without significant restrictions on the processing of data in the cloud, as long as it complies with data protection provisions under EIT law. There is no regulation yet exclusively for cloud services.

Kenya

Blockage/Enabler	Assessment criteria	Result	Explanation
Digital leadership	Articulation of digital ambitions supported by institutional frameworks that encourage digitalization across the economy. This may be illustrated by the following examples: ▪ National CIO (likely to be more appropriate for a smaller nation or city state) ▪ Establishment of a national digital agency ▪ Adoption of policies that encourage digitalization across multiple sectors		The ICT Authority is the Kenyan government agency responsible for managing the government's ICT functions. This agency is also responsible for promoting ICT literacy, capacity, innovation and enterprise in accordance to the Kenya National ICT Master Plan 2017. The ICT Authority has successfully collaborated with various stakeholders in the private sector, civil society and academia in ICT infrastructure development, promoting Kenya's innovation and investment, and building strong ICT businesses. The government has also established the Kenya Innovation Agency (KENIA) to manage the national innovation framework, including in ICT, under the supervision of the State Department of Education, Science and Technology.
Digital literacy	Promotion of knowledge and skills how to utilize digital technologies in society as an enabler for digitalization		The government of Kenya has developed a strategy to promote ICT innovation within society through centres of excellence (CoEs) and science and technology (S&T) parks for research and development of ICT applications and services that will enhance the digital literacy of the younger generation and entrepreneurs.
Cybersecurity	Establishment of cybersecurity standards and guidelines		Specific legislation on cybercrime, regulations and compliance related to cybersecurity has been enacted through Kenya's Information and Communication Act. Kenya is currently in the process of developing an official national cybersecurity strategy. Kenya scored 0.412 in the Global Cybersecurity Index in 2014, ranked at 15 out of 29 in the world.
Data protection	Existence of regulations that deal with data privacy, and possible restrictions, on the usage of personal data		Kenya currently does not have laws regarding data protection. However, there is a draft law, the Data Protection Bill, which regulates the collection, processing, storage, use and disclosure of personal data within the country. The draft of the Data Protection Bill 2013 aims at protecting personal data in accordance with Article 31 of the constitution guaranteeing the right to privacy. The Bill outlines how people's data can be collected and stored, and how agencies can collect, process and safeguard personal data.

e-payment	Existence of regulations addressing transactions made through online platforms using digital financial instruments, such as credit card, mobile money, and electronic cheques.		The government is taking steps to improve the regulatory framework around payment service providers by promoting digital platform participation. The Central Bank of Kenya (CBK) passed the National Payment System Regulations (2014) to govern the digitalization of government services and payment platforms. The new regulations are expected to provide greater transparency for new market entrants, as well as increasing competition and collaboration within the payments market in Kenya.
Cloud services	Existence of regulations addressing cloud services		While there are currently no specific cloud computing service regulations in Kenya regarding restrictions, security and jurisdiction, Kenya's ICT Cabinet announced the development of the Information Communication Technology Practitioners Bill (2016) to standardize ICT practice in the country. In addition, the draft of the Data Protection Bill 2013 aims to ensure that personal data is secured in accordance with Article 31 of the Constitution, which guarantees the right to privacy. These bills are currently undergoing public consultations with stakeholders.

Pakistan

Blockage/Enabler	Assessment criteria	Result	Explanation
Digital leadership	Articulation of digital ambitions supported by institutional frameworks that encourage digitalization across the economy. This may be illustrated by the following examples: ▪ National CIO (likely to be more appropriate for a smaller nation or city state) ▪ Establishment of a national digital agency ▪ Adoption of policies that encourage digitalization across multiple sectors		Pakistan's Ministry of Information Technology and Telecommunications (MoITT) was established with a vision to utilize ICT to accelerate the creation of a national digital ecosystem. The ministry formulated the draft Digital Pakistan policies and an action plan, which it is also responsible for implementing. There are agencies under the umbrella of MoITT that assist in driving digitalization at the national, provincial and sector-specific levels: The National ICT R&D Fund and Universal Service Fund assist MoITT with digital initiatives at the national level. The Punjab IT Board and KPK IT Board have their own budgets to drive digital initiatives at the provincial level. The National IT Board is the body at the national level that leads e-government initiatives across sectors.
Digital literacy	Promotion of knowledge and skills how to utilize digital technologies in society as an enabler for digitalization		The ICT R&D Fund established the National Technical Training Program for ICT skills development, to equip the youth of Pakistan with the ICT skills required for employment. MoITT, with a private sector partner, launched the ICT for Girls program comprising the elements of computing, coding, communication, and coaching, with the goal of improving ICT literacy for girls.
Cybersecurity	Establishment of cybersecurity standards and guidelines		The Prevention of Electronic Crime Act (PECA) 2016 was established to protect Internet users against cyber-crimes including cyber stalking, cyber-terrorism, cyber-fraud and cyber-attacks. The draft Digital Pakistan (2017) plan also addresses the need for a cybersecurity framework in the IT system to mitigate the risks of cyber-crime and respond to cyber-attack. The section on cybersecurity includes policies for digital information protection and cybersecurity awareness. PakCERT, Pakistan's official Computer Emergency Response Team (CERT), was established to respond to potential cyber-attacks. Pakistan scored 0.176 in the Global cybersecurity Index in 2014, ranked at 23 out of 29 in the world.

Data protection	Existence of regulations that deal with data privacy, and possible restrictions, on the usage of personal data		Pakistan's Data Protection Act was drafted in 2005 but has not yet been enacted into law. The draft Data Protection Act regulates the treatment of sensitive data. According to the draft Act, sensitive data belongs under the certification council. Once it is passed, the Act needs to be revised every two years to reflect technological advances. Data protection and privacy are indirectly regulated through other acts, including the Electronic Transactions Ordinance, the Freedom of Information Ordinance and the Prevention of Electronic Crimes Act.
e-payment	Existence of regulations addressing transactions made through online platforms using digital financial instruments, such as credit card, mobile money, and electronic cheques.		There are no regulations governing e-payments in Pakistan, although the draft Digital Pakistan (2017) plan addresses the need to establish e-trade and e-commerce regulations. Efforts have been undertaken to promote e-payment in Pakistan: • The Ministry of Commerce is in the process of finalizing a draft e-commerce framework which includes an initiative to establish a national e-payment gateway. • The Prime Minister established a working group focusing on e-payment infrastructure, to foster an environment conducive for e-commerce. • The MoITT established the Inter-Ministerial Committee (IMC) to develop a holistic approach for developing e-commerce to attract international players. The State Bank of Pakistan requires minimum paid-up capital of PKR 200 million (approx. USD 2 million) for e-payment innovators. This sets a high barrier to entry to the online payments sector in Pakistan. Mobile money services in Pakistan enable e-commerce and m-commerce, which allow users to conveniently make online payments through mobile accounts and merchant partner debit/credit cards.
Cloud services	Existence of regulations addressing cloud services		There is no regulation that limits the use and processing of data through cloud services. The draft Digital Pakistan (2017) plan encourages the development of a framework of standards, privacy and classification for cloud-based services. MoITT, in collaboration with a private sector partner, inaugurated national data centres to provide cloud computing services to government agencies.

Singapore

Blockage/Enabler	Assessment criteria	Result	Explanation
Digital leadership	Articulation of digital ambitions supported by institutional frameworks that encourage digitalization across the economy. This may be illustrated by the following examples: ▪ National CIO (likely to be more appropriate for a smaller nation or city state) ▪ Establishment of a national digital agency ▪ Adoption of policies that encourage digitalization across multiple sectors		The Infocomm Media Development Authority (IMDA) is a statutory board of the government of Singapore. IMDA leads the digital transformation of Singapore through promoting the development and delivery of secure and reliable digital services to individuals and businesses. IMDA contributes to the country's Smart Nation Vision by building a digitally inclusive society, encouraging all sectors to increase the adoption and usage of ICT.
Digital literacy	Promotion of knowledge and skills how to utilize digital technologies in society as an enabler for digitalization		Singapore's government promotes digital literacy in society through a program that aims to achieve 100% computer ownership in homes with school-age children. Infocomm Club is another initiative by the government, in the form of after-school programs, which promotes 'ethical hacking' and cybersecurity education to students across the nation.
Cybersecurity	Establishment of cybersecurity standards and guidelines		Singapore has a national Computer Emergency Response Team (CERT), known as SingCERT. In addition, the Government IT Security Incident Response (GITSIR) team coordinates various relevant government agencies to perform investigations and responses to IT security incidents. International cybersecurity standards, such as the ISO27000 series, are referenced in the development of government security policies and standards. In Singapore, cybersecurity professionals are encouraged to obtain international certifications such as CISSP and the SANS series of certifications. The Cyber Security Associates and Technologists (CSAT) Programme administered by the Cyber Security Agency of Singapore (CSA), in collaboration with IMDA, trains and up-skills fresh ICT professionals and mid-career professionals for Cyber Security jobs. Singapore scored 0.676 in the Global Cyber security Index in 2014, ranked at 6 out of 29 in the world in terms of its preparedness for cyber-attacks/crime.

Data protection	Existence of regulations that deal with data privacy, and possible restrictions, on the usage of personal data		Personal data in Singapore is protected under the Personal Data Protection Act 2012 (PDPA). PDPA governs the collection, use, and disclosure of personal data. It recognizes the rights of individuals to protect their personal data, including rights of access and correction, and the needs of organizations to collect, use and/or disclose personal data for legitimate and reasonable purposes.
e-payment	Existence of regulations addressing transactions made through online platforms using digital financial instruments, such as credit card, mobile money, and electronic cheques.		The Monetary Authority of Singapore (MAS) has created a regulatory framework to promote innovation, encourage non-traditional FinTech players to access the Singapore market, and provide a wider spectrum of payment solutions. MAS actively fosters digital innovation in the financial services sector, collaborating with various FinTech players to create new electronic payment systems, which envisage payments from one entity to another using mobile phone numbers and email addresses. MAS is working to introduce a single regulation for conventional and digital payment service providers that would benefit consumers without compromising the safety of their data.
Cloud services	Existence of regulations addressing cloud services		Singapore's guidelines regarding cloud services have laid out steps on how to address the risks associated with access of data in cloud systems, including its confidentiality, integrity, sovereignty, recoverability, regulatory compliance and auditing. In particular, the guidelines encourage a risk-based approach to be taken by institutions to ensure that the levels of oversight and controls are commensurate with the risks posed by the cloud services. The guidelines have no restrictions on cloud services located in other jurisdictions. However, personal data that is transferred outside of Singapore should follow the standards of protection under the PDPA.

Reference table for policy and regulatory framework per country

Colombia – Agriculture

Blockage/Enabler		Assessment criteria	Result	Explanation
A1	Adoption of Internet of Things (IoT) in agriculture	Promotion of digital literacy and its application in agriculture Funding of digital innovations in agriculture sector		There is no dedicated policy to encourage digital literacy in the agriculture sector. However, the Live Digital Plan aims to increase the nation's digital literacy through the use of ICT across sectors by 2019. Some agriculture subsectors, including agricultural technologies and digital innovations, are partly financed through Parafiscal Funds, made of mandatory contributions by the producers established by Law 101 of 1993. Parafiscal Funds are financial resource funds which are administered by producer associations and provide specific services and programs, including research, technology knowledge transfer and technical assistance.
A2	Improved supply and demand planning through the use of digital technologies	Policies that enable the capture of accurate agriculture-related information Policies aiming to provide free access to supply and pricing data through digital platforms		There is no policy regarding access to demand, supply and prices data, and the accurate capture of agriculture-related information. Access to such data is currently provided by private organizations. For example, Colombia has an online platform that provides farmers with free access to connect with other farmers/stakeholders for information sharing, such as on climate change.
A3	Transparent and direct market access to stakeholders	Policies that support and enable access to online market platform e-payment facilitation by the government		There is no policy regarding connection and access to market platforms in the agriculture sector. E-payments are currently regulated and facilitated in Colombia. However, there is no specific encouragement for the agriculture sector to leverage e-payments in facilitating transactions between farmers and buyers.
A4	Food quality enhancement through the use of digital technology	Regulations enabling the use of technology to trace the origins, ingredients, and nutrition of food		Food safety standards are issued and enforced by the National Institute for the Surveillance of Food and Medicines (INVIMA) under the Ministry of Health and Social Protection. INVIMA is also responsible for establishing policies to ensure food quality and safety. INVIMA has requires Critical Control Point (CCP) technology for fishery products that will be exported and imported. There is no emphasis on the utilization of digital technologies to enhance food quality.
A5	Scientific research for the purpose of agricultural development	Regulations enabling the use of technology to improve the quality of agricultural produce		The Colombian Corporation for Agricultural Research is generating scientific knowledge and developing agricultural technologies through research, technology adaptation and transfer, and technical assistance for improving production competitiveness, equitable distribution of the benefits of technology, and sustainable use of natural resources. This will strengthen Colombia´s scientific and technological capacities in the agriculture sector.

Colombia – Education

Blockage/Enabler		Assessment criteria	Result	Explanation
E1	Policies supporting e-learning creation and building digital literacy	Policies supporting creation of robust e-learning content to attract students, including promoting partnerships between government and non-government entities to develop and deliver e-learning content Policies aiming to building digital literacy		Colombia has programs and initiatives to develop e-learning content together with the private sector, such as A Que te Cojo Ratón, which is a basic online training program for PowerPoint and Excel sponsored by the private sector. Colombia has also entered into project-based partnerships with international organizations to promote the use of technology in open-ended learning environments. In accordance with the National Development Plan (NDP), the Ministry of Education has created Portal Colombia Learn to raise the level of education in the country. The NDP is planning to develop a teacher training program to stimulate innovation practices for learners using technology.
E2	Access to e-learning content	Funding for Internet connection and technology devices for teachers and students of educational institutions		As part of the realization of the Live Digital Plan, Colombia has given 82,000 computers to students in more than 3,500 educational sites through the Computers to Educate Program (CPE). The goal of this program is to improve the quality of education, and better familiarize teachers and students with digital technology. Other programs and initiatives related to e-learning are supported and funded by the Ministry of Education and the Ministry of Information Technologies and Communication.
E3	e-learning content provision	Open source, Internet freedom, and fraud management for e-learning content		Currently, the Ministry of Education does not have regulations against open source for e-learning materials. There is no regulation regarding Internet freedom that limits e-learning content provision. Internet There are no regulations governing fraud management in relation to e-learning content.
E4	e-learning quality and accreditation	Minimum standards for e-learning Standards for accreditation of online courses/studies		According to Law 1341 of 2009, the Ministry of Information Technology and Communications must design and formulate policies to coordinate and standardize actions for the implementation and use of ICT in the education sector. Therefore, the Ministry of Education created the Office of Educational Innovation and Use of New Technologies to promote digital teaching at all levels. This includes the mobility of students and teachers and the establishment of qualifications and accreditation standards.

Colombia – Government

Blockage/Enabler		Assessment criteria	Result	Explanation
G1	Basis for e-government	Elements that enhance institutional capacity of public sector to deliver e-government, such as establishment of a function/agency that drives and enables e-government, and policies supporting electronic transactions, universal citizen ID, government cloud, and e-procurement		According to Decree 2618-2012, the e-government Office of Colombia was established under the Ministry of ICT in Colombia. Under NDP 2010-2014, the government has initiated a series of actions to modernize public administration, improve availability of and access to government information, and promote transparency and the development of new technologies and innovation. This is evidenced by the government's deployment of cloud solutions to facilitate its procurement activities in 2014. In 2016, the UN e-government index ranked Colombia 57th out of 193 countries.
G2	Budget for digital initiatives and/or attracting third party funding	Public budget allocation for digitalization (e-government/e-service) initiatives Enabling private sector investment in e-government/e-service projects		In 2014, the government announced budget allocation for e-government development in its Live Digital Plan II (2014-2018). The government established a website (www.pte.gov.co) that provides information on budget execution and payments available to citizens. According to the Action Plan of the government of Colombia – Open Government Partnership, alliances will be promoted between the government, the private sector and civil society to set guidelines for self-regulation for good governance in critical sectors such as infrastructure and public services. In addition, the Live Digital Plan mentions a partnership between the government and the private sector to develop government services.
G3	Implementation of e-government /e-service	Implementation of e-government and e-service to citizens and businesses		According to the Action Plan of the government of Colombia – Open Government Partnership, the government developed a strategy that is citizen-centered and has been implemented in five phases: information, interaction, transaction, transformation and democracy. Some important accomplishments have been achieved, such as the introduction of procedures and services through electronic media, the creation of scenarios for participation, and the improvement of the quality of information in public agencies. It also presents several improvement mechanisms for e-government, including: • Online transactions for services provided by government agencies and e-democracy to encourage civil society participation. • e-government roll-out at the regional level. e-government implementation began in 2015, followed by subsequent improvements in the monitoring and evaluation model.

G4	Adoption of IoT and access to e-service	Activities developing digital literacy of government personnel and citizens through promotion and socialization of e-service Interoperability standards between government agencies and institutions		According to Colombia's e-government monitoring and evaluation model, there is a dedicated team that specializes in developing the main elements that support digital literacy for government personnel. The model is comprised of six professional sectors (law, international relations, political science, public administration, social, communication) collaborating with e-government office teams and external stakeholders. According to the Live Digital Plan, policies and directives were formed to promote e-government development. These were implemented in relation to security, usage, interoperability, data access and zero paper. Additionally, the Action Plan of the government of Colombia – Open Government Partnership states that the government will implement initiatives to encourage commitment, ethical behaviour and transparency among civil servants through the development of interoperable information systems that allow for higher quality data and more efficient processes, In 2016, the UN e-participation index ranked Colombia 27th out of 193 countries.
G5	Collection and sharing of data and information among citizens and government institutions	Policies/regulations governing the collection of citizens' data and sharing of collected data for non-Governmental purposes (e.g. commercial purposes)		According to the Action Plan of the Government of Colombia – Open Government Partnership, Colombia has an open data initiative which promotes the posting and disclosure by all State entities of their non-sensitive data in a uniform and open-format manner. This data can be used by anyone for commercial purposes or to perform analysis or research. The open data site will enable different agencies to publish data for access and use by the public. According to the e-Government Strategy, Decree 2693 of 2012, the establishment and implementation of protocols for data openness and usage are a priority for e-government in Colombia. Guidelines are provided for posting government-generated data in an open and reusable manner, to encourage its use by third parties to create new added value services for the citizens. However, all data collection, usage, and sharing activities must comply with the applicable data protection laws.

Colombia – Healthcare

Blockage/Enabler		Assessment criteria	Result	Explanation
H1	Adoption of IoT in healthcare	Policies aiming at improving digital literacy of health sector personnel and health/wellness consumers		The government of Colombia is implementing "The Strategy and Plan of Action on e-health" developed by the Pan-American Health Organisation (PAHO) that mentions the provision of courses or programs (not necessarily formally accredited) for health professionals to help them develop ICT skills for application in the health sector. This includes current methods for sharing scientific knowledge, such as e-publication, open access, digital literacy and the use of social networks. In addition, the Live Digital Plan aims to increase the nation's digital literacy through the use of ICT across all sectors by 2019, including the healthcare sector.
H2	Collection and sharing of personal health data	Interoperability standards for health systems that share patient data Regulations on electronic data sharing/data protection/privacy		According to the Strategy for Universal Access to Health and Universal Health Coverage 2014 by PAHO, data in the healthcare system must be comprehensive, timely and reliable, and must be interoperable with other offices and their systems. The strategy mentions the creation of an electronic exchange for demographic, clinical and epidemiological data among different healthcare agents. There is no specific regulation regarding electronic data sharing in healthcare sector. Currently, e-health data can be used, processed and shared in line with applicable data protection laws, as long as patient consent is obtained.
H3	Access to smart health solutions	Policies supporting connection/access to e-health services for medical consultation, diagnosis and/or treatment		According to the Decennial Public Health Plan 2012-2021, the Ministry of Health and Social Protection ensures access to health data, health-relevant information, knowledge and scientific evidence for decision-making. The ministry is responsible for monitoring e-health progress at local, institutional and national levels. The Ministry of Health and Social Protection has developed open access systems, named the Digital Institutional Repository (RID). RID is an online channel for users to retrieve health-related information, such as clinical guides, methodological guides, documents, reports and surveys.

H4	Legal basis for e-health provision, acknowledgment of e-health providers by insurance companies	Making EHR/EMR, e-prescription, telemedicine legally possible Governmental initiatives to establish protocol and/or standards for providers' accreditation		According to Law 1438 of 2011, Unique Electronic Health Records are mandatory starting from the end of 2013. According to Law 1122 of 2007, e-health services are to be rolled out to remote areas. According to Law 1438, the Agency of Health Technology Assessment is responsible for designing, developing and overseeing clinical guidelines, including EHR/EMR. It also oversees prescriptions and telemedicine.
H5	Use of anonymized health data for scientific purposes or international health initiatives	Regulation on electronic data sharing/data protection/privacy across borders Data format standardization		Although there are no regulations governing electronic data sharing in the healthcare sector, the Strategy and Plan of Action on e-Health states that it is necessary to formulate technical and methodological standards for sharing anonymous data and information and knowledge in accordance to targets in the Strategy Plan of Action. Colombia has adopted HL7-FHIR, which is a standard for exchanging healthcare information electronically in a structured and standardized format.

Colombia – Transportation

Blockage/Enabler		Assessment criteria	Result	Explanation
T1	Adoption of digitally-enabled transportation	Policy allowing sharing economy business model and other emerging digitally-enabled transportation modes		Sharing economy business models emerged in Colombia in 2015, but there have been several efforts by the Ministry of Transport to shut down the operation of several of these businesses due to their potential violations of labour and tax laws.
T2	Collection and sharing of transportation related data	Public initiatives for traffic management, travel optimization, routing and pricing		There are no policies and/or regulations regarding traffic management, travel optimisation, routing and pricing. The National Urban Transit Program (NUTP) is designed to strengthen the capability of cities relating to traffic and transportation planning and management, and regulatory oversight and control.
T3	Introduction and usage of smart cards/e-payment in transportation systems	Interoperability standards for cards used by commuters to pay across multiple modes of public transportation		While there is no policy encouraging the interoperability of travel and cash cards, a private organization offers an advanced foundation for developing highly secure, interoperable and flexible applications including an automated fare collection trial in Medellin, Colombia.
T4	Legal basis for innovative transportation services	Regulatory framework allowing operation of autonomous vehicles that are capable of sensing their environment and navigating without human input		While one objective of the Live Digital Plan is to digitalize and automate the transportation sector, autonomous vehicles are not yet regulated in Colombia.
T5	Access to and use of anonymized consumer transportation data	The use of data to plan infrastructure investment Government and private sector planning and research to develop and improve digitally-enabled transportation options		There is no policy regarding ICT infrastructure investments to enhance access to and use of consumers' transportation data for infrastructure investment planning purposes. However, the government has undertaken significant efforts in the last decade to address shortcomings in infrastructure, including roads and railways.

Finland – Agriculture

Blockage/Enabler		Assessment criteria	Result	Explanation
A1	Adoption of Internet of Things (IoT) in agriculture	Promotion of digital literacy and its application in agriculture Funding of digital innovations in agriculture sector		Despite Finland's focus on improving digital skills (Digital Agenda for 2011–2020), there is no specific policy to encourage digital literacy in the agriculture sector. While there is no formal policy that drives the funding of digital innovations specifically in the agriculture sector, Tekes, the funding agency for technology and innovation, provides funding for digital innovation and research across all sectors, including agriculture.
A2	Improved supply and demand planning through the use of digital technologies	Policies that enable the capture of accurate agriculture-related information Policies aiming to provide free access to supply and pricing data through digital platforms		Finland has put in place an initiative, driven by Tekes, to improve supply and demand planning through the distribution of digital devices that allow farmers to upload their information and access supply and demand data online. In addition, Statistics Finland provides agriculture related information such as supply and prices on its website for public access.
A3	Transparent and direct market access to stakeholders	Policies that support and enable access to online market platform e-payment facilitation by the government		According to the Rural Development Program for Mainland Finland 2014–2020, Finland promotes innovative uses of digital technology and online services in the areas of direct sales and local markets to improve the productivity and competitiveness of the agricultural sector. However, there is no policy specifically for the agriculture sector that encourages e-payment.
A4	Food quality enhancement through the use of digital technology	Regulations enabling the use of technology to trace the origins, ingredients, and nutrition of food		According to Food Law Regulation EC1978/2002, all European Union member states are required to follow food safety legislation, including but not limited to Critical Control Point (CCP) management systems, irradiation and labelling. The regulation also requires the establishment of a comprehensive system of traceability within food businesses so that accurate data can be provided to consumers and officials, identifying the point of control failures in the food supply chain and thereby mitigating the risk for system-wide disruption in the event of food safety problems.
A5	Scientific research for the purpose of agricultural development	Regulations enabling the use of technology to improve the quality of agricultural produce		According to the Research and Development Strategy of the Ministry of Agriculture and Forestry (2012-2017), the Ministry of Agriculture and Forestry promotes the use of agriculture related information resources by opening databases for public access. In addition, Finland has established the Department of Agricultural Sciences to perform scientific research in the agriculture sector, including plant production in agriculture and horticulture, livestock breeding and technologies pertaining to them.

Finland – Education

Blockage/Enabler		Assessment criteria	Result	Explanation
E1	Policies supporting e-learning creation and building digital literacy	Policies supporting creation of robust e-learning content to attract students, including promoting partnerships between government and non-government entities to develop and deliver e-learning content Policies aiming to building digital literacy		According to the New National Core Curriculum, e-learning will be integrated into all subjects across grade levels. Computer programming will also be incorporated into the educational curricula, starting with graphical tools in grades 3-6, followed by designing work programs in development environments in grades 7-9. The system of national education and training committees maintained by the Finnish National Board of Education consists of 26 committees representing different sectors. The role of this system includes preparing initiatives and developing e-learning content for the education sector. To advance the digital skills of teachers and students, the Ministry of Education and Culture published a new discretionary appropriation in 2014, which aims to encourage teachers to adopt ICT in their teaching. The objective is to build teachers' capabilities to use new teaching methods and tools in a variety of manners and to increase students' motivation through the use of new technology in learning.
E2	Access to e-learning content	Funding for Internet connection and technology devices for teachers and students of educational institutions		According to the Education and Training 2020 report by the Ministry of Education and Culture of Finland, the development of new and innovative solutions, including technology devices and digital innovation programs for teachers and students, is supported by various sources of funding such as the Lifelong Learning Programme 2007–2013 by the European Union and the European Social Fund by the European Commission.
E3	e-learning content provision	Open source, Internet freedom, and fraud management for e-learning content		Finland places minimal restrictions on e-learning content. Finnish Virtual University (FVU) monitors the quality of e-learning, including fraud management.
E4	e-learning quality and accreditation	Minimum standards for e-learning Standards for accreditation of online courses/studies		There is no national framework that governs minimum standards for e-learning and accreditation of online courses/studies in Finland. The existing e-learning program to obtain a bachelor degree is arranged in co-operation with universities.

Finland – Government

Blockage/Enabler		Assessment criteria	Result	Explanation
G1	Basis for e-government	Elements that enhance institutional capacity of public sector to deliver e-government, such as establishment of a function/agency that drives and enables e-government, and policies supporting electronic transactions, universal citizen ID, government cloud, and e-procurement		According to the Act on Information Management Governance in the Public Sector, the Ministry of Finance is responsible for leading information management governance in central and local Governments. The Ministry of Finance is in charge of public sector digitalization activities and operates the Government 'spearhead' program in this area. The spearhead program will invest €220 million between 2015-2019 for several projects, including a national income registry and a national data exchange layer. The Ministry of Finance is responsible for guiding public sector agencies towards ICT adoption, but each ministry is responsible for ICT adoption in its own field of activity. With the Government Resolution on the Objectives of the National Information Society Policy for 2007-2011, the government aims to develop electronic purchasing, invoicing and payment processes. This resolution promotes electronic identification as an administrative and regulatory basis for the use of biometric identification, and promotes cooperation among actors in electronic identification. In 2016, the UN e-government index ranked Finland 5th out of 193 countries.
G2	Budget for digital initiatives and/or attracting third party funding	Public budget allocation for digitalization (e-government/e-service) initiatives Enabling private sector investment in e-government/e-service projects		According to the EU e-government Action Plan 2016-2020, funding sources are available for Member States through different EU programs, such as the Connecting Europe Facility (CEF), ISA program (Interoperability solutions for European Public Administrations), Horizon 2020, European Structural and Investment Funds (ESIF), the Justice Programme and the Structural Reform Support Programme (SRSP). Another funding source for e-government is from the national government budget. There is no policy to encourage Public Private Partnerships (PPP) for e-government/e-service projects.
G3	Implementation of e-government /e-service	Implementation of e-government and e-service to citizens and businesses		Finland has implemented several e-government strategies: • National Knowledge Society Strategy for 2007-2015 • Government Resolution on the Objectives of the National Information Society Policy for 2007-2011 • Ubiquitous Information Society Action Programme 2008-2011 • eServices and eDemocracy Acceleration (SADe) Programme (2009-2014)

				According to the EU e-government Action Plan for 2016-2020, the eGovernment Action Plan Steering Board, comprised of representatives of Member States, is responsible for the effective implementation and monitoring of the action plan.
G4	Adoption of IoT and access to e-service	Activities developing digital literacy of government personnel and citizens through promotion and socialization of e-service Interoperability standards between government agencies and institutions		According to the EU e-government Action Plan 2016-2020, digital literacy of civil servants is important to the development of e-government, which is regarded as an instrument of change to improve operational processes within the government. The Act on Information Management Governance in Public Administration (634/2011) gives the Ministry of Finance the legal authority to govern the interoperability of public administration information systems. In addition, Finland has introduced a national data exchange solution as part of the implementation of the National Architecture for Digital Services. This data exchange solution enables an interoperable data exchange among public and private sector entities, and across national borders. Public sector organizations are now obligated to implement this technology in delivering e-services. In 2016, the UN e-participation index ranked Finland 11th out of 193 countries. This indicates that the government has been successful in encouraging its citizens to access and use e-government services.
G5	Collection and sharing of data and information among citizens and government institutions	Policies/regulations governing the collection of citizens' data and sharing of collected data for non-Governmental purposes (e.g. commercial purposes)		The Act on the Openness of Government Activities allows the collection of personal data of citizens as long as the requestor declares what the data can be used for. (Chapter 14, Section 13) The Act also states that access to personal data for the purpose of direct marketing, polls or market research shall not be granted unless specifically provided otherwise or unless the individual in question has given consent.

Finland – Healthcare

Blockage/Enabler		Assessment criteria	Result	Explanation
H1	Adoption of IoT in healthcare	Policies aiming at improving digital literacy of health sector personnel and health/wellness consumers		The Government Resolution on the Objectives of the National Information Society Policy for 2007-2011, states that the Ministry of Social Affairs and Health is responsible for promoting innovations and electronic services in social services and healthcare to citizens and medical practitioners. According to Information to Support Wellbeing and Service Renewal, Finland has encouraged the adoption of the IoT in healthcare since the mid-2000s. They have started to adopt Electronic Medical Records (EMR).The standards for the content thereof have been developed since the 1990s, and technical data transfer standards since the 2000s.
H2	Collection and sharing of personal health data	Interoperability standards for health systems that share patient data Regulations on electronic data sharing/data protection/privacy		Under the e-health and e-social Strategy of Finland (Information to Support Wellbeing and Service Renewal) there is a plan to develop legislation regarding interoperability for e-health by 2020. Accessibility, integrity and protection of patient data in the national information system is regulated under the Act on the Electronic Processing of Client Data in Social and Healthcare (159/2007).
H3	Access to smart health solutions	Policies supporting connection/access to e-health services for medical consultation, diagnosis and/or treatment		Access to e-health and telemedicine (e.g. e-prescription, e-consultation) services is allowed and guidelines have been set by Finland's telemedicine authority to govern its operations to protect the interests of its patients. Promotion of e-health services is performed by the Government and private sector healthcare providers.
H4	Legal basis for e-health provision, acknowledgment of e-health providers by insurance companies	Making EHR/EMR, e-prescription, telemedicine legally possible Governmental initiatives to establish protocol and/or standards for providers' accreditation		According to the Act on Electronic Prescriptions 61/2007, e-prescriptions are allowed, and the operations are regulated to ensure that patient information is secured. The Advisory Board for Electronic Information Management in Social and Healthcare drives the development of national information system services in the healthcare sector, such as the National Archive of Health Information (KanTa) and National Electronic Archive of Patient Health (eArchive). The board is also responsible for setting standards for service qualifications and accreditations.
H5	Use of anonymized health data for scientific purposes or international health initiatives	Regulation on electronic data sharing/data protection/privacy across borders Data format standardization		According to the Act on the Electronic Processing of Client Data in Social and Healthcare (159/2007), electronic data sharing for the purposes of scientific research and compilation of statistics is allowed if the patient gives consent. The Ministry of Social Affairs and Health has set standards for patient information in the national repository based on HL7 V3: CDA R2 Clinical Document Architecture (CDA).

Finland – Transportation

Blockage/Enabler		Assessment criteria	Result	Explanation
T1	Adoption of digitally-enabled transportation	Policy allowing sharing economy business model and other emerging digitally-enabled transportation modes		Finland allows the operation of digitally-enabled transportation systems. According to the Enabler for MaaS: Finnish Transport Code by Ministry of Transport and Communications, the new Law of Transportation Services is projected to enter into force in 2018. This legislation will support the digital business environment, including Mobility-as-a-Service (MaaS) by forcing public transportation operators to electronically share their schedules and routes data. The national tax office has issued guidance on how taxation should be treated with income derived from activities of sharing economy business models. The new Law of Transportation Services creates the preconditions for digitalization in the transportation sector and new business models to promote fairness of competition. This includes discontinuation of taxi price regulations and enhancement of new technology, digitalization and new business concepts.
T2	Collection and sharing of transportation related data	Public initiatives for traffic management, travel optimization, routing and pricing		According to Finland's Strategy for Intelligent Transport Systems (ITS), there is a plan to develop traffic control and management systems to provide real-time information and predictions on traffic accidents and incident situations in certain areas: • Road traffic control systems for more efficient and intelligent data compilation systems and user interfaces. • Rail traffic control systems for more efficient and intelligent rail network capacity allocation and real-time passenger data processing. In addition, transportation authorities in Finland are collaborating with the private sector to develop and test ITS solutions for extreme weather conditions. The new Law of Transportation Services proposes that essential data on transportation services are made available to the public.
T3	Introduction and usage of smart cards/e-payment in transportation systems	Interoperability standards for cards used by commuters to pay across multiple modes of public transportation		According to Directive 2004/52/EC, interoperability of electronic road toll systems in the European Union is required, including in Finland. In 2010, the Ministry of Transport and Communications started a project to create an interoperable national public transportation payment system. The target is to use mobile payment and identification in public transportation, parking, and mobility services throughout the country.

				The new Law of Transportation Services also lays down provisions for the interoperability of ticketing and payment systems. Currently, the implementation of the national public transportation payment system has been successful. Commuters can obtain tickets directly on their mobile phones for multiple modes of public transportation.
T4	Legal basis for innovative transportation services	Regulatory framework allowing operation of autonomous vehicles that are capable of sensing their environment and navigating without human input		The Ministry of Transport and Communications has drafted an updated version of the Road Traffic Act to prepare for automation. For example, persons inside a motor vehicle are regarded as road users even though they may not be controlling the vehicle. The Finnish Transport Safety Agency (Trafi) now allows automated vehicle trials. Trafi intends to develop a national action plan for automated vehicle trials to promote the automation of vehicular traffic. In addition, United Nations Economic Commission for Europe (UNECE) has amended the 1968 Vienna Convention on Road Traffic, so that transferring driving tasks to the vehicle will be explicitly allowed in traffic. Technical provisions for self-steering systems are under consideration to ensure that existing regulations that limit automated steering functions are removed and automated driving shall comply with technical requirements to ensure safety.
T5	Access to and use of anonymized consumer transportation data	Infrastructure investment planning Government and private sector planning and research to develop and improve digitally-enabled transportation options		According to Finland's Strategy for Intelligent Transport Systems (ITS), transportation infrastructure planning and construction will be supplemented with, and even replaced by, ITS tools and other small-scale solutions. The document also mentions that the critical factors for ITS production are how easily and economically it can exploit real-time transportation data and transmit this data to service producers, with consideration of citizens' right to privacy and data security.

Indonesia – Agriculture

Blockage/Enabler		Assessment criteria	Result	Explanation
A1	Adoption of Internet of Things (IoT) in agriculture	Promotion of digital literacy and its application in agriculture Funding of digital innovations in agriculture sector		There is no policy for improving digital literacy among farmers. The national ICT Master Plan only mentions about general digital literacy improvements, not specifically for stakeholders within the agriculture sector. However, digital literacy improvement programs for farmers are executed by private organizations to increase their awareness of advances in technology. There is no policy regarding funding for digital innovation in agricultural technology. The current budget allocation is only for research and development purposes.
A2	Improved supply and demand planning through the use of digital technologies	Policies that enable the capture of accurate agriculture-related information Policies aiming to provide free access to supply and pricing data through digital platforms		There is a regulation to publish demand and supply data online for agricultural, livestock and fishery products. The Bank Indonesia regulation, the Payment System and Management of Rupiah requires the online, real-time publication of prices of staple foods such as rice, chili, meat, onion, and certain types of fish.
A3	Transparent and direct market access to stakeholders	Policies that support and enable access to online market platform e-payment facilitation by the government		The Ministry of Agriculture has taken the initiative to develop five mobile applications that can facilitate agricultural transactions, distribution, and farming skills development of farmers (in accordance with a Regulation of the Ministry of Trade regarding technical guidance for the de-concentration of trade for 2015). These mobile apps enable farmers to identify demand for agricultural products and the location of their buyers. Private organizations have initiated several programs, which use mobile technology to provide small-scale farmers with bundled, localized financial services.
A4	Food quality enhancement through the use of digital technology	Regulations enabling the use of technology to trace the origins, ingredients, and nutrition of food		Indonesia's food safety regulations do not specifically enforce the utilization of a Critical Control Point (CCP) management system for all agricultural and livestock products. It only applies to copra, coffee and fishery products as stated in the Presidential Decree regarding the National Sector Policy. There is no regulation to enforce RFID tagging for agricultural, livestock and fisheries products.
A5	Scientific research for the purpose of agricultural development	Regulations enabling the use of technology to improve the quality of agricultural produce		According to the Presidential Decree regarding food and nutrition security, consumption data is allowed to be collected and processed for scientific research as long as it is initiated by a local entity after obtaining approval from the relevant ministry. International organizations must cooperate with local entities to perform such research

Indonesia – Education

Blockage/Enabler		Assessment criteria	Result	Explanation
E1	Policies supporting e-learning creation and building digital literacy	Policies supporting creation of robust e-learning content to attract students, including promoting partnerships between government and non-government entities to develop and deliver e-learning content Policies aiming to building digital literacy		There is a plan to fully integrate ICT content into the school curriculum. The Ministry of Education is working with local Government bodies and industry partners to provide educational content, Internet connections, and infrastructure for educational purposes, particularly to schools and educational institutions. Indonesia also has its own Open University (UT), which has 585,700 students enrolled, a significant number of whom take ICT-based courses. Currently, of approximately 2,000 universities in Indonesia, fewer than 10 provide e-learning programs. Presidential Instruction No. 6 2001 introduced a five-year action plan to develop ICT education and improve digital literacy of the population
E2	Access to e-learning content	Funding for Internet connection and technology devices for teachers and students of educational institutions		According to the Minister of Efficiency of the State Apparatus, the government supports the provision of devices and ICT infrastructure to students and teachers and makes educational content accessible online. This support includes providing tablets to K-12 students, increasing connectivity in rural areas in Indonesia and increasing the numbers of primary and secondary schools with Internet connectivity. Currently, 75% of schools have Internet access.
E3	e-learning content provision	Open source, Internet freedom, and fraud management for e-learning content		Regulations regarding fraud management for e-learning content (e.g. student identification) have not been developed.
E4	e-learning quality and accreditation	Minimum standards for e-learning Standards for accreditation of online courses/studies		There are no restrictions on the provision of e-certification and e-learning content. The government has established a system for the recognition of e-certification and e-learning degrees and accreditation for e-learning institutions. Indonesia's five-year ICT strategic plan includes a plan to ensure the quality of e-learning provided to the Indonesian education sector, through consistent monitoring and evaluation.

Indonesia – Government

Blockage/Enabler		Assessment criteria	Result	Explanation
G1	Basis for e-government	Elements that enhance institutional capacity of public sector to deliver e-government, such as establishment of a function/agency that drives and enables e-government, and policies supporting electronic transactions, universal citizen ID, government cloud, and e-procurement		The Ministry of Communication and Information has developed a data exchange application, MANTRA (data exchange and integration management). However, there is no standard data policy for e-government and a variety of data standards exist for different ministries. The implementation of this application is at an early stage with only a few ministries and several regional offices utilizing the application. There are G2G systems: e-procurement and e-catalogue. The current system of citizen identification (e.g. national identity card, tax ID) is fragmented; there is no universal citizen identification system. A government cloud has not been established in Indonesia and there appears to be no investment planned to implement one. In 2016, the UN e-government index ranked Indonesia 116th out of 193 countries.
G2	Budget for digital initiatives and/or attracting third party funding	Public budget allocation for digitalization (e-government/e-service) initiatives Enabling private sector investment in e-government/e-service projects		The national e-government strategy includes budget allocation to digital initiatives and ministries. Public Private Partnerships (PPPs) have been undertaken to support ICT infrastructure development and other e-government initiatives.
G3	Implementation of e-government /e-service	Implementation of e-government and e-service to citizens and businesses		Indonesia has a national e-government strategy. There are several examples of e-government implementation in Indonesia, which include: • G2B: e-tax; e-billing (billing system for payment of individual and business taxes) • G2C: e-passport; e-tax; e-billing (billing system for payment of individual and business taxes); SAPA (online feedback to government) The Ministry of Home Affairs has enabled the interaction of citizens with government through an online platform. The program is called SAPA Kemendagri.
G4	Adoption of IoT and access to e-service	Activities developing digital literacy of government personnel and citizens through promotion and socialization of e-service Interoperability standards between government agencies and institutions		The national e-government strategy aims to increase citizen awareness of e-government, and establishes a program of trainings for government personnel on how to operate software and applications for e-government. Aa policy has been drafted to enforce the interoperability of information systems for Indonesia's government agencies.

				In 2016, the UN e-participation index ranked Indonesia 114th out of 193 countries.
G5	Collection and sharing of data and information among citizens and government institutions	Policies/regulations governing the collection of citizens' data and sharing of collected data for non-Governmental purposes (e.g. commercial purposes)		Citizens' data is managed by the Ministry of Home Affairs for use in the planning and provision of public services, development plans, budget allocation, democratic developments and law enforcement. As part of the implementation of Indonesia's open government initiative, Indonesia has established an online portal where government bodies, citizens and businesses can access publicly available data for their own purposes.

Indonesia – Healthcare

Blockage/Enabler		Assessment criteria	Result	Explanation
H1	Adoption of IoT in healthcare	Policies aiming at improving digital literacy of health sector personnel and health/wellness consumers		Indonesia's Health Information Architecture Strategy mentions efforts to address challenges in e-health, such as the inadequate integration of Indonesia Health Information System (IDHIS) training material into the curriculum for health professionals.
H2	Collection and sharing of personal health data	Interoperability standards for health systems that share patient data Regulations on electronic data sharing/data protection/privacy		According to Indonesia's Health Information Architecture Strategy, interoperability is an enabling factor for a successful e-health infrastructure. Currently, Indonesia has adopted several e-health interoperability standards, but enforcement is not yet apparent regarding its implementation in hospitals and other healthcare facilities. Health data is protected but may be used and shared with the consent of the patient, for health related purposes.
H3	Access to smart health solutions	Policies supporting connection/access to e-health services for medical consultation, diagnosis and/or treatment		There is no policy yet that promotes access by citizens to e-health services for medical consultation, diagnosis and/or treatment. . At present, patients can only view information about healthcare services through hospital websites.
H4	Legal basis for e-health provision, acknowledgment of e-health providers by insurance companies	Making EHR/EMR, e-prescription, telemedicine legally possible Governmental initiatives to establish protocol and/or standards for providers' accreditation		Currently, e-health initiatives, such as EMR/EHR, e-prescriptions and telemedicine in Indonesia have been formulated. There is no legal framework/legislation yet to support its development. The Ministry of Health conducted an e-health pilot project in 2012 for e-radiology and tele-electrocardiograms, but there is no policy or

				framework to acknowledge treatments provided by e-health providers. According to Indonesia's Health Information Architecture Strategy, the government has recognized this issue and is planning to develop legislative regulatory requirements to address this (e.g. data protection and privacy).
H5	Use of anonymized health data for scientific purposes or international health initiatives	Regulation on electronic data sharing/data protection/privacy across borders Data format standardization		According to Regulation of the Ministry of Health 269/MENKES/PER/III/2008, the use of anonymized medical records data for education and research purposes is allowed without patient consent. The Ministry of Health, in collaboration with the US National Institute of Health, has established the Indonesia Research Partnership on Infectious Disease (INARESPOND), a clinical research network designed to address challenges relating to public health information and delivery stemming from geographical disparities. INARESPOND is working on health data standardization in Indonesia in the area of e-health services.

Indonesia – Transportation

Blockage/Enabler		Assessment criteria	Result	Explanation
T1	Adoption of digitally-enabled transportation	Policy allowing sharing economy business model and other emerging digitally-enabled transportation modes		Sharing economy transportation businesses currently operate in Indonesia. Indonesia has recently published regulation for ride-sharing companies that takes effect on October 1, 2017. This regulation governs pricing, business operations, and licensing. Guidelines include setting passenger fares for ride-sharing transportation and requiring the companies to partner with conventional transportation companies licensed by the ministry or register for their own transportation company license. The regulation recognizes and allows digitally-enabled transportation modes to operate in Indonesia, and maintain a level playing field between digitally-enabled and conventional transportation modes.
T2	Collection and sharing of transportation related data	Public initiatives for traffic management, travel optimization, routing and pricing		The Ministry of Transportation has set policies regarding the application of Information Technology in transportation management systems, such as virtual mobility, Advanced Train Control System (ATCS), real-time traffic management, and an integrated ticketing system. Implementation has only taken place in a few major cities such as Jakarta, Solo and Surabaya. Stronger enforcement by local Governments would result in wider implementation of technology in

				transportation management systems at the local government level.
T3	Introduction and usage of smart cards/e-payment in transportation systems	Interoperability standards for cards used by commuters to pay across multiple modes of public transportation		The development of smart cards/e-payment for transportation systems in Indonesia is at an early stage. Currently, Indonesia has several travel cards issued by various banks. Even though Governor of Jakarta has recently introduced non-cash transactions for all government services, including public transportation, this activity has not been replicated by other provinces in Indonesia. According to the National Payment Gateway (NPG), the Central Bank of Indonesia is planning to mandate interoperability and interconnectivity among the issuing banks to enable a more efficient payment system. In accordance with the Cashless Society program initiated in 2014, The Ministry of Economic Affairs and Central Bank
T4	Legal basis for innovative transportation services	Regulatory framework allowing operation of autonomous vehicles that are capable of sensing their environment and navigating without human input		Indonesia currently does not have a legal or regulatory framework governing the operation of autonomous vehicles. There are no plans or initiatives to conduct research, development and testing of autonomous vehicle technology in Indonesia.
T5	Access to and use of anonymized consumer transportation data	The use of data to plan infrastructure investment Government and private sector planning and research to develop and improve digitally-enabled transportation options		There is no specific regulation in Indonesia that limits access to and usage of anonymized transportation data for infrastructure planning purposes. Initiatives are being driven by private organizations which are working on several transportation issues including data collection and analysis to support infrastructure development. Data processing must take place within the country. However, if the required resources and infrastructure are not present, data processing may be conducted outside the country.

Kenya – Agriculture

Blockage/Enabler		Assessment criteria	Result	Explanation
A1	Adoption of Internet of Things (IoT) in agriculture	Promotion of digital literacy and its application in agriculture Funding of digital innovations in agriculture sector		According to the Law of Kenyan Crops, the Ministry of Agriculture must conduct training to improve farmers' knowledge of production technologies and market potential, and the prospects for various types of crops through training institutions. The E extension project enables farmers to familiarize themselves with digital tools and technologies by equipping counties with digital tools such as laptops, modems, and smartphones. Even though there are no regulations regarding agricultural funding, Kenya's government has been working with private organizations to increase agricultural productivity. One of the activities initiated is funding for increasing local community knowledge, skills and resources to enable them to thrive, even in the face of potential setbacks. An example of Kenya's government efforts to support the agriculture sector is the creation of a digital platform, named the e-Subsidy Information Management System, to facilitate subsidized fertilizer distribution to farmers. The system was implemented in 2014 to reduce malpractice in relation to the distribution of fertilizer and payments. The system has helped to stabilize prices.
A2	Improved supply and demand planning through the use of digital technologies	Policies that enable the capture of accurate agriculture-related information Policies aiming to provide free access to supply and pricing data through digital platforms		The Law of Kenyan Crops implicitly encourages the usage of market intelligence through IT applications to identify supply-demand data. However, there is no explicit emphasis on the use of digital platforms to conduct this activity. The Law of Kenya Crops also enables farmers to obtain information on current and future production, prices and movements in trade. This policy is reflected in a privately owned digital innovation which empowers Kenya's farmers with price transparency and market access through a mobile application and/or SMS.
A3	Transparent and direct market access to stakeholders	Policies that support and enable access to online market platform e-payment facilitation by the government		Even though there is no specific policy that encourages connection and access to market platforms, the Connected Kenya 2017 Master Plan includes actions to provide reliable Internet connectivity for farmers, to enable them to access market information online. Even though there is no specific policy encouraging e-payment facilitation for farmers, a mobile money application in Kenya has supported agribusiness and created transparency in the market using web and mobile technology. Kenya's government regulates mobile money under National Payment Systems Regulations (2014).

				This mobile money is widely used by farmers to perform transactions with consumers and obtain access to loans.
A4	Food quality enhancement through the use of digital technology	Regulations enabling the use of technology to trace the origins, ingredients, and nutrition of food		The Public Health Act and the Occupational Safety and Health Act (2007) sets regulations that the processing and packaging of all agricultural products must be carried out in clean, hygienic and safe conditions. However, it does not encourage the use of digital technologies to enhance food quality.
A5	Scientific research for the purpose of agricultural development	Regulations enabling the use of technology to improve the quality of agricultural produce		Currently, Kenya does not have a centralized database or information to support industrial development. The government realizes that this is a major constraint on the sector, and has begun to formulate the interventions required to address this challenge as mentioned in Kenya's Agriculture Sector Development Strategy (2010–2020). The plan is to develop an integrated agricultural data and information management system. The Ministry has embarked on the process of registering all farmers in the country. This database currently contains records of 1.7 million farmers.

Kenya – Education

Blockage/Enabler		Assessment criteria	Result	Explanation
E1	Policies supporting e-learning creation and building digital literacy	Policies supporting creation of robust e-learning content to attract students, including promoting partnerships between government and non-government entities to develop and deliver e-learning content Policies aiming to building digital literacy		Kenya has established e-learning program, DigiSchool, which provides students with a framework for the identification of approved educational materials to be digitalized and made available through a secure digital platform. DigiSchool was developed by a joint effort between Ministry of Education, Science and Technology and the Ministry of Industrialization and Enterprise Development. In addition, the Kenya Institute of Curriculum Development (KICD) has created an online content team to develop and execute a framework for developing educational content and converting it into a digital platform. Kenya's Government has included two flagship projects in the education sector to be implemented by 2017/2018 per the ICT Master Plan 2014: • An ongoing school laptop project to provide teaching and learning tools for pupils entering Standard One (first grade) in primary schools in Kenya beginning in 2014. • Automation of academic and administrative processes at all levels of education in order to put all educational information online. This

				includes an education e-portal that provides summarized data and statistics to the public.
E2	Access to e-learning content	Funding for Internet connection and technology devices for teachers and students of educational institutions		There is no policy to encourage access to e-learning content. Kenya's ICT Master Plan only covers the funding of flagship projects, including school laptop projects and the automation of academic and administrative projects. The funding for these projects will be generated through national and county Governments, development partners and Public Private Partnerships (PPPs). DigiSchool currently only covers primary schools in Kenya. There is no plan to expand the services to higher level of education. Kenya's government has a plan to collaborate with relevant policymakers and regulators to integrate ICT into education and training at all levels.
E3	e-learning content provision	Open source, Internet freedom, and fraud management for e-learning content		Current laws do not help or hinder e-learning content. The Electronic Communications and Transactions Act (2002) only addresses child pornography, defamatory material and copyright violations. There are no specific regulations that address fraud management for e-learning content in e-learning.
E4	e-learning quality and accreditation	Minimum standards for e-learning Standards for accreditation of online courses/studies		There is a legal and regulatory framework within the national ICT strategy for education and training which governs the accreditation of institutions offering examination and certification for ICT learning programs in relevant institutions. Such activities are governed under the Education Act (1968) and other related Acts of Parliament. The University Standards and Guidelines (2014) and the University Act (2012) set clear guidelines for e-learning programs in universities. Certain infrastructural criteria must be met before starting e-learning programs in institutions of higher learning in Kenya.

Kenya – Government

Blockage/Enabler		Assessment criteria	Result	Explanation
G1	Basis for e-government	Elements that enhance institutional capacity of public sector to deliver e-government, such as establishment of a function/agency that drives and enables e-government, and policies supporting electronic transactions, universal citizen ID, government cloud, and e-procurement		Kenya has established a State Corporation under the Ministry of Information, Communications and Technology, named the ICT Authority, which is responsible for rationalizing and streamlining the management of government of Kenya ICT functions. The ICT Authority also promotes ICT literacy, capacity, innovation and enterprise in line with the national ICT Master Plan. Kenya has a national citizen identification program. In 2016, the UN e-government index ranked Kenya 119th out of 193 countries.
G2	Budget for digital initiatives and/or attracting third party funding	Public budget allocation for digitalization (e-government/e-service) initiatives Enabling private sector investment in e-government/e-service projects		The national ICT Master Plan mentions budget allocations for ICT development within the country. Funding of flagship projects by national and regional Governments, development partners and other public or private institutions through Public Private Partnerships (PPPs) is encouraged. In addition, PPPs activities in Kenya are regulated under the Public Private Partnerships Act No. 27 0f 2013.
G3	Implementation of e-government /e-service	Implementation of e-government and e-service to citizens and businesses		Although Kenya does not have a specific e-government strategy, its ambition to implement e-government is incorporated in its ICT Master Plan. This document addresses the enhancement of government services through digital platforms. The government is deploying a program, Huduma, that aims to transform public service delivery by providing citizens with access to public services and information through integrated technology platforms. Huduma centres are being opened across the country to provide a one-stop shop service to its citizens. Kenya has established a single portal for e-service, named e-citizen. This platform enables citizens and businesses to obtain and pay for licenses, and access visa and immigration related services. Kenya has also begun to leverage its national citizen identification program for the provision of e-service to citizens.
G4	Adoption of IoT and access to e-service	Activities developing digital literacy of government personnel and citizens through promotion and socialization of e-service		Even though the national ICT Master Plan formalizes the strategy to increase the digital literacy of citizens and the workforce in order to exploit digital technologies, but there is no specific program for developing digital skills in the government sector. There is no specific regulation that documents agreed upon standards and ensures compatibility

		Interoperability standards between government agencies and institutions		and interoperability among ICT systems. However, ICT Master Plan encourages to implement technology neutrality, for example through the use of common, interoperable standards and protocols. In 2016, the UN e-participation index ranked Kenya 84th out of 193 countries.
G5	Collection and sharing of data and information among citizens and government institutions	Policies/regulations governing the collection of citizens' data and sharing of collected data for non-Governmental purposes (e.g. commercial purposes)		The ICT Master Plan addresses the need to improve data access and the stewardship of public data. The government is planning to develop and institutionalize a legal framework to enable data and information sharing across Governments (regional, national and county), citizens and ministries, departments and agencies.

Kenya – Healthcare

Blockage/Enabler		Assessment criteria	Result	Explanation
H1	Adoption of IoT in healthcare	Policies aiming at improving digital literacy of health sector personnel and health/wellness consumers		There is no specific policy to encourage digital literacy for health sector personnel and health/wellness consumers. However, the Ministry of Health, together with a private sector partner, has established a training institute to promote digital transformation in healthcare.
H2	Collection and sharing of personal health data	Interoperability standards for health systems that share patient data Regulations on electronic data sharing/data protection/privacy		The Ministry of Medical Services has established Standards and Guidelines for Electronic Medical records Systems in Kenya, which govern the standardization and interoperability of data format, data transmission and protocols. The Kenya Health Information Policy aims to ensure that all health information subsystems are standards-based to promote interoperability. Kenya's Health Bill (2015) mentions the administration of health information banks (centralized databank to store all health-related data), including interoperability frameworks data interchange and security standards. Electronic data sharing governance is regulated under The Kenya Health Policy 2012-2030. The aim is to migrate all data from legacy systems into new systems and formats as well as integrate data from different systems that use different formats, field names, and data characteristics.
H3	Access to smart health solutions	Policies supporting connection/access to e-health services for medical consultation, diagnosis and/or treatment		Kenya's Health Bill (2015) mentions that healthcare service delivery through digital technologies is recognized by the authorities and medical institutions. This regulation implies that the government has enabled citizens to access smart health solutions.

H4	Legal basis for e-health provision, acknowledgment of e-health providers by insurance companies	Making EHR/EMR, e-prescription, telemedicine legally possible Governmental initiatives to establish protocol and/or standards for providers' accreditation		According to the Standards and Guidelines for Electronic Medical Records Systems in Kenya, the Ministry of Health targeted the implementation of EMRs in 100 hospitals by establishing a coordinated system for Electronic Medical Records management by 2017. Kenya's Ministry of Health has partnered with a private sector partner to bring telemedicine to Kenya. This program provides a platform that will enable patients and healthcare providers to interact with health experts at Kenya's main hospital, Kenyatta National Hospital (KNH), using video conferencing. There are no specific protocols and standards for telemedicine accreditation. Telemedicine services currently available in Kenya involve using accredited medical institutions in the country. The Kenya Health Information Policy supports the establishment of Electronic Medical Records, while the Information Committee is responsible to manage and design the content of medical records and forms.
H5	Use of anonymized health data for scientific purposes or international health initiatives	Regulation on electronic data sharing/data protection/privacy across borders Data format standardization		According to The Data Protection Bill (2013) and Kenya Health Information Policy, the processing of personal data, such as health data, is allowed when it is carried out legitimately by authorized organisations within the country (e.g. Ministry of Health), as long as certain levels of confidentiality are maintained. Kenya Health Information Policy regulates data governance – which includes data standards, common vocabulary, reports, and the development and use of standardized data – to improve communication and decision making. It enables the health sector to have an integrated, synchronized, and consolidated set of data from different sectors/departments, and to exchange data with other organizations in a common format. The Ministry of Health recognizes that the development of a data standardization framework is necessary to implement, operate, monitor, review, maintain, and improve data and information systems governance in e-health services.

Kenya – Transportation

Blockage/Enabler		Assessment criteria	Result	Explanation
T1	Adoption of digitally-enabled transportation	Sharing economy business model, which refers to peer-to-peer sharing of access to transportation services		Currently, there are no regulations governing sharing economy business models in the transportation sector. However, the government is undertaking studies to address the emergence of these digitally-enabled businesses.

T2	Collection and sharing of transportation related data	Traffic management, travel optimization, routing and pricing		According to Kenya's National Integrated Transport Policy, there is a plan to develop information management through a National Traffic Information System (NaTIS) and other supporting systems. These will enable the traffic authorities to exercise proper road user control, travel optimization, routing and pricing. The traffic information required for planning, monitoring and control purposes will be collected, analyzed and stored by management at all levels of government (local, provincial and national) according to their functions and needs. Other initiatives, such as Transport Integrated Management System, Fleet Management System, and Intelligent Traffic Management System digitally collect and use data regarding traffic patterns and flow to improve traffic management.
T3	Introduction and usage of smart cards/e-payment in transportation systems	Interoperability standards for travel and cash cards		Kenya has established several card payment options which have been launched in an attempt to build a cashless transportation system, which enables passengers to load money from the popular mobile banking platform and pay their fares without using cash. It is currently regulated under National Payment Systems Regulations. The available cash cards are not interoperable with different modes of transportation, but Kenya's National Transport and Safety Authority is actively encouraging the interoperability of cash cards.
T4	Legal basis for innovative transportation services	Operation of autonomous vehicles that are capable of sensing their environment and navigating without human input		There is no legal or regulatory framework governing autonomous vehicles. There is no plan to conduct autonomous vehicle research, development or testing. Kenya is focusing on other initiatives that are more relevant to its citizens, such as management and integration of public transportation routes through the use of data analytics.
T5	Access to and use of anonymized consumer transportation data	The use of data to plan infrastructure investment Government and private sector planning and research to develop digitally-enabled transportations		According to Kenya Vision 2030, the objective is to develop a national transportation information database for effective transportation planning and management. Even though there is no policy to encourage the use of anonymized consumer transportation data, private organizations have undertaken studies and projects to improve Kenya's public transportation systems, for example to identify transit patterns and key intersections for the development of BRT routes.

Pakistan – Agriculture

Blockage/Enabler		Assessment criteria	Result	Explanation
A1	Adoption of Internet of Things (IoT) in agriculture	Promotion of digital literacy and its application in agriculture Funding of digital innovations in agriculture sector		There are policies in the draft Digital Pakistan (2017) plan that aim to increase the computer literacy levels of farmers through the provision of agriculture extension services. To make digital agricultural devices more affordable, there has been a recent reduction in customs duty, sales tax and withholding tax on imported agricultural machinery that support some degree of automation of farming activities.
A2	Improved supply and demand planning through the use of digital technologies	Policies that enable the capture of accurate agriculture-related information Policies aiming to provide free access to supply and pricing data through digital platforms		The Federal Agriculture and Livestock Product Marketing and Grading Department publishes the prices of 24 essential items from 11 markets through the press and radio on a monthly basis. There are planned measures in the draft Digital Pakistan (2017) plan supporting the creation of the Agriculture Information Portal mobile application that would aggregate and share data on prices, technical topics in agriculture, water quality and demand and supply.
A3	Transparent and direct market access to stakeholders	Policies that support and enable access to online market platform e-payment facilitation by the government		While there is no formal policy for promoting access to market platforms in the agriculture sector, a number of new applications have been launched in an effort to enhance connectivity, reduce information asymmetry and develop the digital skills of farmers. Pakistan has a mobile application that allows farmers to access information such as market prices, weather forecasts, farming advice and news. The ministry and private organizations have introduced mobile apps for various agriculture stakeholders such as potato farmers and fisheries, providing them with access to secured mobile banking services, market information and farming best practices. Financial support has been provided by the Government for the development of the agricultural sector. However, there is no specific reference that encourages e-payments in facilitating agricultural transactions.
A4	Food quality enhancement through the use of digital technology	Regulations enabling the use of technology to trace the origins, ingredients, and nutrition of food		Food quality in Pakistan is governed by the Pure Food Ordinance 1960. There is no specific regulation addressing the use of RFID tagging or any other means of tracking agricultural produce through the food supply chain.

A5	Scientific research for the purpose of agricultural development	Regulations enabling the use of technology to improve the quality of agricultural produce		There are policies in place for the establishment of a computerized agricultural data bank for scientists and policymakers. This data bank is intended to support further advances in agricultural research, focusing mainly on productivity, quality, export competitiveness and resource conservation.

Pakistan – Education

Blockage/Enabler		Assessment criteria	Result	Explanation
E1	Policies supporting e-learning creation and building digital literacy	Policies supporting creation of robust e-learning content to attract students, including promoting partnerships between government and non-government entities to develop and deliver e-learning content Policies aiming to building digital literacy		The Government established Pakistan Virtual University (VU) to incorporate ICT and other forms of modern technology to facilitate e-learning. The revision of the draft Digital Pakistan (2017) plan encourages the development of e-portals for academic purposes among educational institutes across the country. The Ministry of Education, in collaboration with private organizations, developed a National Information and Communications Technology Strategy for Education in Pakistan (NICTE) to innovate and digitalize Pakistan's education system. The NICTE included six elements that will use ICT in order to extend educational opportunity, strengthen teaching quality, enhance learning, build required competencies, develop successful programs and establish a unit to oversee the use of ICT in the education sector. The Technical Implementation Unit (TIU) monitors, plans and evaluates the execution of IT-related policies in the education sector.
E2	Access to e-learning content	Funding for Internet connection and technology devices for teachers and students of educational institutions		The Universal Service Fund (USF) is used by the government to improve digital infrastructure in remote areas. Under this initiative, special emphasis has been placed on improving the connectivity of educational institutions. 1328 education broadband centres and 369 community broadband centres have been established in different areas of Pakistan. The Prime Minister's Laptop Scheme was initiated by the government with the assistance of the Higher Education Commission (HEC) to provide free laptops to students to improve their access to, and familiarity with, information technology. The National IT Policy (2000), addresses the provision of Internet access and low-priced computers to both public and private educational institutions, and encourages the use of computer assisted learning and IT tools in the teaching process. The revised draft of the policy in 2016 continues to focus on promoting the use of ICT in

				education and ensuring that public schools are connected online.
E3	e-learning content provision	Open source, Internet freedom, and fraud management for e-learning content		Fraud management and Internet freedom is governed under the PECA 2016, but no regulation exists specifically for the protection of e-learning content.
E4	e-learning quality and accreditation	Minimum standards for e-learning Standards for accreditation of online courses/studies		There is no regulation governing e-learning quality and accreditation. The National Technology Council under the HEC has been established to monitor the quality of educational degrees/certifications provided by universities and ensure that they are in line with international standards.

Pakistan – Government

Blockage/Enabler		Assessment criteria	Result	Explanation
G1	Basis for e-government	Elements that enhance institutional capacity of public sector to deliver e-government, such as establishment of a function/agency that drives and enables e-government, and policies supporting electronic transactions, universal citizen ID, government cloud, and e-procurement		In 2002, the e-government Directorate was established to lead e-government implementation efforts and set related software and infrastructure standards. The e-government Strategic Plan aims to form an e-government implementation monitoring group with technical sub-committees to monitor the progress of government agencies in implementing e-government initiatives. The Electronic Transaction Ordinance (ETO) (2002) governs electronic transactions and electronically-stored data. The draft Digital Pakistan (2017) plan includes the use of a government cloud and the implementation of e-procurement as part of the national strategy to accelerate digitalization. In 2012, the National Database and Registration Authority (NADRA) introduced the Smart National Identity Card (SNIC) containing biometric data and detailed personal information (such as name, address, father's name and photograph). The SNIC can be used for various purposes, including offline/online verification, voting, and pension and banking-related activities. More than 25 government agencies and their associated departments in Pakistan are in the process of implementing e-filing/e-office initiatives. In 2016, the UN e-government index ranked Pakistan 114th out of 193 countries.

G2	Budget for digital initiatives and/or attracting third party funding	Public budget allocation for digitalization (e-government/e-service) initiatives Enabling private sector investment in e-government/e-service projects		According to the e-government Strategy and Five-year Plan for the Federal Government, MoITT provides the funding for the implementation of e-government projects at both Federal and Provincial levels. MoITT is collaborating with local IT companies to promote private sector participation in the realisation of e-government initiatives.
G3	Implementation of e-government /e-service	Implementation of e-government and e-service to citizens and businesses		The e-government Strategy and Five-year Plan for the Federal government outlines e-government initiatives with the aim of improving government services for citizens and increasing the efficiency of government operations. The strategy was implemented and was revised in 2012 to reflect changes and emerging conditions in the digital environment. The government has conducted a campaign to increase awareness of e-government services and collect feedback from citizens on how the implementation of these services can be improved.
G4	Adoption of IoT and access to e-service	Activities developing digital literacy of government personnel and citizens through promotion and socialization of e-service Interoperability standards between government agencies and institutions		According to the e-government Strategy, the interoperability of applications is one of the key principles for the successful implementation of e-government. The plan is to standardize application interfaces and architecture. There is an effort to connect the main government website with the web portals of all ministries and departments within Pakistan. As a strategy to encourage the use of e-government systems, there is a policy to encourage training by the Pakistan Computer Bureau (PCB) for basic IT literacy and specific software operations. Cash incentives are offered to high-performing trainees and those who pass certain tests. In 2016, the UN e-participation index ranked Pakistan 159th out of 193 countries.
G5	Collection and sharing of data and information among citizens and government institutions	Policies/regulations governing the collection of citizens' data and sharing of collected data for non-Governmental purposes (e.g. commercial purposes)		Although there is no policy to encourage the collection of citizens' data, the National Database and Registration Authority (NADRA) maintains a secure database of such data. The Data Protection Act drafted in 2005 does not apply to the use of citizens' data by the government.

Pakistan – Healthcare

Blockage/Enabler		Assessment criteria	Result	Explanation
H1	Adoption of IoT in healthcare	Policies aiming at improving digital literacy of health sector personnel and health/wellness consumers		The draft National IT Policy 2016-17 outlines a plan to increase digital literacy and introduce digitalization and automation to the health sector across the country.
H2	Collection and sharing of personal health data	Interoperability standards for health systems that share patient data Regulations on electronic data sharing/data protection/privacy		MoITT is planning to expand the roll-out of Hospital Management Information System (HMIS) in compliance with HL7 standards. These initiatives are aligned with the draft National IT Policy 2016-17, which aims to build interoperability standards for established HMIS in the country. Better integration of systems at the federal and provincial levels will help to improve data sharing and enhance the effectiveness of data privacy mechanisms. MoITT is undertaking consultations with relevant stakeholders, including patients, to formulate Personal Data Protection guidelines regarding data sharing, protection and privacy.
H3	Access to smart health solutions	Policies supporting connection/access to e-health services for medical consultation, diagnosis and/or treatment		The Medicine Inventory System is a program under the "Chief Minister-Punjab's Health Reforms Roadmap Programme for Secondary Healthcare". It is a centralized electronic system devised to maintain comprehensive stock information for medicines within the 36 districts of Punjab. The Medicine Inventory System is designed to ensure effective management and monitoring of requisition, allocation, disbursement, receipt and consumption of medicines in health facilities. Several mobile applications for telemedicine, an e-health information portal, and online pharmacies have been introduced by private healthcare organizations.
H4	Legal basis for e-health provision, acknowledgment of e-health providers by insurance companies	Making EHR/EMR, e-prescription, telemedicine legally possible Governmental initiatives to establish protocol and/or standards for providers' accreditation		According to the Code of Ethics of Practice for Medical and Dental Practitioners, e-prescriptions are allowed under certain conditions. Prescriptions without direct patient contact are only allowed if sufficient dialogue between patient and doctor can be proven. In an emergency, a single dose is allowed to be prescribed remotely, and the patient should be scheduled for a check-up. There is no further elaboration of the definition of an emergency, and there is no guidance on digital and non-e-prescription formats. Under the same Act, telemedicine is only allowed for radiological reporting. Even though EHR/EMR has been implemented in hospitals, this is currently not regulated by the government.

				MoITT has identified gaps in e-health policy, such as provision of healthcare providers' accreditation and requisite protocol and standards. These gaps have been incorporated in the draft National IT Policy 2016-17. Pakistan's government has been involved in a PPP arrangement with the US State Department to launch a project to improve telemedicine services in remote areas. There has been investment in the telemedicine equipment and services to operationalize the project.
H5	Use of anonymized health data for scientific purposes or international health initiatives	Regulation on electronic data sharing/data protection/privacy across borders Data format standardization		The Pakistan Health Information System (NHIS) has been developed to comply with WHO international health regulations. It provides monthly data to provincial/national HIS units. The information collected is a compilation of information from both rural facilities and district hospitals using a standard format and software. There is no policy regarding the use or electronic storage of data by other hospitals. The Code of Ethics of Practice for Medical and Dental Practitioners states that patient data can be used by the government (councillors) or agencies for the purposes of research and treatment. However, the use of patients' data by other parties will be considered a breach of confidentiality. The draft National Health Policy (2009) includes a plan to standardize the collection, collation and analysis of health data nationwide. This is to improve the accuracy and reliability of data collected, so that it can be used for the planning, monitoring and evaluation of health services provision and delivery. The data collected is envisioned to be integrated in the national Health Information Resources Centre.

Pakistan – Transportation

Blockage/Enabler		Assessment criteria	Result	Explanation
T1	Adoption of digitally-enabled transportation	Policy allowing sharing economy business model and other emerging digitally-enabled transportation modes		According to the draft Sustainable Urban Transport Policy for Sindh, the government has realized the presence of a ride sharing transportation business model, and identified opportunities for collaboration with the private sector to formulate a framework to promote it. Punjab Information Technology Board (PITB) has collaborated with ride-sharing companies to promote the effective use of technology in Lahore and explore technological and economical innovations. Drivers are required to register their vehicles with the excise department and pay Rs 150 per annum to

				legally use a private vehicle for commercial purposes.
T2	Collection and sharing of transportation related data	Public initiatives for traffic management, travel optimization, routing and pricing		The compilation and storage of individual travel patterns, transportation infrastructures and traffic information into a databank is encouraged by the government of Sindh according to the draft Sustainable Urban Transport Policy for Sindh. The same draft policy encourages the dissemination of data to relevant stakeholders in order to support the development of transportation system planning. However, there is no mention of whether the information will be made publicly available through online channels, or whether there are any constraints on the usage of the shared data.
T3	Introduction and usage of smart cards/e-payment in transportation systems	Interoperability standards for cards used by commuters to pay across multiple modes of public transportation		The government of Sindh has recognized the need to incorporate digitalization into public transportation ticketing systems through the use of an online platform as mentioned in the draft Sustainable Urban Transport Policy for Sindh. However, policy development remains at the initial stage; the participation of other service providers and their roles have not yet been explicitly outlined.
T4	Legal basis for innovative transportation services	Regulatory framework allowing operation of autonomous vehicles that are capable of sensing their environment and navigating without human input		There is currently no existing regulation that governs the operation of autonomous vehicles in Pakistan. MoITT is currently working with international forums to address issues regarding autonomous vehicles as well as addressing this topic in the draft Digital Pakistan (2017) plan.
T5	Access to and use of anonymized consumer transportation data	The use of data to plan infrastructure investment Government and private sector planning and research to develop and improve digitally-enabled transportation options		According to the draft Sustainable Urban Transport Policy for Sindh, there is a plan for the development of a comprehensive transportation planning framework integrated with land use. In the same draft, there is also a policy to create and maintain a centralized transportation database to provide a reliable source of data for planning and analysis.

Singapore – Education

Blockage/Enabler		Assessment criteria	Result	Explanation
E1	Adoption of e-learning	Policies supporting creation of robust e-learning content to attract students Policies aiming to building digital literacy		According to Singapore's Intelligent Nation 2015 (iN2015) Master Plan, there are several joint partnerships between the government and sector partners with three key components: the national Infocomm scholarship; Infocomm club, and; other programs to drive the development of e-learning. Education has been a focus for digitalization ever since the establishment of Singapore's first Masterplan for ICT in Education in 1997. The document states that education should continually anticipate the needs of the future and technological advances, and prepare students for them. The master plan focuses on developing ICT infrastructure, integrating ICT into curricula and digitalizing the students' learning environment. It also includes policies on equipping teachers and students with the right knowledge for a digitalized education environment. Singapore is continuously developing e-learning platforms which are available and accessible to every teacher and student.
E2	Access to e-learning content	Funding for Internet connection and technology devices for teachers and students of educational institutions		Although there is no specific policy regarding funding for Internet connections and devices in the educational sector, Singapore has taken an initiative to be an inclusive society where ICT deployment is a priority. The NEU PC Plus Programme offers students and persons with disabilities from low income households the opportunity to own brand new computers at affordable prices. It comprises the PC Bundles Scheme as well as the iNSPIRE Fund Scheme. The PC Bundles Scheme is a government program that provides subsidies for purchasing computers and software. This program is offered to Singapore's citizens and full-time students below the age of 25. This program goes beyond the educational sector – citizens with disabilities or those who fall below a certain income level may apply for subsidies under this program.
E3	e-learning content provision	Open source, Internet freedom, and fraud management for e-learning content		There are no regulatory restrictions on the provision of e-learning content. According to Singapore's ICT Master Plan, Singapore's government places a high emphasis on digitalization in the education sector. In addition, its copyright laws provide an exception for educational

				content, and its censorship laws exclude the scope of educational content.
E4	Collaboration to develop e-learning content	Attractive government partnerships scheme with non-government entities to encourage them to be involved in developing and/or investing on e-learning content		According to Singapore's Intelligent Nation 2015 (iN2015) Master Plan, there are several joint partnerships between the government and sector partners with three key components: the national Infocomm scholarship; Infocomm club, and; other programs to drive the development of e-learning. The implementation of these programs have effectively increased students' awareness of ICT.
E5	e-learning quality and accreditation	Minimum standards for e-learning Standards for accreditation of online courses/studies		According to the Singapore ICT Master Plan, online certifications/educational degrees are accredited and regulated by the Ministry of Education. The Singapore Standards Council established the Learning Standards Technical Committee (LSTC). The LSTC is responsible for tracking, developing and promoting specifications for learning in Singapore, including common e-learning competencies and general competencies required for all e-learning professionals.

Singapore – Government

Blockage/Enabler		Assessment criteria	Result	Explanation
G1	Basis for e-government	Elements that enhance institutional capacity of public sector to deliver e-government, such as establishment of a function/agency that drives and enables e-government, and policies supporting electronic transactions, universal citizen ID, government cloud, and e-procurement		The Singapore government formed a statutory board in October 2016, the Government Technology Agency of Singapore (GovTech), charged with deploying a wide range of ICT solutions in the public sector, growing new capabilities and talent to support digital service delivery, and developing ICT infrastructure and applications. The Singapore government plans to develop a private cloud to provide a secure and resilient ICT environment for public services. Singapore's Ministry of Finance established e-procurement portal, GeBIZ, in 1998 to facilitate a one-stop government business centre, which would enable public sector officers to engage in e-commerce. In 2016, the UN e-government index ranked Singapore 4th out of 193 countries.
G2	Budget for digital initiatives and/or attracting third party funding	Public budget allocation for digitalization (e-government/e-service) initiatives Enabling private sector investment in e-government/e-service projects		There is no specific policy that sets out budget positions for e-government and/or e-service. According to Singapore iGov (2010), Singapore's government is encouraged to collaborate with private organizations to increase awareness and to stimulate discussions of technology applications and

				their business possibilities through Public Private Partnerships (PPP).
G3	Implementation of e-government /e-service	Implementation of e-government and e-service to citizens and businesses		Singapore has several e-government initiatives/Master Plans that introduced e-services, including: • e-government action plan I & II (2000 - 2005) - public sector efficiency: online service delivery (1,600 e-service deployed) and integrated services • iGov 2010 (2006-2010) – whole-government integration • eGov 2015 (2011 - 2015) – Public-private value innovation and economic competitiveness • Digital government in a Smart Nation (2016 and beyond) - To transform the way people live, businesses work and government delivers public services. e-service and e-government in Singapore was introduced in 2000. The government renews its e-government strategy every five years. According to the Singapore e-government Master Plan 2010-2015, a portal, called REACH (Reaching Everyone for Active Citizenry@Home), was developed to engage and connect with citizens. REACH services include providing online and offline feedback channels (e.g. Facebook, Twitter etc.) and facilitating public consultation on a wide range of topics.
G4	Adoption of IoT and access to e-service	Activities developing digital literacy of government personnel and citizens through promotion and socialization of e-service Interoperability standards between government agencies and institutions		According to Singapore's Intelligent Nation 2015 (iN2015) Master Plan, one of the key enablers for an integrated government (iGov) is Infocomm competency development. Courses and seminars are being organized to equip public servants with the skills to appreciate, understand and implement iGov initiatives. A framework will also be developed to map out competency needs for a digital environment. Singapore has emphasized the importance of the interoperability of the government technology environment to accelerate the delivery of secure application services, e-payment mechanisms and electronic data exchange. In 2016, the UN e-participation index ranked Singapore 8th out of 193 countries.
G5	Collection and sharing of data and information among citizens and government institutions	Policies/regulations governing the collection of citizens' data and sharing of collected data for non-Governmental purposes (e.g. commercial purposes)		According to the Singapore Personal Data Protection Act (PDPA), personal data cannot be collected or used (for any reason) without consent from the individuals affected, unless is it is used in the national interest or for research purposes. Following the policy, Singapore launched data.gov.sg in 2011 to help provide easy discovery of, and access

				to, available government data. More than 3,000 government datasets were available upon the launch of the website, with more datasets being added over time. Users can use the data for research and analysis, or for commercial activities such as the development of innovative products and services.

Singapore – Healthcare

Blockage/Enabler		Assessment criteria	Result	Explanation
H1	Adoption of IoT in healthcare	Policies aiming at improving digital literacy of health sector personnel and health/wellness consumers		According to Singapore's Intelligent Nation 2015 (iN2015) Master Plan, a key goal of the healthcare program is to raise digital literacy among the population. To support this goal, ICT interfaces of health system are designed as simply and intuitively as possible.
H2	Collection and sharing of personal health data	Interoperability standards for health systems that share patient data Regulations on electronic data sharing/data protection/privacy		Interoperability of systems (computers, communication devices, networks, software and other IT components) with other components of the healthcare system is necessary for the effective and efficient delivery of e-health services. Interoperability standards in the healthcare system can be referred to ISO/TR 16056 and ISO/TS 16058. According to the Singapore Personal Data Protection Act (PDPA), Singapore allows the collection and sharing of healthcare data at the national level, which includes admission and visit history, hospital inpatient discharge summary, laboratory results, medication history, history of past operations, allergies, adverse drug reactions and immunisations.
H3	Access to smart health solutions	Policies supporting connection/access to e-health services for medical consultation, diagnosis and/or treatment		Even though there is no policy to access smart health solutions, there is an initiative by Singapore's SmartNation program to co-create impactful solutions to address challenges in healthcare. Singapore has established HealthHub, a one-stop portal and mobile app for Singaporeans to access a wide range of health content, deals, rewards and e-service with key features as follow: • Access to personal hospital records. • Access to immunisation records, dental health records, medical appointments, details of medications and known side effects. • Access to an extensive directory of available healthcare and lifestyle facilities and services.
H4	Legal basis for e-health provision, acknowledgment of e-health providers by insurance companies	Making EHR/EMR, e-prescription, telemedicine legally possible Governmental initiatives to establish protocol and/or standards for providers' accreditation		According to Practice Guidelines and Tools, the utilisation of electronic patient data and issuance of prescriptions are allowed; guidelines to ensure safety are described in the document. Digital health platforms has enabled medication to be prescribed digitally, and are claimable from selected insurance companies. Patients are able to collect

				their medications from pharmacies without a physical prescription. According to Singapore's National Telemedicine Guidelines (2015), there are requirements regarding roles and responsibilities, including the licensing and credentials of healthcare professionals who can perform remote examinations and the required competencies and qualifications of healthcare professionals.
H5	Use of anonymized health data for scientific purposes or international health initiatives	Regulation on electronic data sharing/data protection/privacy across borders Data format standardization		The Personal Data Act (2012) enables the sharing of personal health data among medical institutions for research and treatment. The National Electronic Health Record (NEHR) Act indicates that the Ministry of Health allows personal health data to be shared among medical institutions at a national level. All public medical institutions/ hospitals have access to the NEHR system; there is a plan to expand access to this system to private hospitals in future. All electronic health record must be in a standard format according to the Standards and Interoperability Framework.

Singapore – Transportation

Blockage/Enabler		Assessment criteria	Result	Explanation
T1	Adoption of digitally-enabled transportation	Policy allowing sharing economy business model and other emerging digitally-enabled transportation modes		There is no specific regulation in Singapore that limits the adoption of digitally-enabled transportation. According to the Private Hire Driver Vocational Licensing (PDVL) framework, all private drivers must undergo PDVL starting in the first half of 2017, and their vehicles must be registered with the Land Transport Authority (LTA). The Ministry of Transport has revised the existing Taxi Driver Vocational License (TDVL) framework to ensure fair competition between regular taxis and private hire drivers.
T2	Collection and sharing of transportation related data	Public initiatives for traffic management, travel optimization, routing and pricing		Smart Mobility 2030 - ITS Strategic Plan for Singapore states that LTA is responsible for working on the dynamic processing of big data and analytics, transportation information delivery, transportation data collection technologies, data standardization and security in order to further the development of ITS across the country. Areas impacted include smart junction management and road usage demand management.

T3	Introduction and usage of smart cards/e-payment in transportation systems	Interoperability standards for cards used by commuters to pay across multiple modes of public transportation		Singapore has launched an interoperable national e-purse that integrates banking e-purse, transit and electronic road pricing payment, named the Contactless e-Purse Application Specification (CEPAS). CEPAS can be deployed over both contact (ISO 7816) and contactless interfaces (ISO 14443 and ISO 18092) as well as a GSM SIM application for NFC-enabled phones. It permits direct top-ups to an e-Purse from a bank account, while the ISO 7816 command set and file structure also allows CEPAS to coexist with EMV and contactless credit card features on one card.
T4	Legal basis for innovative transportation services	Regulatory framework allowing operation of autonomous vehicles that are capable of sensing their environment and navigating without human input		Currently, Singapore does not have a regulatory framework, operational requirements or infrastructure support for autonomous vehicles. However, according to the Smart Mobility 2030 - ITS Strategic Plan for Singapore, LTA is collaborating with private organizations on the Singapore Autonomous Vehicle Initiative (SAVI), which oversees and manages autonomous vehicle research, test-bedding and the development of applications and solutions by sector partners and stakeholders.
T5	Access to and use of anonymized consumer transportation data	The use of data to plan infrastructure investment Government and private sector planning and research to develop and improve digitally-enabled transportation options		According to the Smart Mobility 2030 – ITS Strategic Plan for Singapore, LTA has taken initiatives to leverage big data and analytics on transportation data to drive the further development of ITS across the country.

KEY DEFINITIONS

Cloud services – A series of services made available to users from a cloud computing provider's servers through the Internet.

Cybersecurity – A series of technologies, processes and practices to protect programs, network, and data from a breach of access by unauthorized parties.

Data protection – Protection of the storage, processing, usage, and sharing of personal data, which covers any data that can be used to identify an individual, such as name, address, telephone number, and email address.

Digital leadership – The articulation of digital ambitions which is supported by institutional frameworks that encourage digitalization across the economy. This may be illustrated by national CIO and/or digital agency.

Digital skill/digital literacy – An individual's ability to create and/or utilise content using information technologies and the Internet.

E-payment – A process of financial exchange between two parties through online platforms using digital financial instruments, such as credit card, mobile money, and electronic cheques.

ABBREVIATIONS

AISP - Association of Information Security Professionals

AMAD - Agricultural Market Access Database

ATCS - Advanced Train Control Systems

BRT - Bus Rapid Transit

CBK - Central Bank of Kenya

CCP - Critical Control Point

CDA - Clinical Document Architecture

CEPAS - Contactless E-purse Application Specification

CERT - Computer Emergency Response Team

CEF - Connecting Europe Facility

CIO - Chief Information Officer

CIRT - Computer Incident Response Team

CISSP - Certified Information Systems Security Professional

CITREP - Critical Infocomm Technology Resource Programme

CoE - Center of Excellence

CPE - Computers to Education Program

CRC - Communications Regulatory Commission

CSCP - Civil Service Computerization Program

CSP - Cloud Service Provider

DLP - Digital Learning Program

DPB - Data Protection Board

DPO - Data Protection Ombudsman

EHR - Electronic Health Record

EIT - Electronic Information and Transactions

EMR - Electronic Medical Record

EMV - Europay, MasterCard, Visa

ERSA - Education Sector Reform Assistance

ESIF - European Structural and Investment Funds

ETO - Electronic Transactions Ordinance

EU - European Union

FHIR - Fast Healthcare Interoperability Resources

FSA - Financial Services Authority

FVU - Finland Virtual University

G2B - Government-to-Business

G2C - Government-to-Citizen

G2G - Government-to-Government

GCIO - Government Chief Information Officer

GDP - Gross Domestic Product

GITSIR - Government IT Security Incident Response Team

GovTech - Government Technology Agency of Singapore

GSM - Global System for Mobile communications

HEC - Higher Education Commission

HMIS - Hospital Management Information System

HIS - Health Information System

ICT - Information and Communication Technology

IDHIS - Indonesia Health Information System

IDI - Information and Communication Technology Development Index

iGov - Integrated Government

IMC - Inter-ministerial Committee

IMDA - Infocomm Media Development Authority of Singapore

iN2015 - Intelligent Nation 2015

INA-RESPOND - Indonesia Research Partnership on Infectious Disease

INVIMA - National Food and Drug Surveillance Institute

IoT - Internet of Things

IS - Infocomm Security

ISA – Interoperability solutions for European Public Administrations

ISO - International Organization for Standardization

ITDP - Institute for Transportation and Development Policy

ITS - Intelligent Transport System

K-12 - Kindergarten through 12th grade

KENIA - Kenya Innovation Agency

KICD - Kenya Institute of Curriculum Development

KNH - Kenyatta National Hospital

KNIA - Kenya Innovation Agency

LSTC - Learning Standards Technical Committee

LTA - Land Transport Authority

MaaS - Mobility-as-a-Service

MADB - Market Access Database

MAS - Monetary Authority of Singapore

Mbps-Megabits per second

MinITC-Ministry of Information Technologies and communications

MoITT - Ministry of Information Technology and Telecom

MoU - Memorandum of Understanding

MPSVC - Multi-Purpose Stored Value Cards

MSPVC - Multi-Purpose Stored Value Card

NANDRA - National Database and Registration Authority

NaTIS - National Traffic Information System

NDP - National Development Plan

NEHR - National Electronic Health Record

NFC - Near Field Communication

NGO - Non-Government Organisation

NHIS - National Health Information System

NICTE - National Information and Communications Technology Strategy for Education in Pakistan

NPG - National Payment Gateway

NRIC - National Registration Identity Card

NUTP – National Urban Transit Program

OAS - Organization of American States

OECD - Organisation of Economic Co-operation and Development

OJK - Otoritas Jasa Keuangan; Financial Authority

OSPT – Open Standard for Public Transport

PAHO - Pan America Health Organisation

PCB - Pakistan Computer Bureau

PDA - Personal Data Act

PDPA - Personal Data protection Act

PDVL - Private Hire Driver Vocational Licensing

PECA – Prevention of Electronic Crime Act

PEI - Pakistan Education Intranet

PITB - Punjab Information Technology Board

PPP - Public Private Partnership

PSD2 - Payment Services Directive

PSO - Payment system operator

PSP - Payment service provider

R&D - Research and Development

REACH - Reaching Everyone for Active Citizenry@Home

RFID - Radio Frequency Identification

RID – Digital Institutional Repository

S&T - Science and Technology

SADe - e-Services and e-Democracy programme

SANS - SysAdmin, Audit, Network, and Security

SAVI - Singapore Autonomous Vehicle Initiative

SENA - Servicio Nacional de Aprendizaje; Government Learning Services

SNIC - Smart National ID card

SRSP – Structural Reform Support Programme

TDVL – Taxi Driver Vocational License

TIU - Technical Implementation Unit

UNESCO – United Nations Educational. Scientific and Cultural Organization

USAF- Universal Access and Service Fund

USAID - United States Agency for International Development

WTO - World Trade Organization

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