

Think differently.
Think archetype.
Your digital economy model.

A novel approach to digital transformation and policy reform

July 2020

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Foreword



Chen Lifang

Corporate Senior Vice President, Director of the Board
Huawei Technologies Co., Ltd.

In these turbulent times, our first thoughts continue to be with our families, friends, customers and wider communities. Despite the challenges and losses many of us have faced and will continue to face, one solace recently has been the first delicate green-shoots of wider recovery. Lockdowns around the world are beginning to ease, students are returning to schools and business activity in some sectors is bouncing back. A seed that survives the storm will sprout and blossom. A return to normality beckons.

But what will this ‘new normal’ look like? Many eminent scholars are calling this a “hinge” moment in history. Certainly, some things will return to how they were. But other changes to our social and working lives – wrought by the pandemic crisis – look likely to change us forever. One of those changes of significance looks to be a pervasive acceleration in the role that information communications technologies (ICT) play in our society. New technologies have certainly helped better protect

healthcare workers and make their work much more effective. These technologies include 5G, big data, and AI, with new approaches such as remote consultation, mobile ward rounds and infrared body-temperature monitoring. Digital infrastructure through mobile and fixed broadband has also proven crucial to supporting our modern work and home lifestyles. Many of us were fortunately able to continue to work and live through the crisis because of this.

The strength of the global economic recovery remains a big uncertainty. The Economist newspaper for example suggests that we will have to live in the “90% economy” for a long time to come. Many governments around the world will be required to make difficult decisions about the magnitude and length of their support as the consumer of last resort. One certainty we do have though, is that this could be an ideal opportunity for governments to lead a charge to renew and upgrade our national infrastructures. And there is a plethora of evidence that suggests that investment in digital infrastructure and the digital economy would provide the best fiscal multipliers and returns on investment for the long term.

In order to maximize digital returns however, governments will also need to have the very best policy and regulatory environments in place. The richer the soil can be made, the more verdant the resulting ecosystem. That is why I am so delighted with Huawei's partnership with Arthur D. Little's leading thought leaders and analysts on this timely research report. Uniquely, the research recognizes that a 'one-size fits all' approach to ICT policymaking may not be suitable. Huawei operates in over 170 countries around the world and in some, for many years. We deeply recognise that each country is unique as are the challenges faced by its government's leaders. This report provides pioneering research on seven national ICT archetypes and where they sit in the evolutionary global value chain. We provide tools to help government stakeholders understand where they sit in the development path and how they can best transition to other digital economy states. We also provide a nuanced and tailored set of policy recommendations based on one of the largest reviews of the efficacy of global ICT policies to date.

We dearly hope that this research sparks a myriad of fruitful conversations around the world on how to best move us forward into an uncertain future. It is my strongly held belief that only by staying together, working collaboratively across borders and learning from each other that we will be able to build a better connected, more resilient and intelligent world.

Preface



Rajesh Duneja
Partner, Arthur D. Little

Huawei and Arthur D. Little have collaborated on this report based on a shared conviction that improving digital infrastructure should be central to national ICT policy. The positive impact of digitalization on economic and social activities, for governments, enterprises and consumers alike, is limitless.



Kurt Baes
Partner, Arthur D. Little

Yet while every country is increasing its investment in digital infrastructure, many are not able to fully benefit from such investments, which is affecting their wealth creation and prosperity opportunities. A well-structured and focused investment in digital infrastructure can enhance public services, commerce, the labour market, investments and political engagement through improved connectivity, data-powered technology and accessibility – as such, a digital economy is a necessity rather than a nice to have. Governments must prioritize the implementation of pragmatic policies that maximize the benefits of new technology while ensuring that the inevitable short-term disruptions are mitigated.

In this report, we aim to define focus areas for the growth of the digital economy, tailored to the condition and ambition of a country or region.

Successful digital economies require a whole range of infrastructure and capabilities, but countries often have scarce resources and finite funds. Choosing and prioritizing focus areas is therefore key. We begin with the recognition and definition of country archetypes, designed to act as a reference model that countries can adapt based on their current situation.

Many public and private organizations have produced best practice digital economy policies and actions for countries to adopt. However, in this report, we have adopted a novel approach that considers the nuances of different country models and archetypes far beyond the traditional developing-versus-developed split used by many studies.

Before deep-diving into policy recommendations, we took a top-down approach to identify the best-fit digital economy model for each country based on their capabilities and endowments. Identification of a country's archetype helps tailor the recommendations for digital economy policies to ensure they are best aligned with its needs.

Furthermore, our approach considers policy recommendations across all digital economy enablers, advises on strategies for both the short and long term, and leverages examples of different digital economy country leaders in their specific archetypes. Finally, we help countries strategize on how to migrate from one archetype to another and design their transformation.

We sincerely hope that the recommendations in this report will be duly considered by governments and policymakers as a way to rethink national digital strategies, prioritize digital policies and accelerate their digital journeys. We hope that the report will trigger a constructive dialogue between governments, regulators and other digital stakeholders to enable countries to create and capture more value in their digital economies.

Executive summary

Introduction

Today, most countries strive to achieve strong digital economies, yet there is no standard model to follow, and success stories remain limited. Our study proposes a uniquely structured approach that is specific to the varying capabilities, resources and ambitions of different countries. It is designed to help policy makers create tailored strategies to achieve both their mid-term digital ambitions and longer-term visions.

Digital transformation can result in long-lasting benefits for economies

The digitization of economies delivers numerous benefits, driving innovation, fueling high-paying job opportunities and boosting economic growth. Depending on the definition, the digital economy represents between 4.5 and 15.5 percent of the world's GDP¹

Digital infrastructure is the basis for industry and the economy as a whole, forming the foundation for the higher layers in all value chains. This is increasingly becoming the case as most economic sectors undergo digital transformations. Without high-speed and pervasive connectivity infrastructure, there can be no digitalization – for nations of any size.

Transitioning to digital economies can enable countries to boost industry growth and productivity, improve societal well-being and benefit consumers via cost or time savings. Digitalization will help bring about new opportunities for businesses and/or improve productivity in industries such as manufacturing, agriculture and energy & utilities. It provides new tools for tackling persistent development and social challenges and improving access to healthcare, education and other public services. Consumers also benefit through faster access to better products and services at lower costs. Consequently, the transition to a digital economy is a major policy priority for all countries.

A study conducted by Oxford Economics and Huawei,² which captures the value of digital spillovers, estimates that in a high-digitalization scenario, the global digital economy could grow to

account for 24.3 percent of global GDP by 2025, which equates to \$23 trillion.

Embracing digital needs: a tailored approach

A digital economy consists of many aspects. Certain parts of the global digital value chain are dominated by a few countries – for example, software services in Ireland and Philippines, and hardware manufacturing in China. Contrastingly, other elements of the digital economy are intrinsically local – for example, e-government, e-health, support services and connectivity.

As policy makers consider different options and practices aimed at maximizing benefits from the digital economy, they **need to recognize that “one size does not fit all” when it comes to digital policies.** For example, Germany launched its artificial intelligence strategy in 2018 and allocated a €3 billion investment to AI R&D, estimating that AI would add approximately €32 billion to Germany's manufacturing output over the subsequent five years (2019–2023).³ Should policy makers working in the least-developed countries also aim to invest their limited resources in AI and expect the same returns? The obvious answer is no. Every country is unique or can be characterized by a distinct set of national digital traits. The challenge is to identify what individual governments should focus their national efforts on and how they should do this.

Allocating scarce resources and finite funds according to a country's specific context is crucial, particularly if the huge development gap which exists between under-connected developing countries and hyper-connected digitalized economies is to be closed. ICT policy making is extremely complex and decision makers are often overwhelmed when considering the factors involved. Most countries are short of resources and not integrated with the global ICT value chain and lack sufficient skills to develop their local ICT industries. And many of the factors required to develop a domestic ICT sector have long gestation periods – for example, developing local ICT talent can take years, and making an impact in basic research requires sustained effort and substantial funding over many decades.

1 “Digital Economy Report 2019”, United Nations Conference on Trade and Development (UNCTAD), 2019

2 “Digital Spillover”, Huawei, 2017

3 Study commissioned by the German Federal Ministry for Economic Affairs and Energy – “Potenziale der Künstlichen Intelligenz im produzierenden Gewerbe in Deutschland”

As such, policy makers – particularly those in developing countries aspiring to create large numbers of ICT jobs – need to align their resources strategically. This is akin to developing a strategy for a company. Successful companies choose to define their strategies by aligning all their resources to solitary objectives – either to be the lowest-cost producer (e.g., BIC makes disposable consumer products that offer simple, affordable solutions to everyday needs), supplier of the most differentiated product or the provider of a niche product/service (e.g., telecom operators offer services within defined geographic regions).

To support policy makers in their thinking and help develop their strategic focus, we have distinguished a number of different digital economy archetypes. This enables nations to take a tailored and distinctive approach to aligning their digital economy policies and objectives.

Our analysis of the ICT value chain includes detailed benchmarking of beneficial policies and capabilities in 15 countries, discussions with experts in national digital transformation and the ICT market, and a literature review – it also leverages Arthur D. Little’s project repository of national ICT strategies and industry experience. Through this, we have identified seven digital economy archetypes: Innovation Hubs (IH), Efficient Prosumers (EP), Service Powerhouses (SP), Global Factories (GF), Business Hubs (BH), ICT Patrons (IP), and ICT Novices (IN). The archetypes differ in their presence or dominance in the ICT value-chain step, as illustrated Figure 1 below. However, archetypes are not limited to specific steps in the value chain – instead, their position marks the focal domain in the overall value chain. They can be further differentiated through other underlying characteristics, such as economic

status, population size, political stability, geographical advantage and technology penetration. In addition, country archetypes guide policy priorities.

Mapping countries onto archetypes has resulted in two key insights. Firstly, **archetypes are not mutually exclusive**, and a country may also present (some) characteristics of a second archetype. Secondly, **transition to a higher-value-adding archetype is possible and even desirable** but takes concerted effort. For example, Romania has transitioned from an ICT Patron to a Service Powerhouse (especially in cybersecurity services), and Mexico has transitioned from ICT Novice to Global Factory. Romania was able to leverage its institutional legacy of excellence in science, mathematics and technical education, its large domestic market of 20 million population, and lower costs to become a favored IT outsourcing destination for European clients.

Charting a unique digital path and redefining policy priorities

Nations need to develop digital value creation paths that align with their most suitable archetypes, leveraging their inherent strengths, but anchored by their economic and technological realities.

Policy makers need to formulate policies, laws and regulations across four interrelated policy dimensions – technology, capabilities, ecosystem and industry – as we believe these to be the driving forces underpinning digital transformation.

Figure 1: Digital economy archetypes with country examples



Source: Arthur D. Little analysis
 Note *) ICT Patrons can produce and consume as well

■ Technology

Most countries need better connectivity. Irrespective of the national archetype, governments must address policy and regulatory issues relating to broadband, spectrum, cybersecurity, data protection & privacy, and cloud computing.

A best practice 5G strategy is essential to support the introduction of new applications and services that need higher communication speeds and lower latencies. This is critical for all archetypes except for ICT Novices, whose primary focus should be on deploying mature communication infrastructure (4G, fiber) before investing in 5G.

However, for other emerging technologies, we believe the best approach should differ across archetypes. For example, national AI policies, emerging technology development policies, IP rights regimes, science and technology policies focused on cutting-edge technologies, and IP generation and commercialization are all critical for Innovation Hubs and Efficient Prosumers. Service Powerhouses also need national AI and emerging technology development policies, but the focus here should be on building workforce skills in emerging technologies. This will allow companies based in these countries to remain competitive and improve their service-delivery capabilities.

■ Capability

The capability development and resources assigned also differ across archetypes.

For Innovation Hubs, Efficient Prosumers and Service Powerhouses, the focus should be on developing digital foundational skills, ICT higher education and specialized skills.

On the other hand, ICT workforce development policies are critical for Global Factories and Business Hubs, as they need to access talent to sustain their digital economy models.

ICT Patrons and Novices should focus their resources on improving digital awareness among both individuals and businesses.

■ Ecosystem

Digital business funding and support policies and ease-of-doing-business (EoDB) reforms are critical for Innovation Hubs, Efficient Prosumers, Service Powerhouses, Global Factories and Business Hubs because they need to attract

private sector investments, particularly in domains that support their archetype strategies.

Emerging technology regulation is critical for Innovation Hubs, Efficient Prosumers, Service Powerhouses and Business Hubs, as they need to offer conducive environments for digital businesses to test new technologies and innovate.

■ Industry

ICT Patrons have used e-government strategies to kick-start digital-capability building and increase awareness and digitalization of other sectors in these economies. This is also critical for ICT Novices to stimulate digital services demand in their economies. Typically, other archetypes have implemented e-government strategies in the past and do not necessarily need to focus on this.

Industry 4.0 policy is critical for Global Factories and Efficient Prosumers in order to maintain manufacturing competitiveness in the digitalized world, as well as in traditional manufacturing.

Other sector-specific digitalization policies are good to have across all archetypes, but they should focus on their respective dominant industries.

The importance of digital economy policies varies fundamentally between archetypes. Different combinations of policies should be considered for different archetypes. This does not mean countries should disregard other policies, but instead they should ensure that policies critical to their archetypes are given due resources, budget and attention first. These tailored and specific “recipes for success” should shape the strategy each country deploys to build its own digital economy.

The incentive for digital transformation is clear – and the need to embrace change has never been greater. However, nations will only realize the full benefits of this transformation if their digital strategies are built on their own strengths, and their digital policies are prioritized and focused.

Putting policy designs into practice

Our structured archetype definition approach and integrated policy framework helps governments to identify and develop well-suited digital policies. However, it requires a coherent and comprehensive whole-of-government approach to both realize the potential of digital transformation and address its challenges.

Ultimately, the main value of any strategy lies in its successful implementation.

- Effective communication, constructive negotiation, and cooperation with all relevant stakeholders during the design phase and implementation process are crucial. For example, see the added value of cooperative regulation drafting and setting outlined by the International Telecommunications Union (ITU) in its recommendations for Fifth Generation ICT Regulatory Frameworks.
- The targeting and sequencing of measures must be well planned – for example, act first on those that are prerequisites for the success of others in order to minimize trade-offs and enable synergies between policies (OECD, 2018).
- All policy measures in the action plan that involve public spending or investment should identify the required amount and the source(s) of funding.
- Finally, a successful strategy requires a clear time frame for implementation and quantifiable targets with relevant indicators to monitor satisfactory progress.

This white paper outlines a strategic approach for developing digital economies for all countries based on their potential archetypes⁴ and recommends an overarching policy framework tailored towards each. It also provides examples of how countries have successfully transitioned across archetypes. In particular, it provides guidance for developing a digital strategy tailored to the country that reflects a whole-of-government approach to policy making in the digital age.

⁴ A tool to identify 200+ countries'/regions archetypes was developed as part of this study



1. Digitalization: Aiming for growth and well-being

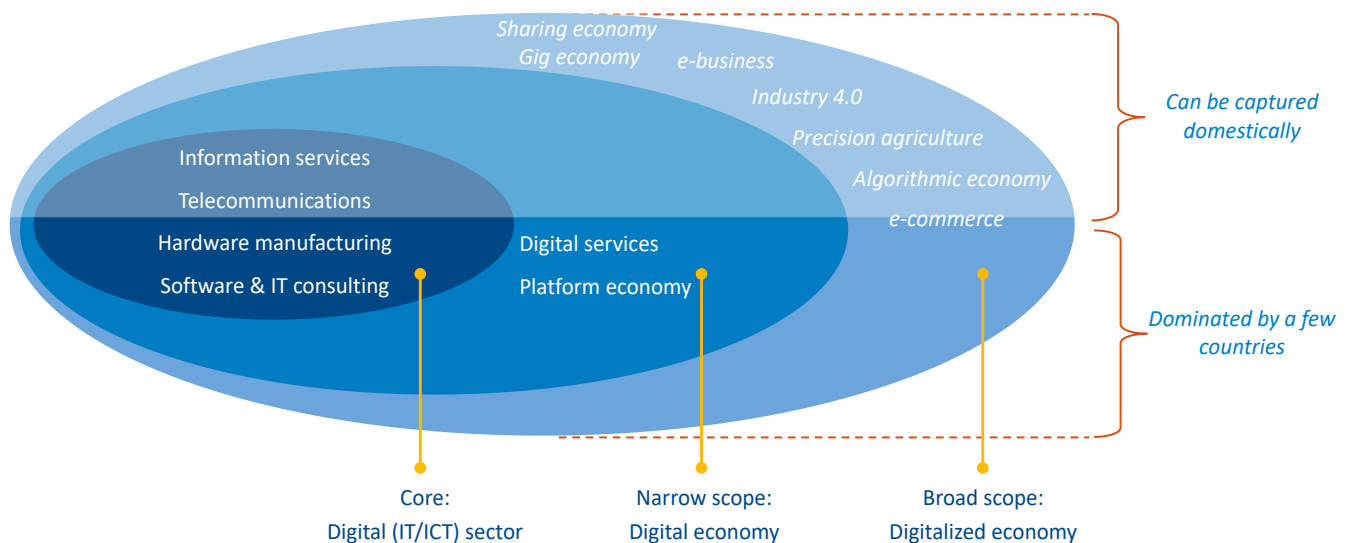
1.1 The digital economy today

Since the early 1990s, the definition of the digital economy has evolved based on the technology trends that characterized the times, as well as the level at which technology penetrated different tasks and markets. In the mid-1990s, “digital economy” was an abstract term associated with the emergence of the internet. Some saw it as the new networking of humans enabled by technology, and others as the convergence of computing and communication technologies that enabled e-commerce;⁵ still others defined it based on its ICT infrastructure foundations. Today, as technology rapidly evolves and becomes ubiquitous, it is widely agreed that the digital economy encompasses all those definitions. It also goes beyond the traditional ICT sector and refers to a broad range of economic activities that use digitized infrastructure and knowledge as key factors of production or value creation.

The digital economy today can be sub-divided into three categories,⁶ as shown in Figure 2:

- The core: The ICT sector, as defined by the Organization for Economic Communication and Development (OECD), is composed of manufacturing and services industries that capture, transmit and display data and information electronically. This includes semiconductors, processors, devices (computers, phones) and enabling infrastructure (internet and telecoms networks).⁷
- Digital economy (narrow scope): The digital functions or applications that create economic value-add to business sectors and customers. This includes services and platforms (both B2C and B2B) using devices and data and connectivity infrastructure as inputs. Innovation in these sectors is widely driving spillover impacts to other sectors.
- The digitalized economy (broad scope): Sectors that were not traditionally digital are now being transformed by the adoption of digital technologies. These include, for instance, e-health, e-commerce, and use of digitally automated technologies in sectors such as manufacturing and agriculture, which include 4.0 and precision agriculture, among many others.

Figure 2: The “digital economy” definition



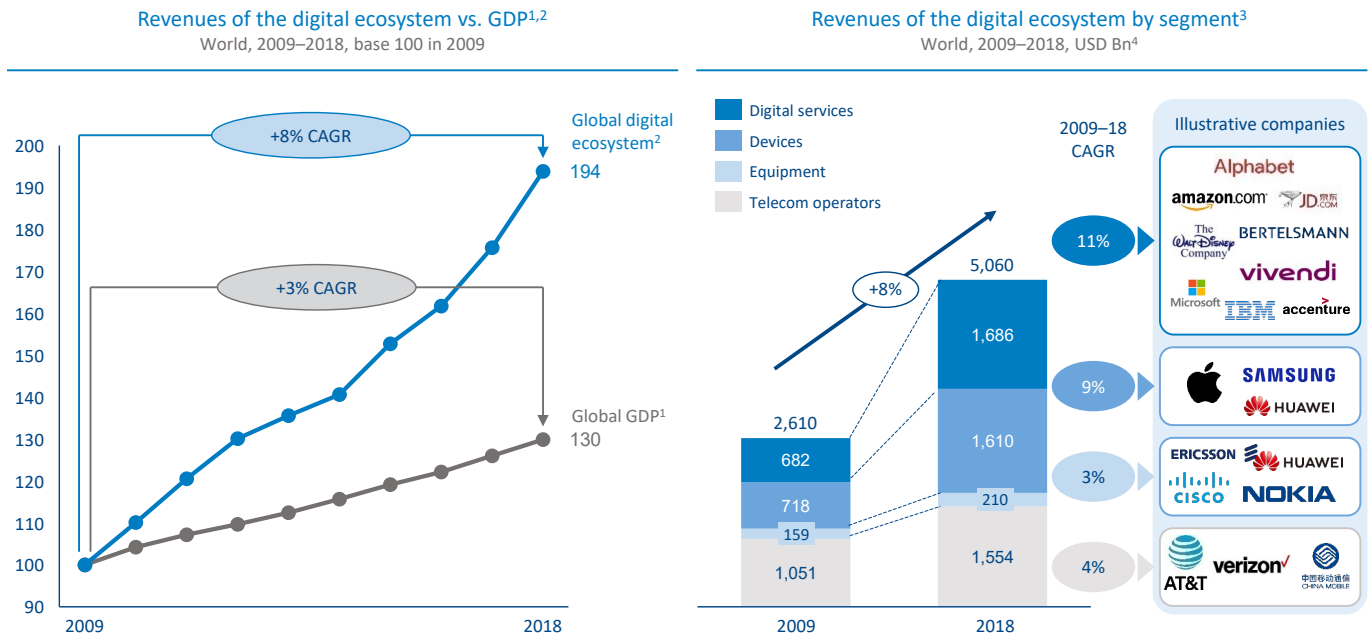
Source: Rumana Bukht and Richard Heeks, 201

5 “Advancing the Digital Economy into the 21st Century”; Neal Lane, 1999

6 “Defining, Conceptualising and Measuring the Digital Economy”; Rumana Bukht and Richard Heeks, 2017

7 “Digital Economy Report 2019”; United Nations Conference on Trade and Development (UNCTAD), 2019

Figure 3: Evolution and trends of the digital ecosystem



Source: Thomson Reuters, World Bank, Arthur D. Little; Note 1: GDP based on purchasing-power-parity growth of regions captured in the digital ecosystem (same scope); Note 2: Digital ecosystem: top 30 players by 2018 revenues in each category; Note 3: Top 30 per category by 2018 revenues; Note 4: Constant USD

The worldwide digital ecosystem is estimated to be growing three times faster than global GDP, with digital firms leading the growth, as shown in Figure 3. While global GDP had a CAGR of 3 percent from 2009 to 2018, digital ecosystem revenues had a CAGR of 8 percent during this period. Digital ecosystem revenues, when broken down by segment, show that digital services and platform players are driving this growth (with a CAGR of 11 percent), followed by digital devices (with a CAGR of 9 percent), which showcases the increasing demand for digital services and devices globally.

Although certain components of the global digital economy are dominated by a few countries – for example, software services in Ireland and the Philippines, and hardware manufacturing in China – other parts of it are intrinsically local: e-government, e-health, support services and connectivity. Hence, large pockets of value creation and capture in the digital economy are available to all.

1.2 Digital infrastructure as a basis for transformation

High-quality and pervasive digital infrastructure is crucial to all countries. It serves to underpin the entire digital economy, forming an essential foundation for the higher layers in all value chains. Indeed, the requirement is accelerating as many economic sectors experience much-needed partial or whole digital transformations. Without high-speed and pervasive connectivity infrastructure, there can be no digitalization – for nations of any size.

As illustrated in Figure 4 digital infrastructure can be split broadly into four components: connectivity and transportation, storage and processing, digital services and applications, and terminals and devices.

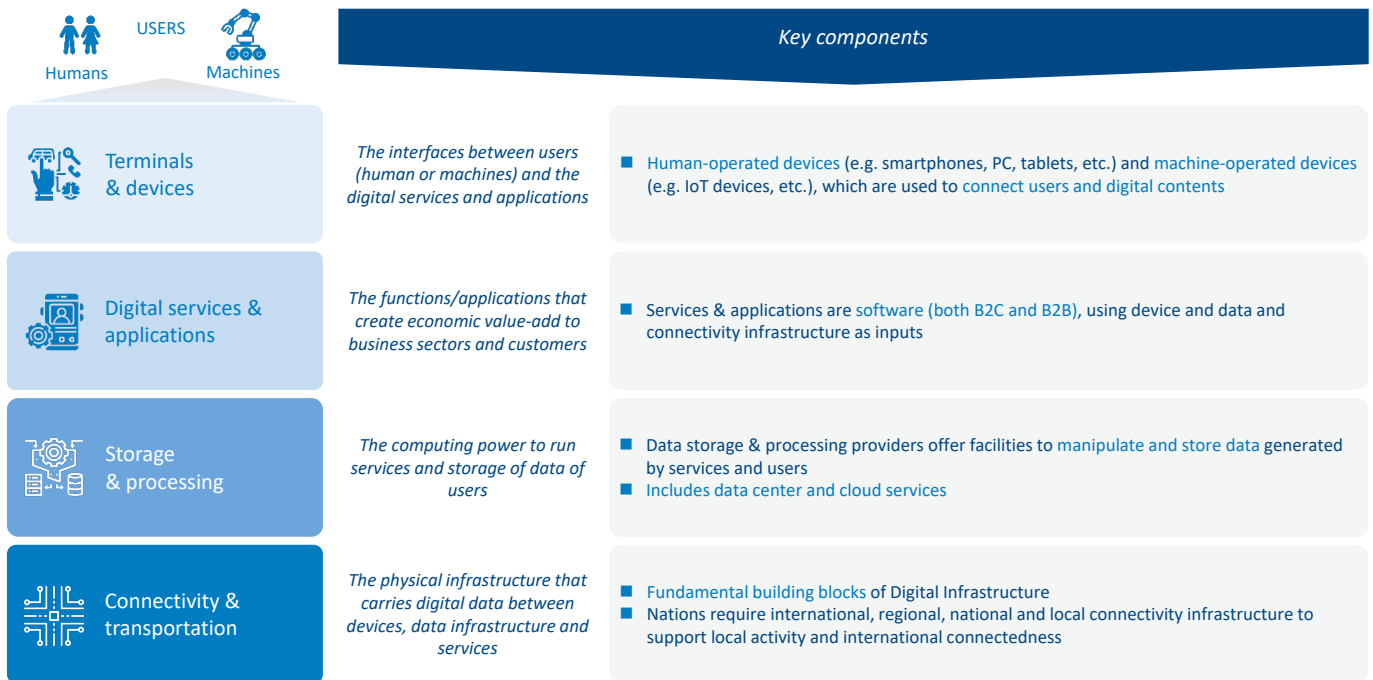
Connectivity & transportation are the fundamental building blocks of digital infrastructure. All nations need international, regional, national and local connectivity infrastructure to support local activity and international connectedness. The infrastructure distribution is uneven in developed, developing and emerging markets.

Storage & processing primarily include data centers, cloud services and other data-processing services that facilitate manipulation and storage of data. Hyper-scale data centers and hyper-converged storage are likely to become indispensable with the ongoing and future expected data explosion.

Digital services and applications encompass functions and applications that create economic value-add to business sectors and customers. This is the fastest-growing segment, and various industries are disrupted by digital technologies.

Terminals and devices serve as interfaces between digital users, including both individuals and machines. Penetration of human-operated devices is moving towards saturation, especially in developed countries. Human augmentation is gaining prominence in devices.

Figure 4: Digital infrastructure components



Source: Arthur D. Little analysis

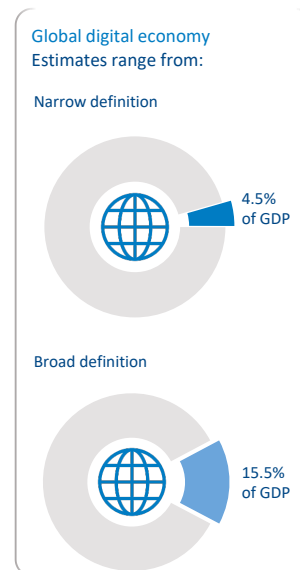
Key challenges across all components of digital infrastructure development are security, funding and adoption. In addition:

- The primary challenge for connectivity infrastructure continues to be lack of clarity on funding and regulations, especially for reducing the digital divide as return on investments remain low in sparsely populated, rural areas.
- Breaches of cybersecurity, privacy and data sovereignty are key challenges for storage and processing infrastructure.
- Digital literacy and skills remain a key barrier for digital services.
- Fragmented M2M technical standards and low affordability are stifling growth of terminals and devices.

Policy makers globally should acknowledge these challenges and address them to promote next-generation digital infrastructure development and enable their digital economies to grow.

1.3 Stakes are high: Economic and social impact

Digital transformation can result in long-lasting benefits for economies because digital technologies drive innovation, fuel high-paying job opportunities and spur economic growth. Depending on the definition, estimates of the size of the digital economy today range from 4.5 to 15.5 percent of world GDP⁸. When defined as a distinct economic sector on the narrowest of definitions, it would still rank among the top 10 economic sectors globally.



Source: United Nations Conference on Trade and Development (UNCTAD), 2019

The digital economy, per the broadest of definitions, is estimated to be \$11.5 trillion, or 15.5 percent of world GDP – 18.4 percent of GDP in developed economies and 10 percent in developing economies, on average.

The transition to a digital economy will also boost national competitiveness across all sectors and bring about myriad new opportunities for businesses. It can also provide new tools and facilitate knowledge transfers for tackling persistent development and social issues.

8 "Digital Economy Report 2019", United Nations Conference on Trade and Development (UNCTAD), 2019

To reap such benefits, countries need to overcome several challenges, which may vary with levels of economic development.

Developed nations are less constrained, as most have adequate ICT infrastructure foundations in place. However, they face the challenge of aging populations, which limit their economically active bases and pose a risk to digital consumption. In most countries, seniors remain largely disconnected from the digital revolution.

On the other hand, developing countries face larger constraints to grow their digital economies. Firstly, they lag in digital infrastructure availability, which translates into lower levels of internet usage across these nations. In least-developed countries (LDCs), only one in five people uses the internet, compared with four out of five in developed countries.⁹ Further challenges arise from a wide gap in digital capabilities and awareness compared to those of developed nations. Developing nations need to carefully recognize their digital landscapes and select policy actions that will maximize the benefits of digitalization, given their limited resources.

If developed countries succeed at adopting digital technologies, they will become more competitive and maintain their global influence. For developing countries, the prize is even more significant, as digitalization could support an economic leapfrog.

Impact of digital infrastructure investments

The positive economic impact of mobile and fixed broadband has been widely studied and acknowledged. In 2019, using a cross-sectional time-series analysis, ITU explored the economic impact of broadband in LDCs, LLDCs and SIDS¹⁰ for the period 2000–2017. Its findings confirm that mobile broadband appears to exert a slightly stronger impact than fixed broadband, generating a 2.5–2.8 percent increase in GDP per capita per 10 percent increase in penetration, compared to a 2.0–2.3 percent increase for fixed broadband. In developed and developing countries, a 10 percent increase in fixed broadband penetration generated a 0.8 percent increase in GDP. A 10 percent increase in mobile broadband penetration generated a 1.5 percent increase in GDP.

Another ITU study¹¹ showed that the economic impact of digitization¹² was even higher than that from fixed broadband diffusion and similar to that of mobile broadband. The positive impacts of digitization were found to be even higher in more advanced countries. According to this study, an increase of 1 percent in the digital ecosystem development index¹³ (used as a proxy measure for the extent of digital transformation in a country) equated to an additional 0.13 percent growth in GDP per capita. An increase of 1 percent in the digital ecosystem development index yields an increase of an additional 0.14 percent in per capita GDP for OECD countries, while the impact of a similar change in non-OECD countries was 0.10 percent. The same study also indicated that an increase in the digital ecosystem development index of 1 percent yielded an increase of 0.26 percent in labor productivity, and 0.23 percent in total factor productivity.

While the impact of legacy technologies has been extensively reviewed, the economic impact of emerging technologies remains largely unquantified, with the exception of a few studies published on specific technologies. For example, 5G is expected to influence two billion new users to come online worldwide and result in \$2 trillion to \$4 trillion cumulative real GDP boost by 2030.¹⁴ At 70% adoption rate, AI is estimated to contribute \$13 trillion¹⁵ (cumulatively from 2020) to global GDP by 2030. One Gartner study estimated that the business value-add of blockchain will be \$3.1 trillion¹⁶ by 2030.

In another study by Oxford Economics and Huawei,¹⁷ a new approach to measuring the digital economy was developed, which captures the value of digital spillovers. As per this study, in a high-digitalization scenario, the global digital economy could grow to account for 24.3 percent of global GDP by 2025, which equates to \$23 trillion. This scenario assumes all 50 economies in the study can maintain an aggressive pace of digital investment and work together to deliver a strong digital strategy, including a supportive infrastructure, a thriving entrepreneurial class and a vibrant technology sector.

Impact of digitalization on industry, consumer and society

The potential impact of digitalization is maximized when digital infrastructure is leveraged by industry, consumers and society at large. We have classified digitalized economic sectors into these three broad groups, as observed in Figure 5.

9 "Digital Economy Report 2019", United Nations Conference on Trade and Development (UNCTAD), 2019

10 "Least developed countries (LDCs), landlocked developed countries (LLDCs), and small island developing states (SIDS)

11 "The economic contribution of broadband, digitization and ICT regulation, ITU, 2018

12 Encompasses the infrastructure of digital services, connectivity of devices, the digital transformation of households and production, the development of digital industries, and the availability of digital factors of production

13 "The digital ecosystem development index was based on 64 indicators, for 75 developed and developing countries and emerging economies between 2004 and 2015

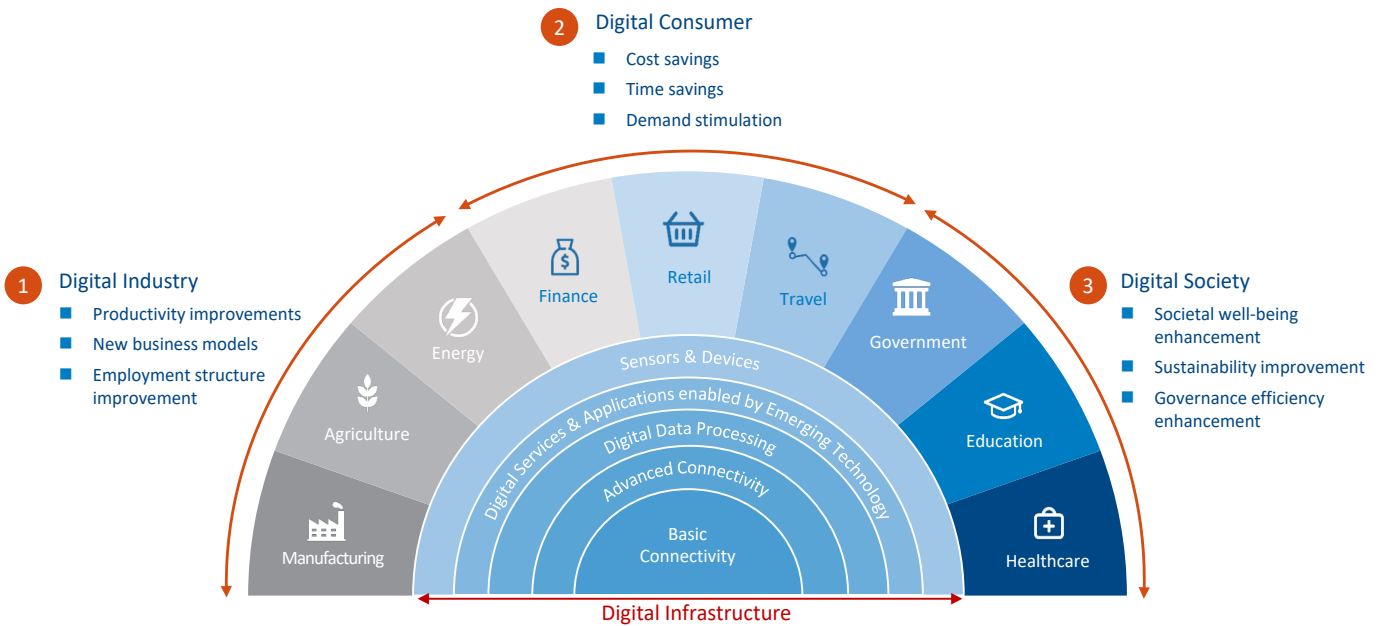
14 McKinsey institute, Oxford Economics

15 ITU, World Economic Forum, Forbes, BBVA

16 Gartner, Forecast: Blockchain Business Value, Worldwide, 2017-2030

17 "Digital Spillover", Huawei, 2017

Figure 5: Impact of digitalization on industry, consumer and society



Source: Arthur D. Little analysis based on publicly available data

Digital industry

Traditional sectors such as agriculture, manufacturing and energy are facing disruptive challenges from declining prices for many commodities, lack of skilled and unskilled labor, and alternative markets. However, with the proliferation of the IoT and other digital technologies, there is significant potential to improve productivity.

The individual economic impact for each sector will differ by country, but it will be significant for nations that strongly depend on these sectors. For instance, smart manufacturing is expected to generate productivity gains of between 15 and 25 percent. In Germany, this translates to €153 billion of additional growth created by 2020¹⁸ and an expected rise in employment of 6 percent between 2015 and 2025.¹⁹ In Germany, for example, the government has established central Platform 4.0, which includes an overall governance team, a research council, a standardization council and an Industry 4.0 labs network – it also undertook extensive efforts to retain the dominance and competitiveness of the manufacturing sector. Germany is enabling Industry 4.0 by ensuring that the appropriate technology, capabilities and ecosystem are in place and well-coordinated among all stakeholders.

Similarly, the adoption of digital technologies in agriculture is enabling the development of precision farming, enhanced

livestock monitoring, and other use cases. Furthermore, the digitalization of the energy and utilities sector enables improved energy management, more precise extraction of raw materials and remote management of energy assets, which improves safety. Digital transformation in this sector is forecasted to save up to \$750 billion globally by 2025.²⁰

Digital consumer

Consumer-oriented sectors such as retail, finance and travel are also rapidly digitalizing. Digitalization helps to cope with pressing consumer trends such as product personalization and rapid delivery, higher demand for product traceability, and increased cost and time sensitivity for travel. It enables a reduction in end-product costs, enhances the shopping experience, increases financial inclusion, improves travel efficiencies and has a positive impact on the environment.

In the retail sector, for instance, technology use cases range from mature e-commerce activities, to customer analytics, to emerging virtual-store experiences. The use of simulation and virtual reality in the last use case will allow customers to engage fully with their products before even purchasing them. For products such as cars, sports gear, and other experience-oriented goods, such enhanced retail opportunities will be a large differentiating factor. For some markets, such as China, B2C e-commerce contributed around 2 percent of total GDP in 2018.²¹

18 "Industrie 4.0," Federal Ministry of Economic Affairs and Energy, Germany, 2020
 19 "Industry 4.0: The Future of Productivity and Growth in Manufacturing Industries," BCG, 2015
 20 Wood Mackenzie, 2019
 21 "B2C e-commerce as percentage of GDP in 2018," Statista

The government of China played a key role in implementing regulations and policies to support the e-commerce sector in three stages to support its rapid development. In the first stage – Initiation & Acceleration (2000–2008) – basic digital infrastructure was deployed, new regulations for e-commerce were formulated and rolled out, and an e-commerce five-year plan was developed. In the second stage – Standardization (2008–2014) – a national policy management system for the e-commerce industry and standards were formed, and the first enterprises were granted permission for online payment transactions. In the third stage – Globalization (2014–2019) – detailed cross-border e-commerce development strategies and international cooperation policies were put in place, and other policies were undertaken, including making it easier to build e-commerce infrastructure (e.g., logistics hubs), financial incentives, and initiatives to strengthen the credibility of payment systems and enhance e-commerce security. All this led to China's e-commerce sector becoming a large economic contributor, supporting 34 million direct and indirect jobs in total in 2019.²²

Likewise, the digitalization of financial services has enabled e-payments that complement various sectors and increased accessibility to financial markets. It has also facilitated enhanced security by utilizing blockchain to trace transactions, big data and analytics to detect fraud, and the IoT to develop tailored insurance policies. By 2025, the digitalized financial sector is expected to generate between \$0.6 trillion and \$0.8 trillion in total revenues globally and create around 95 million jobs²³ in the developing world.

In transportation, digitalization is enabling dynamic systems that help reduce traffic and pollution, integrated platforms that enhance the travel experience and reduce travel times, and smoother logistics through the use of blockchain and digital twins. More advanced technologies are expected to have a significant impact. Most of the value would arise from reducing the toll of vehicle crashes, as well as from giving productive time back to commuters, improving energy security by reducing dependence on oil, and providing environmental benefits.

■ Digital society

Sectors focused on benefiting society as whole, such as healthcare, education and government, are utilizing digital technologies to improve access to high-quality services,

progress urban management, enhance government transparency, and enable a more secure country ecosystem. Furthermore, countries that are highly advanced in embracing digital society solutions have introduced a holistic approach that aims to provide citizens with a fully digital experience.

Having 94 percent of the population digitally engaged in both online public and private services, Denmark is well on its way towards a digital society. The Danish government has made a commitment to go “digital by default” and most transactions are cashless, and almost all interaction with the Danish authorities takes place online. Its e-government projects, such as NemID, have already yielded positive responses from the citizens, with 88 percent of the population actively engaged with digital public authorities.

The economic impact of digitalizing individual society-focused sectors is smaller than its two counterparts, as most of the benefits are quality-of-life improvements rather than economic-output generation. Government digitalization enables countries to do traditional public processes in a more agile manner, recognize threats more effectively, and increase access to public services for communities that might not be well served. Revenues from the digitalization of government are expected to reach \$655 billion globally by 2025²⁴ and generate up to 70 percent in cost savings.²⁵ Similarly, digitalizing healthcare has tremendous potential for society as it helps increase access to such services, tailors more effective treatments, prevents diseases, and enhances the precision of health interventions such as operations. Revenues for this sector may reach around \$500 billion by 2025²⁶ and reduce consultation costs by up to 30 percent. Finally, in the education sector, students can access more engaging and creative experiences using smart boards and gamification approaches. Virtual classrooms are also becoming predominant and could be transformed into engaging, immersive 3D experiences that could replicate environments such as laboratories. In addition, digital technologies may serve a better purpose, to tailor education to students' needs rather using a “one size fits all” approach, which would enhance academic attainment and reduce dropouts. However, it is crucial for policy makers to ensure equitable access to digital infrastructure, otherwise welfare gaps could be exacerbated.

22 “E-Commerce in China”; Statista, 2019

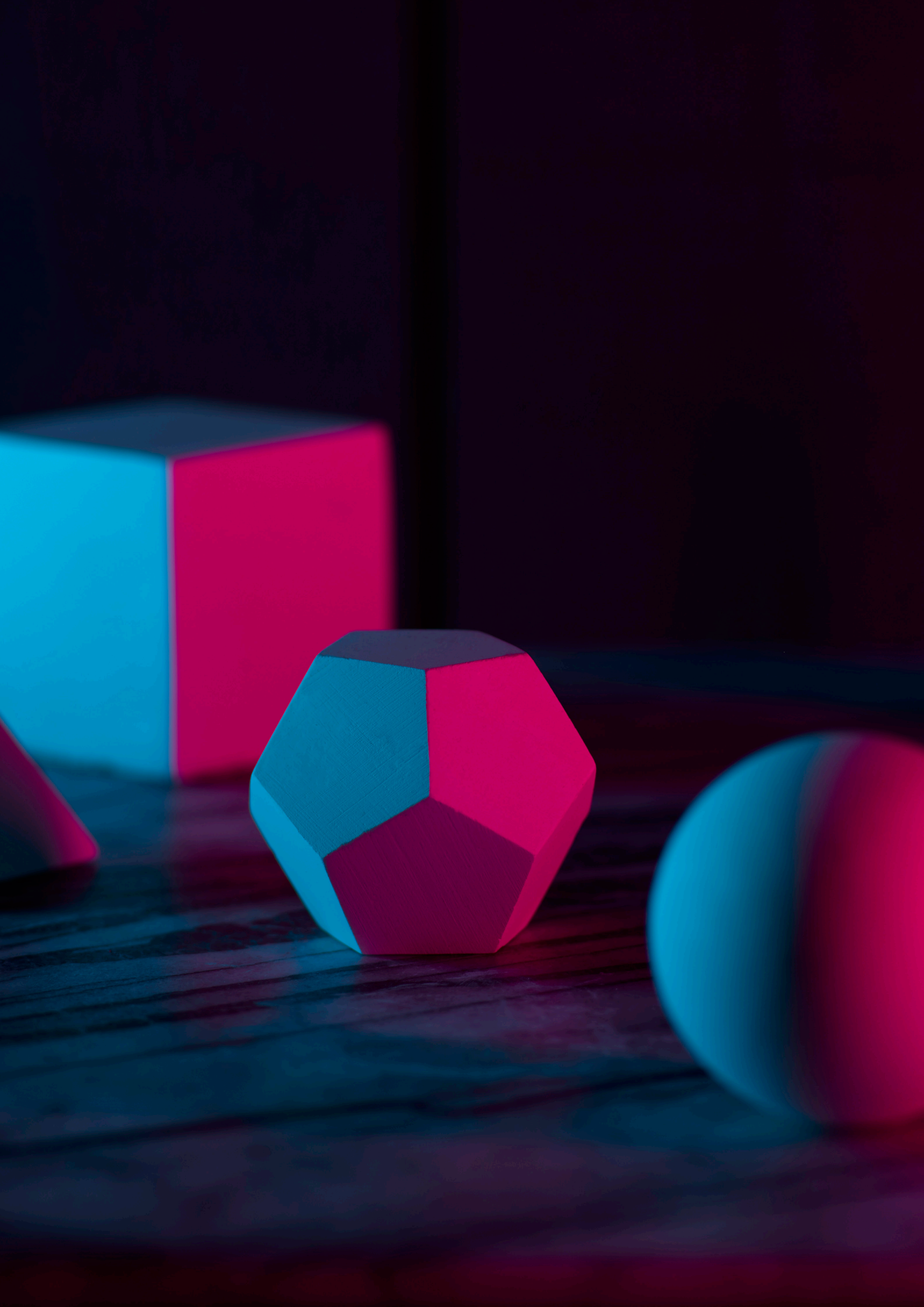
23 “Digital Finance for All: Powering Inclusive Growth in Emerging Economies”; McKinsey Institute, 2016

24 “ICT Investment in Government Market”; Grand Review Research, 2017

25 “Digital Government: Principles and Best Practices”; Alexei Pavlichev, 2003

26 “Digital Health Market Size”; Global Market Insights, 2018

Overall, the net impact of digitalization in nations will depend on the level of development and digital readiness of each country and its stakeholders. It will also depend on the policies adopted and implemented at national, regional and international levels. Most importantly, to maximize the benefits of digitalization, policy makers will need to ensure that their digital policies are crafted to meet specific country challenges.



2. Digital economy models for all

2.1 Defining archetypes

There is a universal acceptance of the need for economies to digitalize, but countries face dilemmas in allocating scarce resources and finite funds. The challenge emanates from the inability to define focus areas for the growth of the digital economy, as successful digital economies require a whole range of infrastructure and capabilities.

“one size does not fit all”

The question for policy makers is, what does it take to use ICT to transform an economy?²⁷ Why do some countries rapidly accelerate their development journeys using ICT, while others fail? How do successful countries balance strategic leadership and bottom-up innovation? What should the roles of government and the private sector be?

The key questions are: “Which recipe best fits my current situation, and builds towards my ambition?”

“What should I have in common with others, and where should I differentiate?”

Most importantly: “Why?”

When considering different policy options and practices aimed at maximizing benefits from the digital economy, policy makers need to recognize that “one size does not fit all”. They need to make careful and deliberate choices on how their nations take part in the new digital world – not just as users and consumers, but also as producers, exporters, innovators, and regulators – to create and capture more value on their paths towards sustainable development. With the objective of supporting policy makers in their thinking processes, we have identified different digital economy archetypes and developed an aspirational digital strategy for each. This tailored digital strategy will guide policy priorities.

Our approach begins with the recognition and definition of archetypes. An archetype serves as a reference model that countries can adapt based on their current situations.

Using an archetype framework for assessing opportunities and challenges, and then analyzing the options for development of ICT strategies, goes beyond a static assessment of the ICT industry. It looks at a typical long list of recommendations for transforming the ICT sector in a country. It allows a country to make necessary choices and trade-offs when designing and implementing ICT strategy within human, financial and institutional constraints. It considers initial conditions, stakeholder interest, institutional dynamics and political willingness. Rather than looking at the causality of individual elements of the digital infrastructure, such as connectivity, ICT skills, e-government initiatives and development objectives, an archetype approach allows these elements to be strategically linked.

An archetype approach allows the country to link ICT strategy to national development strategies, which leads to an “interaction effect” – interaction between ICT investment, infrastructure, skill levels and policy environment. Reaching a minimum threshold allows the country to benefit sufficiently from returns to scale and investment in digital infrastructure. The different archetypes demonstrate the manner in which countries have captured and managed various interdependencies over time. This approach allows policy makers to define the interdependence between actions and resources of different stakeholders, the linkages between various stakeholders, and the roles of various stakeholders and their interactions.

²⁷ National Strategies to Harness Information Technology: Seeking edited by Nagy K. Hanna, Peter T. Knight

Figure 6: Digital economy archetypes with country examples



Source: Arthur D. Little analysis
 Note *) ICT Patrons can produce and consume as well

Our analysis of the ICT value chain includes detailed benchmarking of beneficial policies and capabilities in 15 countries, discussions with experts in national digital transformation and the ICT market, and a literature review – it also leverages Arthur D. Little’s project repository of national ICT strategies and industry experience. Through this, we have identified seven digital economy archetypes, as show in Figure 6. Archetypes differ in their positions across the ICT value-chain steps, and thus the value they capture from the ICT industry. However, archetypes are not limited to specific steps in the value chain, but rather, their positions mark focal domains in the overall value chain. They can be further differentiated through other underlying characteristics, such as economic status, population size, political stability, geographical advantage and technology penetration. Through specific combinations of these elements, we have distinguished seven archetypes.



Countries in this archetype capture the highest value from the ICT industry. They are leaders in conceptualizing and developing new technologies and commercializing innovative solutions based on them. They are home to global digital giants and can foster technology-enabled start-ups, and consequently capture large shares of the digital economy. For instance, countries that are advanced in developing AI applications or introducing IoT-enabled platforms, such as South Korea match this archetype. The advancement of technology innovation is based on a robust ecosystem that promotes basic and applied research and technology development across the

public, private and academic sectors. Becoming an Innovation Hub requires significant investments, a long-standing base of knowledge, and extremely high levels of technical capabilities, which are usually built over decades. The archetype’s primary focus is not to produce technology for its own consumption, but rather, to be the leader in cutting-edge innovation and create worldwide demand for its products.

Countries in this archetype are niche players that innovate and deploy solutions for dominant local industries. They focus on the same step of the ICT value chain as Innovation Hubs: technology design and product development. They also have strong ecosystems that promote research and development (R&D) activities around emerging technologies.



The key differentiating characteristic is that Efficient Prosumers focus their efforts on developing technology solutions that will enhance the competitiveness of a single or a few economic sectors within their countries. The digitalization effort in the core industries leads to spin-off benefits in other industries. An example is Germany, which has heavily invested in digitalizing manufacturing, including the automotive and machine-building sectors, and pursuing Industry 4.0 at large. In the past, digitalization of the manufacturing sector in Germany led to SAP becoming a leading player in the enterprise resource planning software domain.

Countries in this archetype are recognized for their formidable positions in the global supply of ICT services. Their competitive



advantage in this sector is the result of large, active populations that were effectively translated into surpluses of ICT workers, which resulted in low costs for delivering such activities. Nonetheless, countries without such advantages must not be discouraged, as other skills, such as strong international

language proficiencies, have also proven to increase the opportunity for countries to become key players in the ICT services market. The Philippines, for example, became one of the largest ICT service outsourcing markets in the world, given its large, economically active population with a good command of English, as it is the language of instruction in schools. Service Powerhouses are not generally high-income countries. Their technology innovation efforts are relatively low compared to the two previously mentioned archetypes and are limited to processes involved in creating and delivering ICT services.

Countries in this archetype lead in ICT manufacturing and also have large surpluses of labor force. However, compared



to Service Powerhouses, a workforce with an adequate level of ICT skills is less critical. The large, economically active populations tend to be employed in manufacturing activities, with ICT goods constituting a large proportion of production. Low costs of labor tend to enhance the competitiveness of ICT goods

prices, allowing countries in this archetype to be large global exporters. Mexico and Malaysia are representative members of the Global Factory archetype; ICT goods exports accounted for >15 percent of total goods exports for both in 2017. To retain this advantage, countries tend to focus on complementary investment in physical infrastructure that enhances the competitiveness of exports such as factory clusters, trade warehouses and logistics hubs. Technology innovation efforts are relatively low & tend to be limited to production processes & tools.



Countries in this archetype are characterized by the presence of advanced & conducive business environments when compared to their regional counterparts. They tend to be the preferred locations for international firms to set up their regional headquarters or key operations offices. They attracted businesses owing

to their flexible and conducive business regulations, availability of state-of-the-art infrastructure, attractive standards of living, and strategic connectivity to various markets in comparison to other countries within their regions. Examples include the United Arab Emirates and Turkey. Beyond a conducive business ecosystem, Business Hubs are also politically stable and provide favorable terms of trade for both producers and consumers of ICT goods and services. Consequently, Business Hubs' biggest contributions to the ICT value chain is to serve as trading platforms for ICT products that are to be distributed to nearby countries.



Countries in this archetype are known for their large-scale consumption of ICT goods and services, but their contribution to the global ICT value chain is low. Their large demand for technology solutions is rooted in the prevalence of high-income societies and robust basic ICT infrastructure such as high-speed internet

and large international bandwidth. However, most of their consumption is satisfied through imports. Examples of these countries include Saudi Arabia, with ICT consumption rising annually, and Denmark as the world leader in e-government as per the UN E-Government Survey 2018. ICT Patrons tend to be differentiated from Business Hubs by the fact that they are not as attractive for international companies to set up their key offices, and thus do not feature large volumes of trade beyond the imports needed to satisfy local demand.



The last of our archetypes is constituted by countries with the least contributions to the ICT value chain. Usually these countries have limited economic resources and low levels of educational attainment and may suffer from geo-political instability. Based on this context, ICT Novices have not prioritized ICT infrastructure

investments historically, as their limited economic resources have been allocated to more pressing needs. Therefore, they tend to fall behind in internet penetration and ICT skills across their populations. This translates into low demand for ICT solutions, which is met either by low-tech innovative local players or through imports, depending on specific needs, and most importantly, the lowest prices available. Most of these countries will have only recently become aware of the benefits that could arise from digitalization. Therefore, they will have started drafting their digital economy strategies and thinking about the best ways to close the gap with countries already advanced on the digital transformation quest.

The archetypes have distinct presence across ICT value-chain steps and distinct comparative advantages derived from their endowments, such as economic status, population size, political stability, geographical advantage or abilities gained over decades due to legacy policy choices. Except for ICT Novices, the archetypes typically have politically stable environments and are not very low-income economies.

The archetype approach supports policy makers in their thinking processes and helps articulate the countries' strengths, core capabilities, and unique differentiators. Recognition of each country's archetype is the critical first step towards developing a tailored digital strategy that will guide policy priorities.

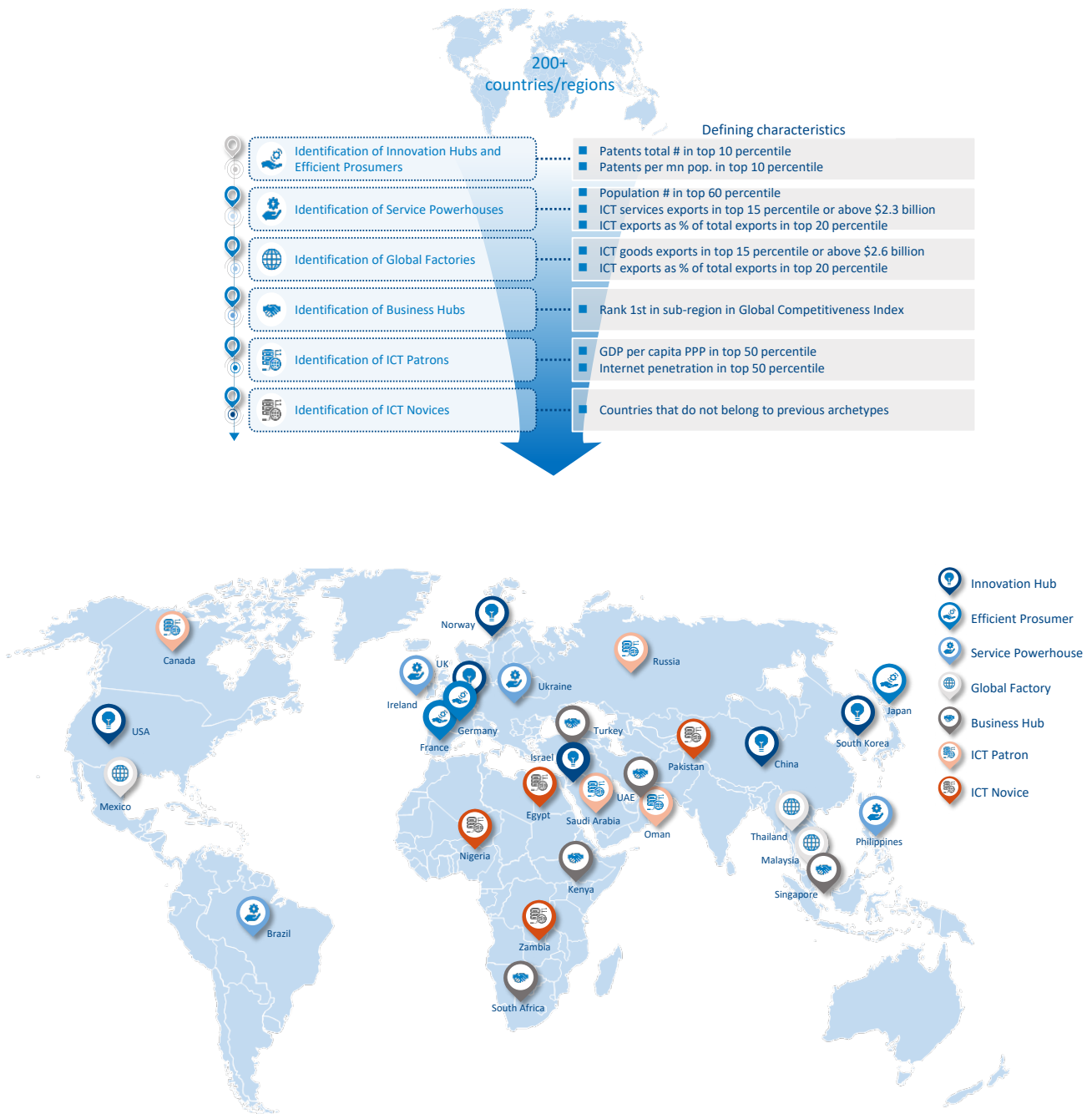
2.2 Mapping the world

We identified 200+ countries'/regions archetypes based on their defining characteristics. This is illustrated in Figure 7, which showcases a sample of 28 of these countries/regions and archetypes. Multiple defining characteristics were used to identify the countries'/regions archetypes, including the rate of innovation, importance of the ICT sector in terms of services and goods, international competitiveness, economic development, and degree of internet connectivity. Each of these characteristics was proxied by a quantifiable indicator, including (in the same order) number of patents, ICT goods exports, ICT services exports, competitiveness ranking as per the WEF's global competitiveness index, GDP per capita (PPP), and internet penetration.

The analysis resulted in two key insights:

- Archetypes are not mutually exclusive, and countries/regions can also present the characteristics of a secondary archetype. Out of our sample of 204 countries/regions, we found that around 14 percent had secondary archetypes. For instance, China's primary archetype is recognized to be Innovation Hub; however, given it belongs to the top 10 percent of countries in terms of ICT goods exports as a percentage of GDP, as well as total value, it also presents the characteristics of a Global Factory. A similar trend is observed for Malaysia, whose primary archetype is Global Factory; nevertheless, the country also presents salient characteristics of a Service Powerhouse, scoring in the top 15 percent of countries in terms of ICT services total value.
- Transition to a higher-value-adding archetype is possible and even desirable but requires a concerted effort. For example, China transitioned from Global Factory to Innovation Hub, and Mexico from ICT Novice to Global Factory.

Figure 7: Country archetype identification



Source: Arthur D. Little analysis



3. Tailoring digital strategy and public policy

3.1 Succeeding within the archetype

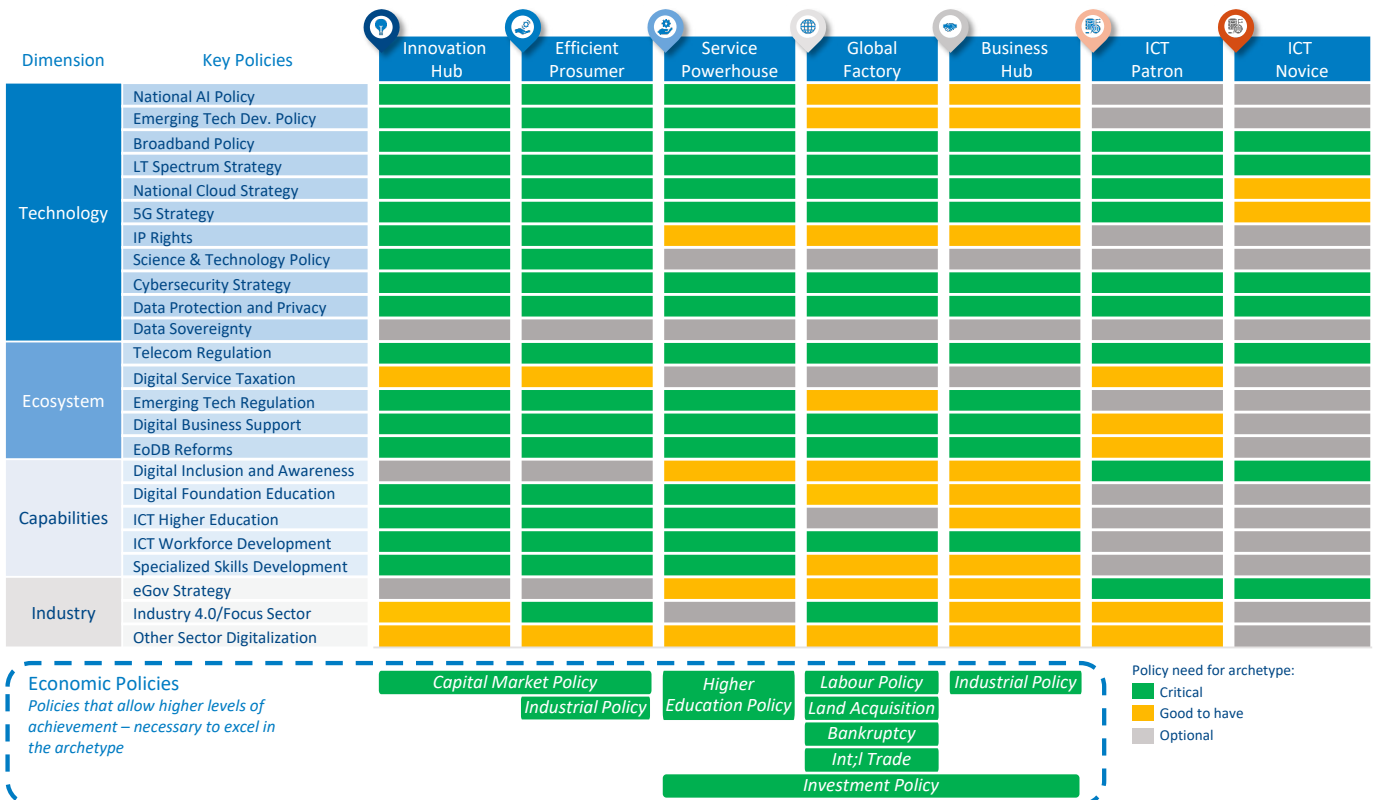
The kind of digital future that a country aims for will be central to the success of the country's digital economy. We believe that selecting the best strategic path should be based on the characteristics of the country's archetype. Policy makers may need to adapt existing policies, laws and regulations, and/or craft new ones to ensure consistency with their desired digital futures.

That being said, the digital economy calls for unconventional thinking and policy analysis. The archetype framework provides the opportunity to recognize variations of digital economy strategies that require different policy-domain combinations across digital economy dimensions. This does not mean

countries should disregard other policies, but instead, ensure that policies critical for their archetypes are given due resources, budget and attention.

The final list of policy areas was built by thoroughly studying existing policies in countries with different levels of economic, social, geo-political and technological development. This was further enhanced through a literature review of digital economy policy papers from leading international organizations. Detailed analysis of digital policies, highlighting best-practice policy components, can be found in the Appendix document. In Figure 8, we have outlined the policy list, grouped as per the digital economy pillars, and mapped their criticality for each archetype.

Figure 8: Digital economy policy criticality matrix



Source: Arthur D. Little analysis based on existing policies in countries with different levels of economic, social, geo-political and technological development, literature review of digital economy policy papers, expert inputs

Throughout the remainder of this section, we will provide synopses of how different archetypes may follow varying policy strategies, as described in chapter 2. It includes:

- An overview of the digital economy strategy of the archetype and key focus areas/strategic objectives.
- The policy domains that are most critical for each focus area.

Countries may use these narratives as starting points to reflect on how they wish to shape their unique digitalization paths. However, when designing digital economy strategies, it is crucial for individual countries to go one level deeper and understand their specific performances across digital economy enablers, as the archetype is merely a tool to structure and stimulate thinking, rather than the basis of a fixed model. The stories below include examples and short case studies of approaches taken by countries to help ground the theory.

3.1.1 Innovation Hub

As implied by its archetype title, the overall digital economy strategy of an Innovation Hub is to maintain its leading position as “the location” for innovation. Consequently, the key strategic objectives of an Innovation Hub are to:

- Become a leader in emerging technology research and innovation.
- Be the preferred private sector destination for new product design and commercialization.
- Build future-oriented, skilled digital human capital to sustain the innovation ecosystem.

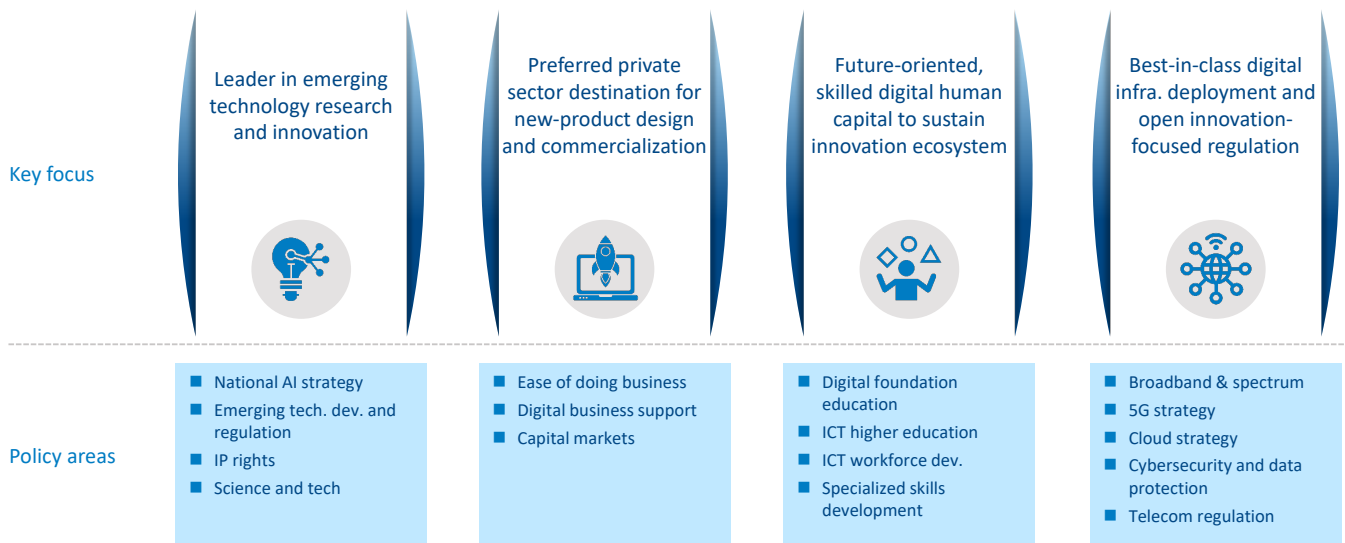
- Deploy best-in-class digital infrastructure and open innovation-focused regulation.

Each of these strategic objectives can be strengthened through efforts across various policy domains.

Leader in emerging technology research and innovation

To be a pioneer in emerging technology innovations, large-scale public and private sector funding in science and technology research is critical. To drive R&D, policy makers can offer direct or indirect financial support to public agencies, academic institutions or private sector players engaging in such activities. Although countries should consider pursuing a mix of both measures, direct funding offers governments the opportunity to steer the focus of R&D efforts into key areas with the most added-value potential for the country. Israel is an example of a leading country in R&D; its expenditure reached 4.2 percent of its GDP, and it hosts 320 R&D centers across the country, operated by leading international companies such as Apple, Google, Intel, Microsoft, HP, IBM and eBay. Israel built an attractive environment for R&D by setting up financial incentives, ensuring an adequate supply of specialized workforce, and encouraging cooperation between public, private and academic stakeholders.²⁸ Innovation Hubs should also have comprehensive AI and emerging technology development policies aimed at encouraging innovation and fostering business investments and technology commercialization, while managing issues around regulation, ethics and privacy to protect citizens and society. Robust IP-rights protection is paramount to promote private sector participation in R&D in the country.

Figure 9: Key strategic focus and relevant policies for Innovation Hubs



Source: Arthur D. Little analysis based on expert inputs

28 “R&D centers in Israel”, Ministry of Economy and Industry of State of Israel, 2018

Preferred private sector destination for new product design and commercialization

To convert research into commercial products, larger private sector involvement is critical. Policy instruments to achieve such goals include digital business funding support such as public-private funding schemes with existing incubators or business accelerators and setting up government-backed venture capital (VC) programs to convert research into commercial products. In the UK, 41 percent of existing business accelerators received public funding, with a key focus in space and satellite technology development, agriculture-tech and transport.²⁹ Policies to enable EoDB and those that facilitate access to capital markets are critical to attract the private sector and foster an innovation ecosystem.

Future-oriented, skilled digital human capital to an sustain innovation ecosystem

To sustain the advancement of their technology innovation ecosystems, Innovation Hubs should retain and attract the best talent in science, technology, engineering and mathematics (STEM). Achieving such goals requires transformation of the entire education system of a country. At the foundational education level, it entails developing students’ creativity, critical thinking, entrepreneurship and communication skills, as well as reinforcing their abilities in STEM subjects and engaging them with technology usage from young ages. At the tertiary education level, governments need to increase interest in careers that will support the evolving ICT and innovation ecosystem. This may be realized through scholarships, subsidized research programs, international exchanges, academic challenges and labor-office support offered to students pursuing such careers.

Those already in the workforce should not be left behind. As the country becomes technologically advanced, the mismatch between existing skills and those required by new jobs increases. Governments can support closing this gap through provision of retraining schemes, offering incentives to the private sector to enhance workers’ ICT skills, or setting up online resources that may be accessed according to the person’s own pace and schedule. They may appeal to foreign talent through incentives such as attractive visa options and income-tax exceptions. Sweden has ensured a pool of international talent through its conducive migration legislation; only a job offer is needed for a work permit. Sweden also has the second-largest proportion of ICT specialists in the EU, at 6.8 percent of the working population.³⁰

Best-in-class digital infrastructure and open innovation-focused regulation

To sustain the innovation ecosystem, Innovation Hubs should deploy best-in-class digital infrastructure, as well as set up conducive regulatory ecosystems that support emerging technology use-case development. Policy makers need to promote the growth of next-generation mobile technologies (5G), as these have the potential to stimulate innovation, support digitalization of various economic sectors, and help meet the increasing demands of the digital economy. Policy makers should consider streamlining rights of way, managing spectrum efficiently, enhancing deployment and access to fiber backhaul, and updating infrastructure-sharing regulations. In addition, they should follow adaptive regulation regimes for emerging technologies, taking responsive and iterative approaches.

3.1.2 Efficient Prosumer

The overall strategy for an Efficient Prosumer is to drive technology innovation in a few dominant local industries to enhance economic competitiveness globally. Consequently, the key strategic objectives of an Efficient Prosumer are to:

- Become a pioneer in technology innovation emanating from selected dominant sectors.
- Digitalize key dominant sectors to retain competitive advantage.
- Ensure wide availability of specialized labor to operate digitalized sectors.
- Deploy best-in-class digital infrastructure and open innovation-focused regulation.

Each of these strategic objectives can be strengthened through efforts across various policy domains.

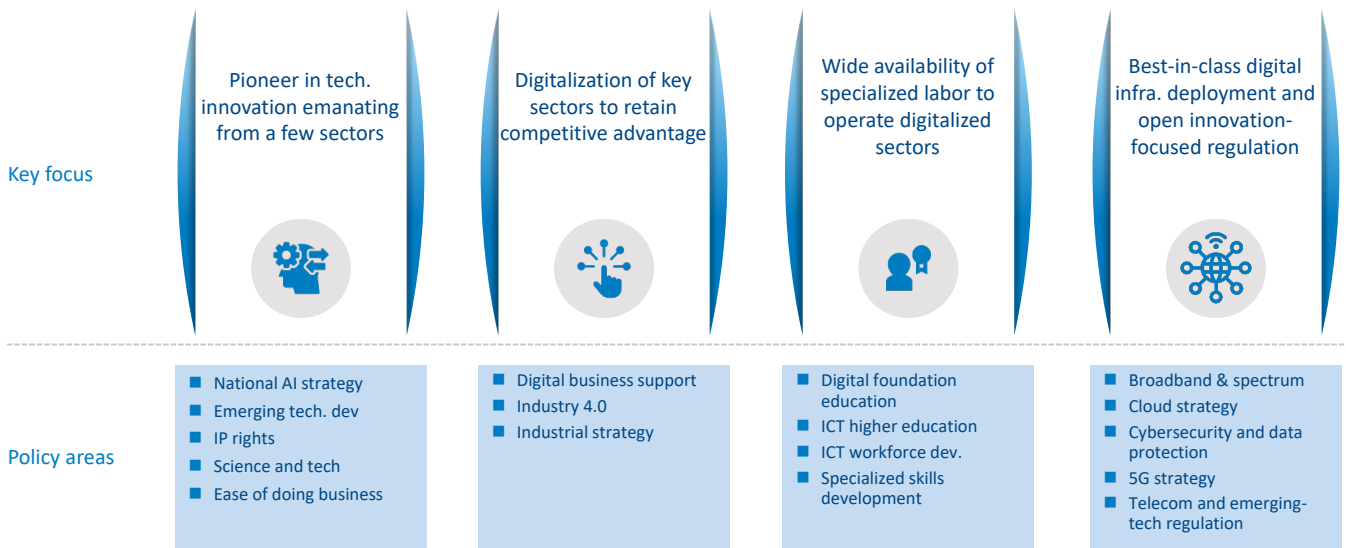
Pioneer in technology innovation emanating from selected dominant sectors

Efficient Prosumers aim to become pioneers in innovative technology development and commercialization, with specialization in a few sectors. For instance, Germany is characterized by innovating in well-established industries to keep its worldwide leadership position in sectors such as automotive, chemical, mechanical, electronic, materials, and, more recently, renewable energies. To achieve such a goal, Efficient Prosumers should have comprehensive AI and emerging technology development policies aimed at encouraging innovation and fostering business investments and technology commercialization in the dominant sectors.

²⁹ UK Department for Business, Energy and Industrial Strategy, 2018

³⁰ “ICT specialists in employment,” Euro Stat, 2018

Figure 10: Key strategic focus and relevant policies for Efficient Prosumers



Source: Arthur D. Little analysis based on expert inputs

In addition, governments should directly provide funding or mentoring, or set up specific hubs for companies focused on developing innovative solutions. Germany’s Federal Ministry for Economic Affairs and Energy has over eight funding programs aimed at providing capital for pre-commercial research and development projects to help transform scientific findings into state-of-the-art technology that can then be sold in the market.³¹ Robust IP rights protection is also critical to promote private sector participation in R&D in the country. Furthermore, Efficient Prosumers may support the growth of digital businesses through the adoption of conducive EoDB policies – for example, streamlining the process of starting a business through the aid of digital platforms, reducing costs of licenses, and removing financial barriers such as minimum-capital requirements.

Digitalization of key sectors to retain competitive advantage

To maximize the benefits of innovation efforts, Efficient Prosumers seek to incorporate locally developed digital solutions into key sectors to increase productivity and retain competitive advantage. Specific sector policies serve this purpose; some examples include Industry 4.0, fintech and e-health strategies. Initiatives within these strategies should foster the demand for digital technologies across all business sizes; some options include the provision of financing incentives to those emerging technologies in industry, capability-building activities, infrastructure enhancement and spaces to trial new technology solutions. Germany’s Industry 4.0 strategy is a policy reform that aims to drive digital manufacturing forward by increasing digitization and the interconnection of products, value chains and

business models. It also aims to support research, networking of industry partners and standardization of cyber-physical systems. Since many public, private and academic entities are engaged in the German industrial innovation landscape, the country established “Platform Industrie 4.0” to serve as a point of contact for policy makers and guide public efforts around the topic.³²

Wide availability of specialized labor to operate digitalized sectors

Driving digital transformation at an advanced level requires extensive availability of a specialized workforce that can operate effectively in the digitalized sectors. Policy makers need to consider reforms across the entire education system to guarantee that the country is building strong digital foundation skills in schools. This will help build both interest and capabilities for students to pursue careers in STEM tertiary education or follow advanced technical vocational paths. To increase the number of specialized professionals, countries should enhance the supply of local workers or attract skilled foreign workers. The former may be achieved through scholarships for STEM degrees, subsidized vocational education, and technical centers, while the latter may be attained by establishing incentives for foreigners. In Japan, a country facing workforce challenges from an increasingly aging population, the government has launched the “Highly Skilled Foreign Professional” working visa, which is designed to attract highly skilled professionals across 14 industry fields to work in Japan by giving them preferential visa processing and residency benefits.³³

31 “Taking Control of the Digital Transformation, Federal Ministry for Economic Affairs and Energy, Germany, 2019

32 “Germany: Industrie 4.0,” European Commission, 2017

33 “A New Status for Residence,” Ministry of Foreign Affairs of Japan, 2019

Best-in-class digital infrastructure deployment and open innovation-focused regulation

Digital infrastructure plays a central role in enabling advanced sector digitalization. Efficient Prosumers should have state-of-the-art ICT infrastructure as a foundation to support development, commercialization and adoption of emerging technology solutions. As investment costs in passive infrastructure can be very high, governments may intervene through regulation and funding to encourage universal fiber deployment. 5G networks are also key to supporting emerging technologies, particularly to enable cyber-physical systems, which are expected to prevail in industries such as manufacturing, mining and logistics. In terms of storage and data processing, cloud adoption presents the biggest benefits, as it enables cost-savings and enhanced productivity through easier collaboration, and fosters innovation as new business models are enabled.

As in the case of Innovation Hubs, an adaptive regulatory regime is crucial to drive innovation of use cases in emerging technologies. In Germany, for instance, The Data Ethics Commission recommends adopting a risk-adapted regulatory approach to algorithmic systems, which are key in AI technology solutions. It states that the greater the potential for harm, the more stringent the requirements and the more far-reaching the intervention by means of regulatory instruments.³⁴ In other words, it recommends that regulation adapts to the potential risk of the emerging technology.

3.1.3 Service Powerhouse

The overall strategy of a Service Powerhouse is centered on improving investments and capabilities to drive ICT services business. Consequently, the key strategic objectives of a Service Powerhouse are to:

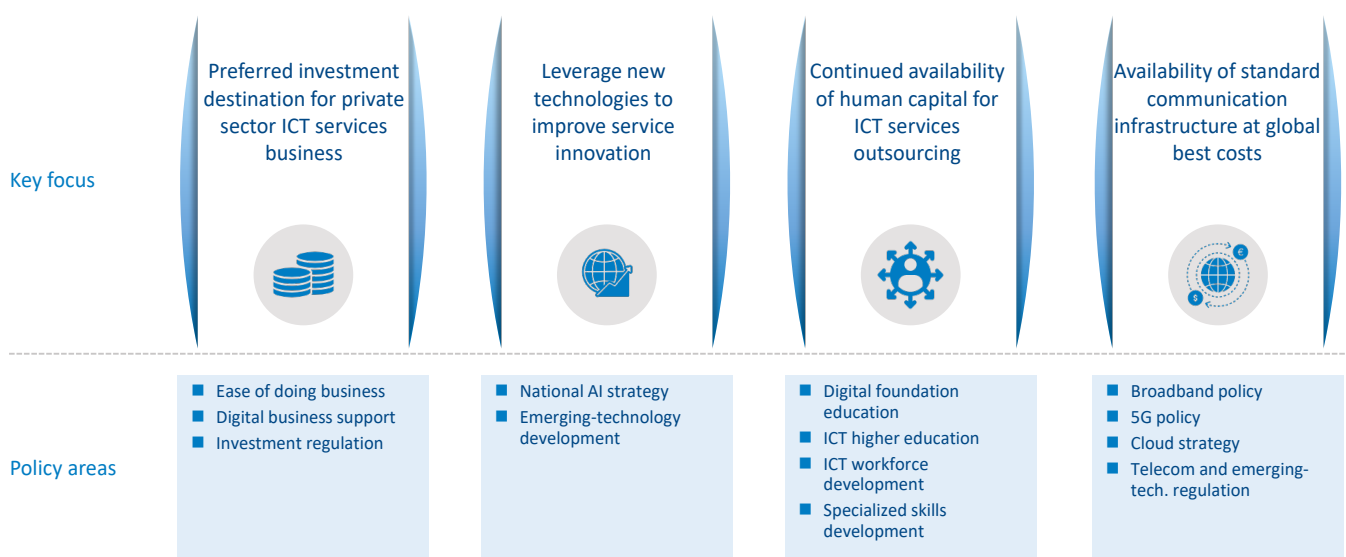
- Be a preferred investment destination for private sector ICT services business.
- Maintain availability of human capital for ICT services outsourcing.
- Leverage new technologies to improve service innovation.
- Maintain availability of standard communication infrastructure at global best costs.

Each of these strategic objectives can be strengthened through efforts across corresponding policy domains.

Preferred investment destination for private sector ICT services business

To increase private sector investment in ICT services from local businesses and multinational companies (MNCs), Service Powerhouses need robust EoDB policy reforms, investment-enabling regimes and digital business support policies. This may include attractive taxation policies for the services sector, easy access to capital and flexible labor market regulations, and funding support. Ireland, one of the largest ICT services exporters in the world, provides a flexible and pro-business environment, as well as a competitive corporate tax regime. These have encouraged most of the largest global technology companies to establish their European headquarters there.

Figure 11: Key strategic focus and relevant policies for Service Powerhouses



Source: Arthur D. Little analysis based on expert inputs

34 "Opinion of the Data Ethics Commission", Data Ethics Commission of Germany, 2019

Leverage new technologies to improve service innovation

Service Powerhouses need to leverage new technologies to improve service delivery capabilities and stay relevant and competitive in an increasingly digital world. Substantial investments in emerging technology and AI, specifically targeted at use cases for service innovation and emerging technology skill development, are critical for this archetype to sustain its positioning. AI policy typically aims at enhancing and empowering human capabilities to address the challenges of access, affordability, shortage and inconsistency of skilled expertise in Services Powerhouses.

Continued availability of human capital for ICT services outsourcing

To grow and sustain the ICT services industry, Service Powerhouses should ensure access to large pools of human capital well-versed in ICT skills. To achieve such a goal, they may use ICT higher education and ICT workforce development policy initiatives, such as expanding the availability of ICT degrees at affordable prices, reskilling their current workforces into ICT roles, providing ICT apprenticeships for recent graduates, or attracting foreign talent. To increase the number of tertiary graduates with ICT skills, Ireland introduced the “ICT Skills Conversion” program, which targets tertiary graduates who do not have existing backgrounds in ICT. They are invited to join a free, highly practical one- to two-year ICT course with national validity. Service Powerhouses may also drive upskilling by establishing partnerships with private sector technology providers to develop programs that support the growth of ICT skills in the population. In Brazil, the government has built a massive open online course platform with the aid of large technology firms and local academic institutions. It delivers over 53 free courses in basic ICT, programming, emerging technologies and games content development, among others. In just over a year, the platform has already seen more than 400,000 students enrolled and over 3,800 teachers delivering the courses.³⁵

Availability of standard communication infrastructure at global best costs

Enhancing communication infrastructure at global best costs is also a key strategic objective for Service Powerhouses. As such, infrastructure will support the unique needs of ICT services businesses. Policy makers should incentivize the private sector to increase its investment in broadband infrastructure by directly subsidizing it or providing tax breaks. Conducive reforms to telecom regulation may also encourage broadband deployments. Service Powerhouses should consider establishing market liberalization laws, promoting rights-of-

way (RoWs), enforcing infrastructure sharing, and ensuring regular pricing monitoring. Growing the ICT services ecosystem requires that businesses place a lot of trust in security of data stocks and flows. Service Powerhouses should ensure robust cybersecurity regimes. Ireland established the National Cyber Security Centre and developed a comprehensive set of measures around protecting key critical national infrastructure and the security of Government systems and data. These measures also embrace a broader set of issues around skills, enterprise development and cybersecurity research.

3.1.4 Global Factory

The overall strategy of a Global Factory is to remain a competitive location for ICT goods manufacturing. Consequently, the key strategic objectives of a Global Factory are to:

- Be a preferred investment destination for private sector ICT manufacturing.
- Maintain availability of competitive labor for ICT goods export businesses.
- Leverage new technologies to improve manufacturing productivity.
- Maintain availability of standard communication infrastructure at global best costs.

Each of these strategic objectives can be strengthened through efforts across various policy domains.

Preferred location for the private sector for ICT manufacturing

Global Factories need to attract private sector investments in ICT manufacturing through EoDB initiatives such as enabling the processes necessary to set up manufacturing facilities and providing world-class supply-chain infrastructure, access to capital, and fiscal incentives to export such products. Thailand moved up six places to 21st out of 190 countries in the World Bank’s 2020 EoDB rankings by streamlining the approval process for doing business, adopting digital systems for government services, and improving rules and regulations to catch up with changes in business.³⁶ Pro-investment and trade agreements are extremely critical for Global Factories. Furthermore, to ensure that small and medium enterprises (SMEs) also take part in the growth of the ICT manufacturing sector, governments may introduce support in the form of technical and financial assistance for promising SMEs. In Thailand, where SMEs are the backbone of the economy, the Ministry of Industry issued a \$950 million fund for 2020, which can be accessed by SMEs in various sectors, including ICT.³⁷

35 “Brasil Mais Digital”, Moviment Brasil Digital, 2019

36 “Thailand leaps 6 spots in ‘Ease of doing business’ ranking”, Bangkok Post, 2019

37 “B3bn in SME loans issued for 2020”, Bangkok Post, 2019

Figure 12: Key strategic focus and relevant policies for Global Factories



Source: Arthur D. Little analysis based on expert inputs

Leverage new technologies to improve manufacturing productivity

Another strategic objective of Global Factories is to leverage new technologies to improve manufacturing productivity to remain globally competitive. To achieve this, countries may develop Industry 4.0 strategies with specific objectives, policy roadmaps, governance models and sufficient budget. A strong Industry 4.0 strategy is composed of initiatives to grow the supply of technology solutions and increase the demand and adoption. Since Global Factories are not necessarily producers of emerging technology solutions, they may need to attract foreign firms to locate offices in their countries or offer attractive import-tax regimes to encourage the flow of industrial technology solutions into their markets. To encourage adoption, policy makers may set the example by procuring emerging technology solutions for some of their industrial projects in the utilities or transportation space. They may also provide digital business support to enhance digitalization. Malaysia has introduced a national “Industry 4.0” policy framework aiming to implement standards for systems interoperability for smart manufacturing.³⁸ Similarly, Thailand established its “Thailand 4.0” strategy, targeting 10 industries in the hope of their serving as new and more sustainable growth engines.³⁹ However, neither strategy has seen much advancement in terms of implementation yet.

Continued availability of competitive labor for ICT goods-export businesses

Global factories should also target continued availability of competitive labor to meet the evolving business needs of ICT goods businesses. Particularly, they must ensure that labor is

able to adapt to the introduction of new technologies into ICT manufacturing operations. The current workforce will need to be proficient at using cutting-edge facilities for tooling, production process design, testing and calibration. To facilitate a steady flow of cost-competitive labor, governments may advance vocational training programs, introduce Industry 4.0 capability centers to upskill their current workforces, or provide tax incentives for private companies to drive training efforts. In Mexico, the government has set up 98 centers for industrial innovation across the country to promote training in Industry 4.0 technology use cases. In Thailand, the government provides up to 200 percent corporate tax breaks for companies investing in upskilling employees in digital skills.

Availability of cutting-edge communication infrastructure at global best costs

The entire ecosystem will require cutting-edge communication infrastructure; hence, Global Factories should develop long-term digital infrastructure strategies that can support their target to become advanced manufacturing hubs. 5G connectivity will be a key digital enabler for this archetype, as it will permit the adoption of several emerging technology solutions in industrial sites through deployment of campus networks. Consequently, fiber deployments will be crucial to support 5G rollouts and for improved connectivity. Ensuring healthy competition among telecommunications infrastructure and services providers can be key to enhancing the speed at which broadband policy targets are achieved, as well as ensuring affordable connectivity prices for all. The Malaysian Communications and Media Commission introduced the Mandatory Standard on Access Pricing (MSAP).

38 “National Industry 4.0 policy framework,” Ministry of International Trade and Industry of Malaysia, 2018

39 “Industry 4.0 Policies in Thailand,” Thammasat University, Thailand, 2020

The MSAP regulates prices and terms for alternative internet service providers (ISPs) to access the incumbent’s wholesale broadband capacity. This allows alternative ISPs to offer lower-priced and higher-quality services to their subscribers.⁴⁰

3.1.5 Business Hub

The overall strategy of a Business Hub is to become the most lucrative regional trading destination, encouraging firms across the world to set up their key offices there. Consequently, the key strategic objectives of a Business Hub are to:

- Be a preferred destination for regional operations of leading businesses.
- Maintain availability of an ICT-skilled workforce to sustain regional business development.
- Provide a conducive regulatory framework for emerging technologies.
- Maintain wide availability of cutting-edge ICT infrastructure and access to new-age technologies.

Each of these strategic objectives can be strengthened through efforts across various policy domains.

Preferred destination for regional operations of leading businesses

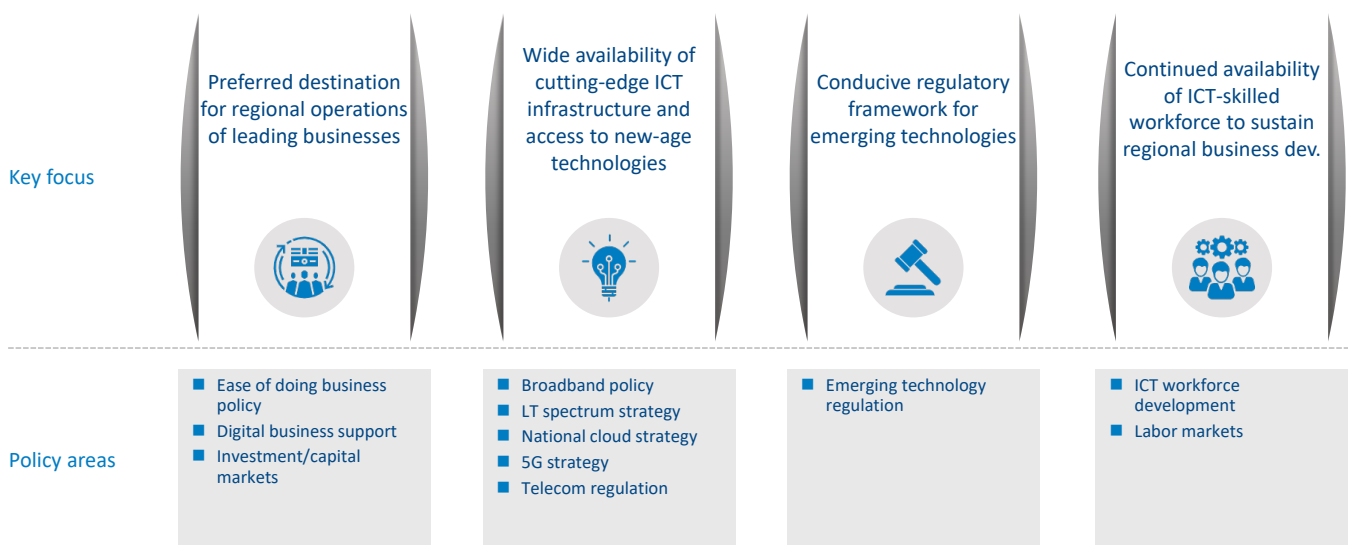
Attracting foreign companies to set up their HQs and operational offices requires a conducive business environment. EoDB policy options to stimulate private sector relocation to Business Hubs

include enhancing ease to access other markets, streamlining importing and exporting activities, providing financial incentives to set up companies, and ensuring easy access to talent. In the UAE, government policies have been focused on streamlining registration and approval processes, especially in commercial areas such as Dubai and Abu Dhabi. For instance, the local government launched the Bashr platform, an integrated e-service which enables investors to establish their businesses in the UAE within 15 minutes through a unified online platform.⁴¹

Wide availability of cutting-edge ICT infrastructure and access to new-age technologies

In terms of digital infrastructure, Business Hubs aim for wide availability of cutting-edge networks that allow access to new-age technologies. An ambitious broadband policy targeting high penetration of fiber and rollout of 5G networks is key to retaining the regional competitiveness of the country. Advanced connectivity infrastructure unlocks the opportunity to deploy emerging technology solutions in trade activities. For instance, blockchain and IoT solutions in ports are starting to be used to streamline import and export activities. Most advanced nations are either rolling out 5G already, such as the UAE, or are a few steps behind. Singapore, for instance, has awarded 5G spectrum to three telecom operators and set requirements to have at least half of Singapore covered by 5G networks by the end of 2022, and scale up to nationwide coverage by the end of 2025.⁴²

Figure 13: Key strategic focus and relevant policies for Business Hubs



Source: Arthur D. Little analysis based on expert inputs

40 “Malaysia’s need for speed: How regulatory action is unleashing ultrafast Internet”

41 “Bashr (Doing business in 15 minutes); UAE government webpage, 2018

42 “Singapore Forges Ahead with Nationwide 5G Rollout,” Infocomm Media Development Authority, Singapore, 2020

Conducive regulatory framework for emerging technologies

Business Hubs target establishment of regulatory environments that are conducive to diffusion of emerging technologies and promote healthy competition in the telecommunications sector. To reach such a goal, policy makers may adopt a “test and learn” regulatory approach to govern emerging technology solutions, through which they can encourage companies to both innovate and trial new digital products. For instance, the UAE has established a “Regulations Lab” designed to anticipate and develop future legislation governing the use and application of emerging technologies. It recognizes regulatory needs by being closely involved with emerging-technologies projects.⁴³ Telecommunications competition and quality-of-service regulation are also important, as they allow users access adequate and affordable prices, as well as high-quality connectivity services, which enhances the attractiveness of the country for establishing HQs.

Continued availability of an ICT-skilled workforce to sustain regional business development

Adequate availability of an ICT-skilled workforce is key to sustaining regional business development, particularly as businesses want to digitalize their operations. Policy makers need to provide incentives for firms and workers to take more and well-targeted ICT upskilling training. They may set up continuing education and training (CET) centers with ICT upskilling programs for recent graduates or mid-career professionals, online programs accessible for upskilling and re-skilling the workforce to improve ICT skills, or even credit opportunities for individuals willing to enroll in private

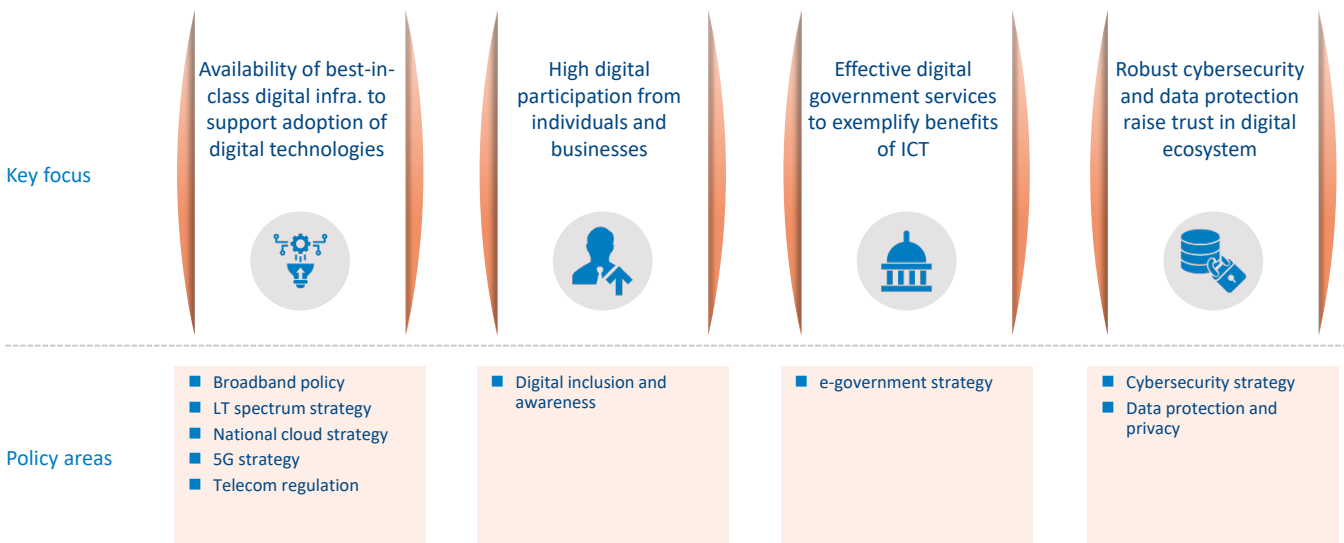
ICT training programs. To capture the exact needs of sector digitalization, it may be more effective to encourage the private sector to drive upskilling; financial benefits or fiscal breaks may be good incentives to encourage such initiatives. In Singapore, the “SkillsFuture” program aims to develop the ICT skills potential of its population with initiatives directed at students, the workforce and enterprises. For instance, one of the initiatives to encourage employers to embark on enterprise and workforce transformation is to provide them with a one-off \$10,000 credit to cover up to 90 percent of out-of-pocket expenses for selected enterprise-capability development and workforce transformation programs.⁴⁴ Regardless of which path is chosen, it is key that policy makers coordinate with industry and other key stakeholders to better design and target training that matches ICT skills demand with supply.

3.1.6 ICT Patron

The overall strategy of an ICT Patron is to empower its nation and improve the competitiveness of key economic sectors through effective use of ICT. Consequently, the key strategic objectives of an ICT Patron are to:

- Provide best-in-class digital infrastructure to support adoption of digital technologies.
- Ensure a high level of digital participation from individuals and businesses.
- Deliver effective digital government services to exemplify the benefits of ICT.

Figure 14: Key strategic focus and relevant policies for ICT Patrons



Source: Arthur D. Little analysis based on expert inputs

43 “Regulations Lab”, UAE government, 2019

44 “SkillsFuture Singapore and Workforce Singapore”, Singapore government, 2020

- Maintain robust cybersecurity and data protection to raise trust in the digital ecosystem.

Each of these strategic objectives can be strengthened through efforts across various policy domains.

Availability of best-in-class digital infrastructure to support adoption of digital technologies

To ensure that the population can adopt ICT effectively, ICT Patrons primarily focus on the availability of best-in-class digital infrastructure. Achieving this entails provision of high-speed internet by expanding broadband infrastructure through a unified investment and rollout plan across the country. In Canada, a country with an already-extensive ICT infrastructure, the focus has shifted to closing digital gaps. The “Connect to Innovate” program is investing \$585 million by 2023 to bring high-speed internet to 975 rural and remote communities.⁴⁵ Furthermore, to guarantee readiness for usage of next-generation technologies, ICT Patrons should consider 5G policies, as this novel connectivity technology is expected to drive digitalization and enhance productivity across sectors. Policy makers must establish 5G strategies, study future spectrum needs, design infrastructure-sharing regulatory frameworks, and incorporate sandbox testing of 5G use cases. Saudi Arabia is an ICT Patron that has rapidly rolled out 5G across the country, with over 13,000 tower cells already installed.⁴⁶ Saudi Arabia’s Minister of Communications has said the Kingdom expects 5G technology to support 45 million new “Internet of Things” devices, creating a market worth more than \$12 billion by 2030.

High digital participation from individuals and businesses

To reap the benefits of digitalization, ICT Patrons seek to maximize the digital participation of their populations. To encourage digital participation among individuals and businesses, ICT Patrons must make sure they recognize the benefits of ICT and understand how to use it. A digital awareness policy is crucial to unlock those results. Governments need to recognize the population segments that use the internet the least, as well as the underlying reasons for this, which could include limited access, no motivation or low trust. A successful project aimed at raising the digital inclusion of a rural population is Croatia and Slovenia’s RuNe, the first case in the EU in which a rural-only, wholesale-only, open-access, active-layer fiber infrastructure obtained private financing without non-refundable public grants, with the support of the “Connecting Europe” fund. RuNe will guarantee broadband connections to more than 370,000 households, businesses and public institutions in rural areas of both countries.⁴⁷

Effective digital government services to exemplify the benefits of ICT

ICT Patrons aim to establish effective digital governments to exemplify the benefits of digitalization to other sectors, as well as adoption of technology in operations. It also compels citizens to become digitally aware. A robust digital government provides access to high-quality online public services across the country. Denmark is one of the leading digital governments in Europe, as ranked by the UN E-Government Survey which measures a government’s ability to deliver public services digitally to its citizens. Denmark’s progressive digital-first strategy makes it legally mandatory for citizens to access public services online. Governments’ procurement of digital solutions can impact the speed at which the private sector adopts technology too, as it brings trust in cybersecurity protocols. In addition, digital government strategies can improve the quality of government service delivery as processes become more efficient and easier to access. Another lever to ease e-government adoption is to launch a cloud-first policy, encouraging the adoption of cloud solutions across public agencies.

Robust cybersecurity and data protection raise trust in the digital ecosystem

Large-scale digitalization requires a robust cybersecurity and data protection scheme, given the large volumes of information that must be transferred; it also is key to raising trust in the country’s digital ecosystem. ICT Patrons may utilize cybersecurity policy tools to develop and sustain regimes that ensure globally accepted practices, which mandate monitoring risks, responding to threats and establishing recovery strategies. Danish government has placed a great emphasis on cybersecurity via the 2018-2023 Defense Agreement. Denmark’s cyber defenses are being considerably reinforced and include better protection against sophisticated cyberattacks. In addition to an overall framework governing cybersecurity, policy makers need to promote awareness of cybersecurity best practices to reduce unintentional exposure to online risks.

3.1.7 ICT Novice

The overall strategy of ICT Novices is to accelerate the limited uptake of digitalization within their borders. Consequently, an ICT Novice’s key strategic objectives are to:

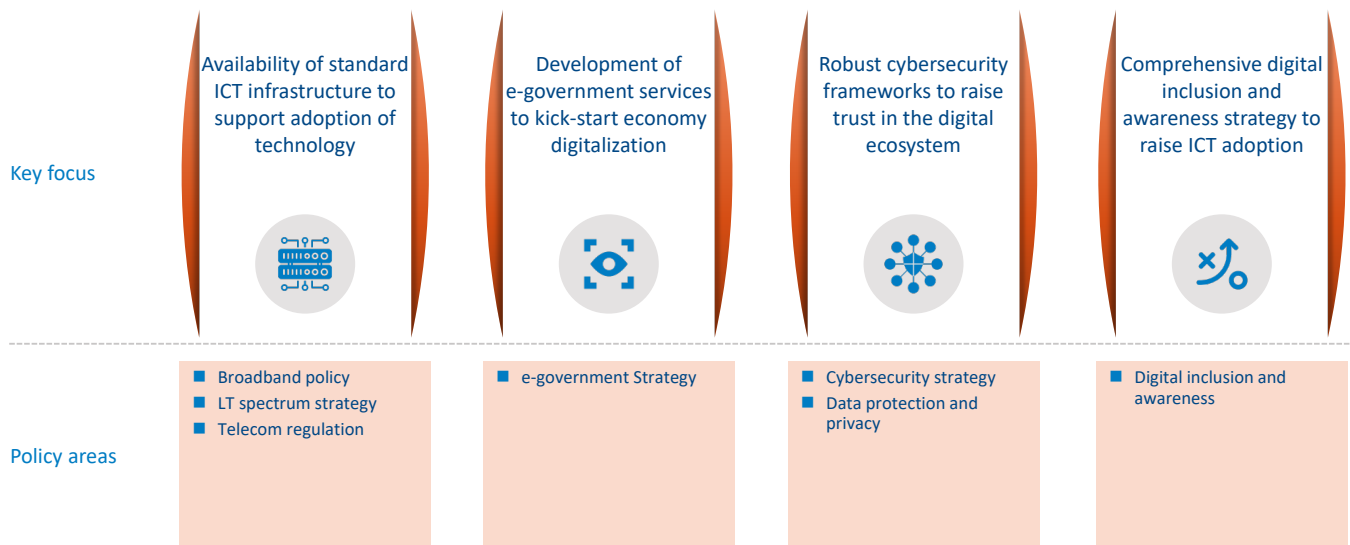
- Maintain availability of standard ICT infrastructure to support adoption of technology.
- Develop e-government services to kick-start digitalization of the economy.

45 “Connect to Innovate”; Government of Canada, 2019

46 “Saudi Arabia ranks third globally in deployment of 5G technology”; Saudi Gazette, 2020

47 “Broadband Good Practices 2019”; European Commission, 2020

Figure 15: Key strategic focus and relevant policies for ICT Novices



Source: Arthur D. Little analysis based on expert inputs

- Deliver a comprehensive digital inclusion and awareness strategy to raise ICT adoption.
- Develop robust cybersecurity frameworks to raise trust in the digital ecosystem.

Each of these strategic objectives can be strengthened through efforts across various policy domains.

Availability of standard ICT infrastructure to support adoption of technology

ICT Novices focus on ensuring the availability of standard ICT infrastructure to support the effective adoption of digital technologies. Countries in this archetype are developing nations that could benefit much from broadband policy. An increase of 10 percent in fixed-broadband penetration has been found to raise developing nations’ GDP per capita by 2 to 2.3 percent, while a 10 percent increase in mobile-broadband penetration can have a slightly higher impact, with a 2.5 to 2.8 percent increase in GDP per capita.⁴⁸

To increase broadband deployments, ICT Novices should first map the level of access to telecommunications services across their countries to identify underserved areas. Next, a broadband strategy should be crafted or updated, with realistic targets and an appropriate selection of ICT infrastructure, fixed or mobile, depending on budget, geographical barriers and urgency. Furthermore, telecommunications services should be deregulated, processes simplified, and prices made more affordable for everyone. Encouraging competition, simplifying license requirements, removing regulatory uncertainty and facilitating efficient access to RoW (right of way) can help

stimulate much-needed private investment. A universal service provision fund may also close the digital gap, as it can serve to finance the rollout of broadband in rural and other unserved areas. There are around 37 universal-access funds in Africa today, typically financed through mandatory contributions by mobile network operators and other telecommunications providers. If targeted effectively, the collective investments from these funds can support closing digital gaps in areas that would not generally be catered for by the private sector.⁴⁹

Comprehensive digital inclusion and awareness strategy to raise ICT adoption

With the future of ICT infrastructure clearly laid out, ICT Novices should aim to introduce comprehensive digital inclusion and awareness strategies to advance digital prospects. Community centers play a key role in these nations, as internet penetration is not necessarily high at home. ICT training and awareness programs may be offered in these centers, as well as other public spaces such as libraries or schools. Countries that identify unserved populations with critical needs for internet connectivity may decide to finance their digital inclusions directly. In Colombia, the government launched a subsidy program for low-income households that included fixed support to purchase computers and a monthly subsidy for two years of internet connectivity. Moreover, an affordable and far-reaching way to raise basic ICT awareness is to provide access to devices and internet connectivity in all public schools; this will give students experience in the use of digital technologies from a young age. The success of this intervention is profoundly rooted in training schoolteachers on how to use, and teach the use of, computing technologies.

48 “Economic impact of broadband in LDCs, LLDCs and SIDS”, ITU, 2019

49 “Universal Service and Access Funds: An Untapped Resource to Close the Gender Digital Divide”

Robust cybersecurity frameworks to raise trust in the digital ecosystem

Digitalization is ubiquitous; even less developed nations with limited participation in the ICT value chain have observed increased use of the internet. Therefore, ICT Novices, as do all other archetypes, perceive a robust cybersecurity framework as a strategic focus area. However, many of these nations do not necessarily have the ICT skills to design or enhance their current cybersecurity strategies, and neither do their populations have the awareness to comply with cybersecurity regulation. Therefore, partnering with external, more experienced stakeholders, such as private sector technology companies, other governments or international organizations, can be an efficient way to leverage the knowledge of other parties to build a unique and robust cybersecurity framework with adequate data protection regulation. For instance, ITU has launched the “Enhancing Cybersecurity in Least Developed Countries” project, aiming to ensure that 49 LDCs can maximize the socio-economic benefits of access to ICTs in a cybersecure environment. The assistance is provided in the form of policy mentoring, capacity building and equipment distribution.⁵⁰ As the cybersecurity landscape evolves, ICT Novice nations will need to also educate their populations to understand cyber risks and best practices in how to avoid them.

Development of e-government services to kick-start economy digitalization

To kick-start the digitalization of their economies, ICT Novices may begin with individual government agencies as pilots, and then migrate to integrated e-government strategies. A comprehensive e-government strategy comes with an open-data initiative that allows agencies to cooperate more efficiently and supports transparency of government transactions. However, most ICT Novices remain behind in development of e-government services. In Latin America, for instance, only Mexico, Brazil and Uruguay have reached the level of deploying e-government strategies, and none are ICT Novices. Completing one government transaction in the LatAm region takes an average of 5.4 hours, and up to 11 hours in some countries. The effective provision of e-government in such nations could reduce the time taken for such activities by 74 percent.⁵¹ However, ICT Novices face a number of challenges in the deployment of e-government strategies. One is the low level of ICT skills present in both public agents and individuals. This means government employees may have difficulty operating new digital platforms or systems – thus, a key initiative for policy makers should be to set up ICT training schemes for public servants and retention plans for highly skilled ICT professionals working in the government sector. For individuals, digital awareness practices should enhance understanding of government online services.

A second challenge is guaranteeing high-quality digital services. Policy makers should ensure they include monitoring capabilities that analyze both the use and quality of government digital services to regularly enhance these services.

3.2 New frontiers: Transitioning to another archetype

Previous policy recommendations were targeted at strengthening an identified country’s positioning within its archetype. This is, in itself, a good-enough vision and strategy to pursue in any archetype.

However, nations can aspire for more, as limited mobility among archetypes is possible. However, the transition will take decades and depends on restrictions defined by the country’s endowments. By participating or growing their presence in higher-value-adding ICT activities, countries can aim for better economic and social benefits and improve their positioning or roles in the global digital ecosystem.

Figure 16 illustrates a range of probabilities for archetype transitions. Generally, moving to higher-value-adding archetypes requires significant effort in terms of both investments and time. Although theoretically all transitions to higher-value-creation digital economy models/archetypes are possible, limited examples of successful country transitions can be quoted. The probability ratings indicate the degree to which evolutions are likely to succeed – these, in any case, also heavily depend on the nation’s investment in this goal.

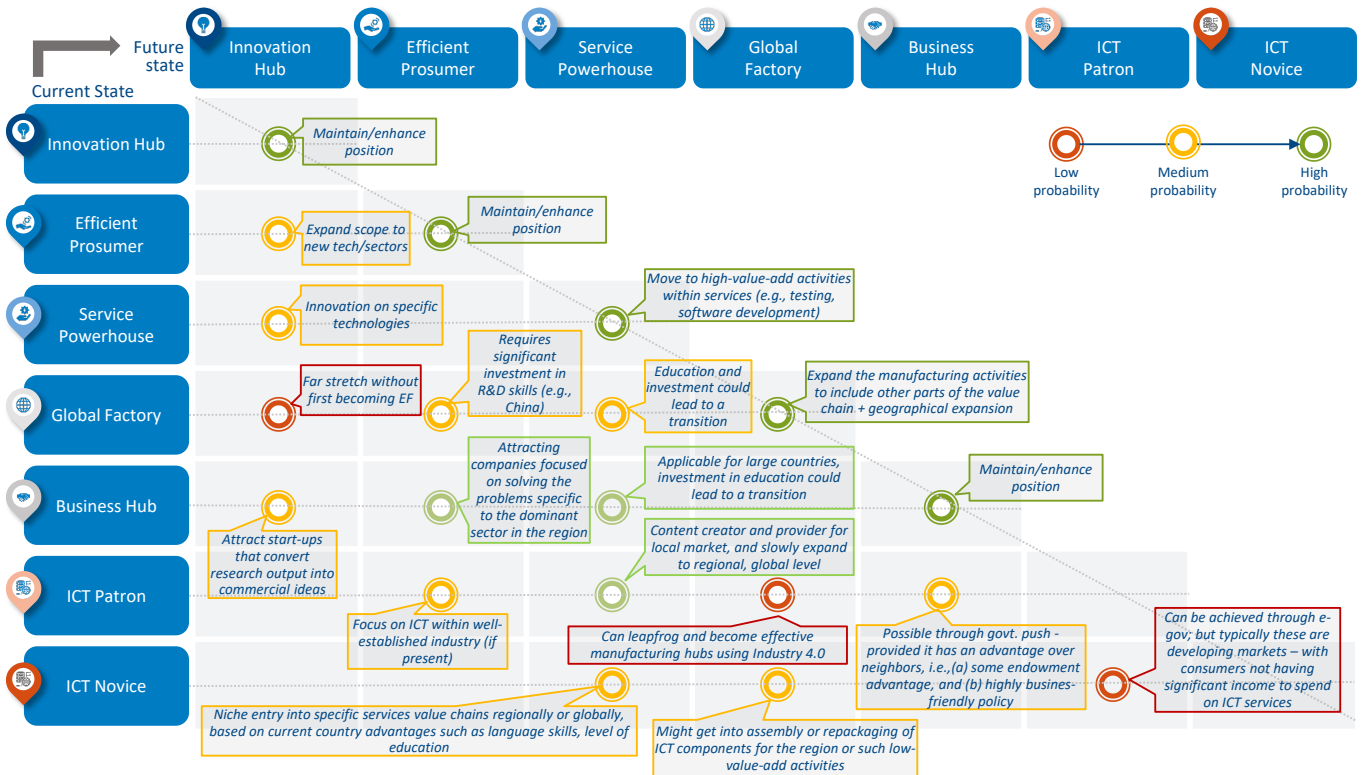
Some examples of successful archetype transitions made possible by deliberate policy measures undertaken by governments include:

- Ukraine’s transition from an ICT Novice to a Service Powerhouse. In 2000, Ukraine’s ICT services exports were merely \$56 million, and the country ranked 52 globally. By 2017, it had repositioned itself as an ICT services hub and boasted annual ICT exports of \$2.8 billion, ranking 25th globally.
- Mexico transitioned from ICT Novice to Global Factory.
- The Slovak Republic transitioned from an ICT Patron in 2000 to a Global Factory by 2017. The Slovak Republic’s ICT goods exports rose from \$0.4 billion (rank 41) in 2000 to \$13 billion in 2017 (rank 19). The electronics industry is one of the key economic sectors of Slovakia, as well as the second-strongest employer and exporter. Slovakia is a regional leader in labor productivity, while remaining cost-competitive at regional and European levels. Slovakia’s transition was possible thanks to EoDB reforms and investments in workforce skill development.

⁵⁰ “Enhancing cybersecurity in less developed countries,” ITU, 2016

⁵¹ “Digitization of transactional public services would reduce red tape and corruption, save money in Latin America and the Caribbean,” IADB, 2018

Figure 16: Archetype transitions



Source: Arthur D. Little analysis based on expert inputs, and publicly available information on different countries' past transitions

- Romania transitioned from an ICT Patron to a Service Powerhouse. In 2000, Romania's ICT services exports were \$189 million with a global ranking of 36. By 2017, its ICT services exports grew to \$4.5 billion, which placed it at rank 21 globally. Romania's transition can be credited to its high-quality ICT education at both high school and university levels, its advantageous quality-to-price ratio and the government's elimination of salary tax for software developers, price liberalization, an open foreign-trade regime, and encouragement of fair competition in the informational sectors. All of this stimulated the business environment and attracted significant investments.
- Luxembourg transitioned from a financial Business Hub to an Efficient Prosumer in its dominant local industry, financial services. It implemented (1) cluster policies reinforcing the links between business and research; (2) a growing start-up ecosystem fostered by dedicated seed funds (Digital Tech Fund, Fit4Start); (3) digital-skills programs, makerspaces, tech schools, Fit4Coding programs, and cybersecurity competence centers; and (4) fintech strategy development. ICT patents doubled from 2000 to 2015, and employment in the ICT sector, as a percentage of total employment, is among the highest in the OECD. In 2017, Luxembourg ranked 8 for ICT patents filed per million people.

- China's transition from a Global Factory to an Innovation Hub is widely acknowledged. Its R&D spending accounts for 20 percent of the world's total. Its ongoing investments in sci-tech research, AI development plan and national engineering laboratories, as well as its quantum computing research facility – the largest in the world – have driven this transition.
- Finland transitioned from an ICT manufacturing-focused economy in the 1990s on the back of Nokia to a leading innovation-driven economy today. (Further details of this transition are described below.)

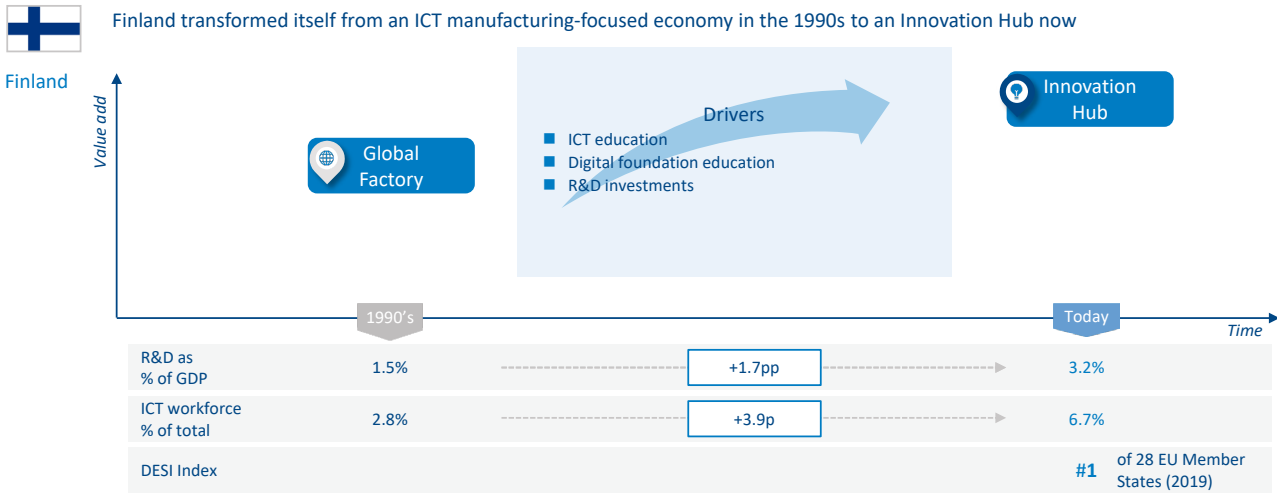
Finland's transition from Global Factory to Innovation Hub

Finland transitioned from an ICT manufacturing-focused economy in the 1990s largely on the back of Nokia to become a leading innovation-driven economy today, as illustrated in Figure 17.

Finland's transition was a drastic, visible shift in employment from equipment manufacturing to IT services. It involved determined action and robust decisions by the government and key sectors.

Finland enjoyed extraordinary growth in the mid-1990s. The ICT sector, with Nokia as its flagship, was at the center of this development. This growth was a result of the government's

Figure 17: Finland’s archetype transition



Source: Arthur D. Little analysis based on expert inputs, publicly available information

investment in digital and mobile communications in the 1970s and 1980s.

In the early 2010s Nokia experienced a rapid decline due to competition from Apple and Samsung in the smartphone segment. However, by then the Finnish ICT sector ecosystem had begun to broaden, reducing its over-reliance on Nokia. It moved away from manufacturing products to producing services and software due to investment in education and policies focused on service innovation.

From the mid-1990s, Finland was preparing to go down its path to become an Innovation Hub; it made radical increases in intangible investments – education, R&D and organization of work – and built a national knowledge base. This contributed to an increase in productivity, redirecting and refocusing employment into more productive, knowledge-intensive sectors. The state played an active role, expanding university-degree programs in electronics and information technology; it achieved the highest proportion of ICT specialists in the workforce in the EU, at 6.7 percent, in 2017, up from 4 percent in 2010. Finnish education policy emphasizes comprehensiveness and equality. The tertiary enrollment rate in Finland is 85 percent – one of the highest in the world – and it has one of the world’s highest percentages of students enrolled in engineering and natural sciences.

R&D investments as a percentage of GDP were at 1.5 percent in 1990, but by 2010, the state increased its investment, reaching and maintaining 3.2 percent of GDP per year.

In addition, the country ensured high awareness and understanding of digital technologies, with 91 percent penetration of internet usage in 2017. Investments were also targeted at ensuring best-in-class digital infrastructure; by 2017,

fixed broadband was available to 97 percent of Finnish homes, which is remarkable given the geographic characteristics of the country.

Finland put in place several advanced policies, such as a national AI policy, emerging technology innovation support, and a regulatory ecosystem that included emerging technology solutions testing. Finland ranks first out of the 28 EU Member States on the Digital Economy and Society Index 2019 (DESI).

Transitions at large – Steps to take

Overall, countries that aim to transition into higher-added-value archetypes should follow these steps:

- Assess the degree of capture of existing archetype potential: Recognize the archetypes the country is in today and assess its room for improvement within these archetypes. This is done through evaluation of its performance in key digital economy indicators compared to their archetype thresholds. If there is a substantial gap, strengthening the country’s position within the archetype is preferable. If room for improvement is limited, transitioning to a higher-value-adding archetype could positively impact the economic and social landscape.
- Assess transition options with the highest probability of success: Identify the most feasible transition option from the current primary archetype, based on guidance in Figure 16. Identify the critical incremental policies needed to succeed in the transition, based on the criticality of policy focus for the archetype, as per Figure 8.
- Evaluate the transitions of other countries to understand key investment requirements and enhance policy decisions: Thoroughly evaluate implications and risks and develop an elaborate long-term transition plan.



4. Leveraging archetypes to drive a country's digital economy

How can countries benefit from this different, albeit strategic, approach? This report serves as an aid for policy makers to define the roadmap for their future digital economies, providing answers to two questions:

Key question #1: "How can my country excel at capturing maximum value from my current digital archetype, to the benefit of the nation, people and economy?"

Key question #2 (optional): "Once my country is best in class within its archetype, what is my next achievable ambition and which buttons should it push to reach a new steady state in the mid-term?"

As illustrated in Figure 18 below, we have outlined a four-point approach for individual countries to engage with the concepts discussed on this paper.

- 1. Identify the country's archetype:** The first step entails identifying the defining characteristics of the country, i.e. its digital archetype. Consider questions such as: What is my country's current play in the ICT value chain? How significant is its contribution to innovation compared to those of other countries? What is its level of economic development? Is internet penetration high? Is the country a major regional trade hub, or is it lagging across most digital economy pillars? Specific defining characteristics of the archetypes that can help with country mapping can be found in Figure 7.
- 2. Recognize the best-fit strategy:** The next step involves understanding the digital economy strategy relevant to the country's archetype. Each archetype has a unique strategic focus aimed at strengthening its position as a leader at a specific step of the ICT value chain, as well as advancing digitalization. This strategy is composed of focus areas relevant to this transformation. Understanding this strategy is key before moving to the next steps, as what follows is a deep dive into policies that help achieve the preferred outcomes. Strategies are detailed in Figure 9 to Figure 15 in section 3.1 of this report.

- 3. Develop a policy roadmap:** It is then time to identify and define the policies that will allow the country to unlock the full potential of its archetype. The criticality of policies varies depending on the country's archetype, as observed in Figure 8. The selection of policies can be used to develop a short- to medium-term digital economy policy roadmap for the country. However, it is crucial to study the current state of the digital economy in the country itself to identify the specific gaps that will help tailor the policy roadmap further.
- 4. Define future steps:** Finally, nations can aspire for more, as mobility among archetypes is possible. However, the transition will take decades and depend on restrictions defined by the country's endowments. By participating or growing their presence in higher-value-adding ICT activities, countries can aim to reap better economic and social benefits. The paper demonstrates that those transitions require success in the current archetype and consideration of a new policy mix. Therefore, once policies in the previous step have been defined and implemented, countries can consider outlining longer-term strategies, with new sets of policies that can be kick-started from the stronger position in the current archetype.

Figure 18: Country approach to digital economy strategy and policy reforms



Source: Arthur D. Little analysis



5. Conclusion

Digitization is poised to become the new engine of economic growth; therefore, it is important for countries to foster it within their territories. Already, the digital economy based on the broad definition of measurement is estimated to be \$11.5 trillion, or 15.5 percent of world GDP – 18.4 percent of GDP in developed economies and 10 percent in developing economies, on average. This includes the contribution of sectors that have not been traditionally digital, which are now embracing digital technologies to tackle the rising challenges of a competitive, growing and interconnected world. It is no surprise that the potential of digitalization is reached only when industries, consumers and society at large effectively leverage digital infrastructure. Nonetheless, if governments are to capitalize on the potential of digital technologies, they need to put in place the right policy levers and choose their priorities carefully.

Digital economy strategy and the ensuing policy paths cannot be the same for all countries; global digital economy studies seldom go beyond recommending best-practice policies for all. Our approach is unique as it helps tailor policy actions based on countries' best-fit digital economy models – also known as archetypes and the archetype strategy. The archetype the country belongs to or chooses to pursue must leverage its inherent strengths but also be anchored by its economic and technological realities.

Through our analysis of the ICT value chain, detailed benchmarking of 15 countries' policies and capabilities to capture significant benefits, literature review, discussions with experts in national digital transformation and the ICT market, and project repository of countries' ICT strategies and industry experience, we identified seven digital economy archetypes: Innovation Hubs (IH), Efficient Prosumers (EP), Service Powerhouses (SP), Global Factories (GF), Business Hubs (BH), ICT Patrons (IP) and ICT Novices (IN). These differ in presence or dominance in the ICT value chain, and their characteristics are outlined in detail in the report.

The archetype framework provides the opportunity to recognize variations of digital economy strategies that require different policy-domain combinations across digital economy dimensions. This means countries should not disregard other policies, but instead, ensure that the sets of policies with high criticality for their archetypes are given due resources, budget, and attention.

This report narrows down policy priorities for countries based on generic archetype strategies that can later be thoroughly analyzed based on the nation's strategic objectives, gaps and distinctive characteristics.

Mobility among archetypes is possible for countries. However, the transition takes decades, and depends on restrictions defined by the country's endowments. By participating or growing their presence in higher-value-adding ICT activities, countries can aim to reap better economic and social benefits and improve their positioning or roles in the global digital ecosystem.

We recommend that countries aiming to maximize the benefits of digitalization consider both enhancing their positions within their archetypes and establishing longer-term digital economy visions to set the building blocks for future transitions.

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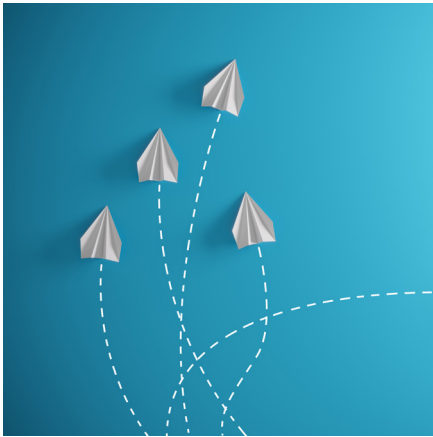
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