Economic and Social Commission for Western Asia

UNITED NATIONS
الاسكوا
ESCWA

Perspectives on the Digital Economy in the Arab Region

E/ESCWA/TDD/2017/2

Economic and Social Commission for Western Asia

Perspectives on the Digital Economy in the Arab Region

United Nations
Beirut

© 2018 United Nations
All rights reserved worldwide

Photocopies and reproductions of excerpts are allowed with proper credits.

All queries on rights and licenses, including subsidiary rights, should be addressed to the United Nations Economic and Social Commission for Western Asia (ESCWA), e-mail: publications-escwa@un.org.

The findings, interpretations and conclusions expressed in this publication are those of the authors and do not necessarily reflect the views of the United Nations or its officials or Member States.

The designations employed and the presentation of material in this publication do not imply the expression of any opinion whatsoever on the part of the United Nations concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries.

Links contained in this publication are provided for the convenience of the reader and are correct at the time of issue. The United Nations takes no responsibility for the continued accuracy of that information or for the content of any external website.

References have, wherever possible, been verified.

Mention of commercial names and products does not imply the endorsement of the United Nations.

References to dollars ($) are to United States dollars, unless otherwise stated.

Symbols of United Nations documents are composed of capital letters combined with figures. Mention of such a symbol indicates a reference to a United Nations document.

United Nations publication issued by ESCWA, United Nations House,
Riad El Solh Square, P.O. Box: 11-8575, Beirut, Lebanon.

Website: www.unescwa.org

Cover photo credits: © Shutterstock

Acknowledgements

The Economic and Social Commission for Western Asia (ESCWA) is publishing this study as part of efforts to promote economic development in Arab countries and to increase the readiness of the Arab region to use digital technologies to achieve the 2030 Development Agenda. It sets out proposals and recommendations for harnessing these technologies in economic growth and expanding opportunities. ESCWA's Technology for Development Division conducted this study under its programme of work for the biennium 2016-2017 and within the Information Society and Digital Economy Hub for the Arab Region (ISDEHAR) framework, endorsed by governments of member countries at the first intergovernmental meeting on technology for development in Dubai from 11-12 February 2017.

This study was guided by Haidar Fraihat, Director of the Technology for Development Division at ESCWA. The authoring team was supervised by Ayman el-Sherbiny, the division's Chief of Information and Communication Technology (ICT) Policies Section. Mirna Barbar, the section's Programme Management Officer, contributed to drafts of the study, revised them and enhanced the final version of the study.

Souheil Marine, an ESCWA regional consultant and expert in information society policies and strategies, was the main consultant and prepared a report on which the study is based. Lize Denner, Associate Programme Management Officer in the Innovation Section at ESCWA and the gender focal point at the Technology for Development Division, reviewed the publication and provided feedback on the gender dimension. Zahr Bou-Ghanem, a research assistant at the ICT Policies Section, participated in the review process with the Publication Committee.

The study was peer reviewed by several ESCWA experts, including regional ICT policy consultants Abdulilah Dewachi, Ibaa Oueichek and Mansour Farah, in addition to Youssef Nusseir, an expert in information society policies and strategies. They provided their comments and discussed the draft during the Arab High-level Forum on the World Summit for Information Society and 2030 Agenda for Sustainable Development held at the UN-House in Beirut during 8-12 May 2017.

ESCWA welcomes comments from member States to the following address: escwa-tdd@un.org.

Executive Summary

The digital economy describes the pervasive use of information and communication technologies (ICT) in social and economic endeavours, leading to expanded opportunities, economic growth and improved public service delivery. The digital economy is crucial to creating 'smart' societies where all actors – public authorities, businesses and citizens, particularly youth and women – use ICT tools and services to take informed decisions. The digital economy is key also to reducing inequalities.

The digital economy revolution is having a monumental impact, in a similar vein to that of the industrial revolution in the 19th century when steam power, the combustion engine and electricity transformed society. The early part of this century has brought many technologies underpinning the digital economy: fixed and mobile broadband access to the Internet, the Internet of things, massive computing power in the cloud and in every hand (smartphones), big data, powerful data analytics and machine learning. These have the potential to overhaul the way people live and work, and how firms carry out their business, governments and public authorities offer services to citizens and the latter, in turn, interact with them.

Along with its many socioeconomic benefits, the digital economy can also bring challenges if not properly managed. These include the potential for rising inequalities and unemployment, dominance by a small number of economic actors, and privacy and security risks affecting individuals and public data and infrastructure. These challenges point to the need for proper policy stewardship to augment the positive impact of ICT and mitigate the risks. Developing digital economy policy should be an open endeavour involving all stakeholders and government departments, even when it seemingly addresses 'technical' issues.

The Arab region cannot stand removed from this digital revolution. It should embrace the benefits and address the risks. Arab countries, with their large human potential, educated youth, financial resources and central geographic position, should utilize the assets offered by the digital economy to transform their economies and societies.

Many Arab countries are challenged by slow economic growth, massive unemployment or underemployment, particularly among youth and women, environmental challenges, political instability and/or conflict and population displacement. One might argue that advanced technologies are not immediate priorities given the problems many Arab populations are experiencing. However, ICT, when properly applied, has the potential to address many of these socioeconomic problems and help achieve the Sustainable Development Goals (SDGs). An informed digital economy agenda for the region would be a major tool to guide

Arab countries and put them on the track for inclusive and sustainable economic growth. This report considers the components needed to build such a successful agenda.

Many Arab countries have successfully deployed ICT infrastructure and many individuals are using the Internet, particularly youth. Statistics show that Arab countries have made significant advances in this respect, quadrupling the percentage of users over the past decade and bridging the gap with developed countries. This has been largely due to improvements in mobile broadband and the quality of Internet access. Additionally, some governments in the Arab region have made significant advances in the use of ICT to improve their services.

However, there remains a weak local supply of ICT goods and services, insufficient skills and research and development, and weak ICT adoption by businesses. The absence of reliable statistics on the digital economy makes it difficult to elaborate well-informed policies and to monitor and evaluate them.

Exploiting the digital economy's potential should be high on the agenda of public policymakers, even in developing economies. Policy must address the supply and demand of ICT technologies and services, and their use in all socioeconomic endeavours. Organizational, human and regulatory changes are also needed. Europe has elaborated a common digital strategy and related measurement framework, as few countries, even developed ones, can address these challenges alone. Arab countries should heed this lesson. This report aims to create awareness about the digital economy and help policymakers and other stakeholders in the Arab region identify priority areas and develop digital agendas to enhance their transformation into smart societies.

The publication is divided into five chapters. Chapter 1 introduces the concepts of the digital economy and related fields, highlighting policymaking priorities and the underlying technological developments and associated risks. Chapter 2 presents an overview of the global digital economy. It discusses the components on the supply side, including the ICT sector and infrastructure, and on the demand side, covering ICT use by individuals, businesses and governments, as well as skills. The chapter also discusses how emerging models, such as data-driven innovation and sharing economy platforms, transform established business models and create new markets and ways of working. The analysis is based mainly on data from developed and developing countries. Chapter 3 assesses the digital economy in Arab countries, taking a hybrid approach derived partially from aspects introduced in chapter 2 combined with analyses of several global assessment frameworks by the World Economic Forum and European Institute of Business Administration (INSEAD). Complementary data is drawn from other sources. Chapter 4 discusses how digital agendas can boost digital economy growth and inclusiveness. Selected cases from the Arab region are also presented. Chapter 5 provides two sets of recommendations, pertaining to policy and to measurement, to help overcome the challenges in the region.

The overarching policy recommendation for Arab countries is to devise digital agendas at national and regional levels to promote the digital economy, and to develop detailed digital economy statistics upon which policy priorities and targets will be based, while improving the collection of sex-disaggregated data.

Policy recommendations to promote the supply side of the digital economy

- Involve the private sector in the transition towards the digital economy;
- Improve fixed high-speed broadband to provide a quality experience to citizens;
- Open avenues to develop new digital economy markets involving, for instance, 'triple-play' bundles of broadband/telephony/television;
- Improve access to credit and venture capital for young, innovative entrepreneurs – both women and men – in the ICT sector;
- Improve ICT research and development expenditure by all stakeholders, particularly the business sector;
- Bolster patent protection and competition laws to protect and reward inventors and avoid abuse of monopoly situations.

Policy recommendations to promote the demand side of the digital economy

- Mobilize political will to deploy smart policies through smart governments, smart cities and smart citizens, and improve e-participation for improved public service delivery and to combat corruption;
- Promote and expand basic and smart e-government programmes to achieve smart cities, smart homes, smart governments and smart citizens;
- Build capacity and change management plans, which are equally important as adopting technology;
- Develop national strategies and laws to protect human and data privacy;
- Devise policies and prepare plans and initiatives to empower women.

Recommendations to promote digital economy measurement

- Generalize business surveys to gauge the level of ICT adoption and to implement well-thought industrial policy to leverage ICT for growth;
- Monitor foreign direct investment flows quantitatively and qualitatively, and gear them towards areas that result in technology transfer;
- Improve the efforts of national statistical offices in Arab countries to measure internet use by individuals and by sex;
- Improve the collection of data on the skills of students, adults and ICT specialists (all disaggregated by sex);
- Improve the collection and analysis of big data and open data.

Researchers and expert houses, non-governmental organizations (NGOs) and governments are encouraged to build on this study, customizing it to the particular needs of each Arab country. ESCWA is ready to provide technical assistance in this regard. The digital economy is an economic and social endeavour, not a technological one. Technology is the easy part, a mere enabler and facilitator. Politicians, policymakers, business people and citizens

need to march towards the digital economy in an orchestrated manner, enlightened by a sound vision, strategy and workplan. ESCWA can play a key role in helping to develop national digital economy agendas and to compile a new set of indicators with which to conduct a specialized digital economy profiling exercise in the next decade.

Contents

List of Tables

List of Figures

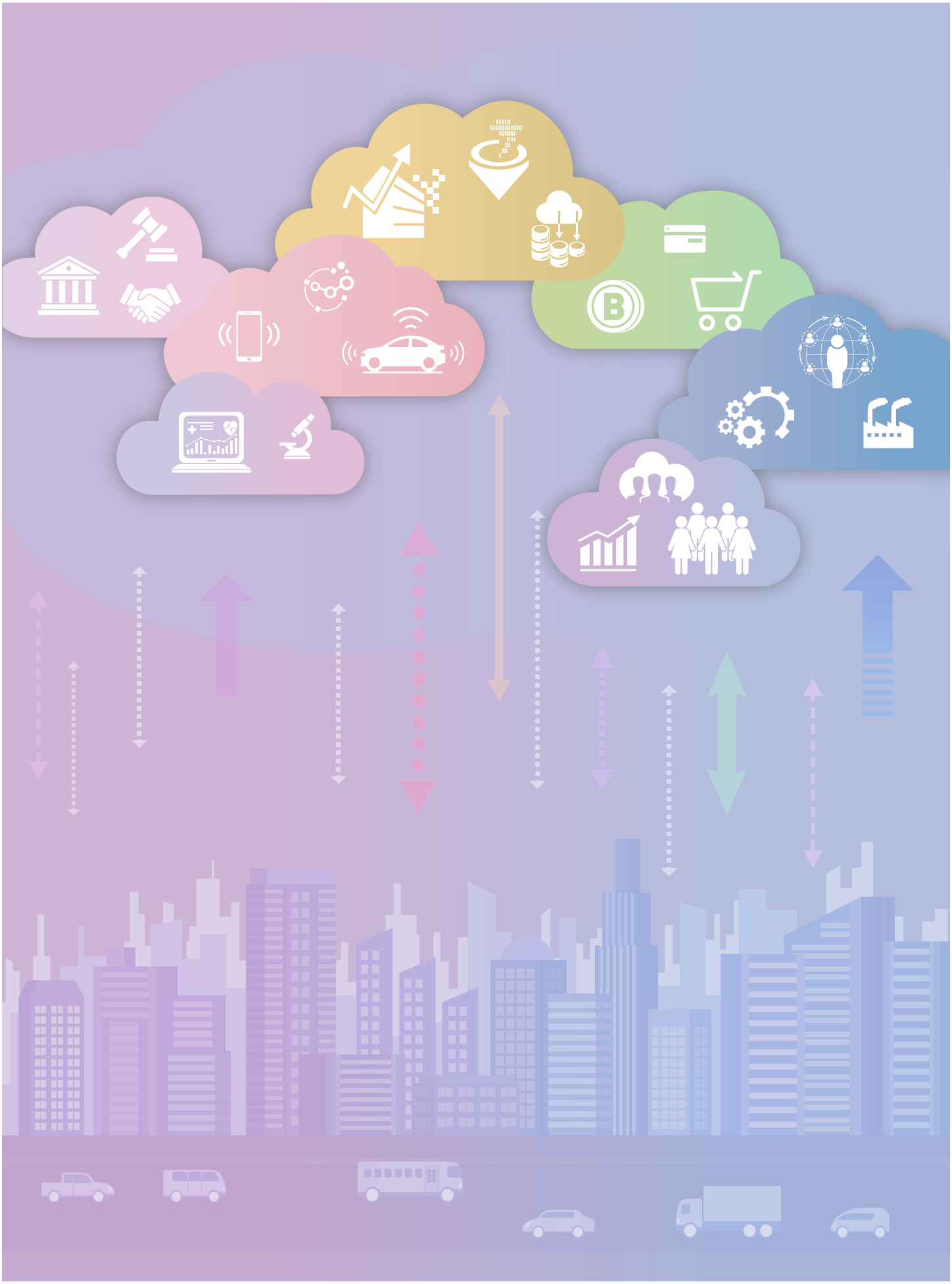
List of Boxes

Abbreviations and Acronyms

AI	artificial intelligence
BERD	business expenditure on research and development
ccTLD	country code top-level domain
CITC	Communications and Information Technology Commission
DDI	data-driven innovation
EGDI	E-Government Development Index
ESCWA	Economic and Social Commission for Western Asia
FDI	foreign direct investment
FTE	full-time equivalent
GCC	Gulf Cooperation Council
GDP	gross domestic product
GERD	gross domestic expenditure on research and development
GII	Global Innovation Index
gTLD	generic top-level domain
HCI	Human Capital Index
ICT	information and communications technologies
IIE	Institute of International Education
IoT	Internet of things
IP	Internet Protocol
ISDEHAR	Information Society and Digital Economy Hub for the Arab Region
ISIC	international standard industrial classification
IT	information technology
ITU	International Telecommunication Union
Mbits/s	million bits per second
Mbps	megabits per second
MENA	Middle East and North Africa
MEPI	Middle East Partnership Initiative
NGO	non-governmental organization
NRI	Networked Readiness Index
OECD	Organization for Economic Cooperation and Development
OSI	Online Service Index
PCT	Patent Cooperation Treaty
PIAAC	Programme for the International Assessment of Adult Competencies
PISA	Programme for International Student Assessment
PPP	purchasing power parity
SCOOT	Split Cycle Offset Optimization Technique

SDG	Sustainable Development Goal
SME	small and medium-sized enterprise
STI	science, technology and innovation
TDL	top-level domain
TII	Telecommunication Infrastructure Index
UNCTAD	United Nations Conference on Trade and Development
UNESCO	United Nations Educational, Scientific and Cultural Organization
WeMENA	Women Entrepreneurs for a Resilient Future in the Middle East and North Africa
WIT	Women in Technology

1. Introducing the Concept of Digital Economy



1. Introducing the Concept of Digital Economy

A. Digital economy

The concept of the digital economy was introduced in 1995 by Canadian business executive and strategist Don Trapscott.[1] At the time, the Internet was still in its early inception as a global network. The first commercial web browser was released only in October 1994. Websites published only content and did not process transactions. People accessed the Internet through dial-up connections (at 9,600 bits per second) when they were fortunate.[2]

Today's digital economy is characterized by technologies unknown at the time the concept was introduced, including fixed broadband access reaching tens of megabits per second, mobile broadband, smartphones and their apps, interactive websites, social networks, sharing platforms, cloud computing and the Internet of things. These technologies materialize the potential, stemming from the networking power of the digital economy and its capability to "redefine collaboration and leadership, expand human productivity, and begin to uproot many industries and challenge the power of incumbents".[3] This is becoming a reality in most developed and emerging countries, affecting growth and development potential in all.

B. Digital economy and public policies

The digital economy is high on the agenda of public policy debates in many countries, primarily developed ones.[4] This interest stems not only from the tremendous growth in digital technologies, with nearly half the world's population accessing the Internet and 80 per cent of citizens from Organization for Economic Cooperation and Development (OECD) countries accessing fixed and/or mobile broadband connections, but equally because "these technologies permeate the world economy, from retail (e-commerce) to transportation (automated vehicles), education (massive open online courses), health (electronic records and personalized medicine), social interactions and personal relationships (social networks)".[5]

National digital agendas and plans are critical for boosting economic and social growth to attain the SDGs. These agendas are the main form of strategic and political support to enable the digital economy to reach its full potential. This can be achieved by: increasing the share of ICT goods and services in global added value and trade; rerouting venture capital and other financing instruments to support the core sector of the digital economy (ICT sector); deploying broadband access and improving its quality; and leveraging the use of ICT by businesses, individuals and governments to create services, products and business models that enhance economic growth and social benefits. This report addresses the major factors that could impact on this potential, globally and in the Arab region.

C. Security and privacy in digital economy

The digital economy presents complex policy challenges as a consequence of the technical convergence of fixed, mobile and broadcast networks, the blurring of market boundaries between traditional telecommunication providers and new Internet players providing over-the-top applications, and the disruptive effects of sharing economy platforms on established businesses and services.[6] The main challenges accompanying these new technologies are associated with concepts such as fair competition, low entry barriers, consumer protection from predatory practices, preserving the rights and duties of workers and employers in new work models and protecting privacy. Due to the pervasiveness of these digital technologies and ever-increasing amounts of personal data exchanged through e-commerce, social networks and other government and e-service applications, it becomes essential to secure data privacy against increasingly sophisticated cyberattacks. Such attacks not only potentially jeopardize digital economy benefits but provoke severe economic losses, damage the personal integrity of people and disrupt critical public services and infrastructure. To address these challenges, national cybersecurity strategies should be high on the agenda of every country, whatever its transition level towards becoming a digital economy. The digital economy requires informed, comprehensive policies to mitigate the risks and ensure the benefits from economic and social development flow through and enhance efforts to achieve the SDGs through inclusive and sustainable growth. This publication will not focus on security and privacy issues as they are addressed in other ESCWA documents.

D. Digital economy and smart society

A smart society can be defined as a community where human interaction, public infrastructure and services are intelligently (or smartly) administered through technology. Thanks to ICT, such a society provides the best services at optimal cost, and it engages with citizens so that they can help improve these services. Such a broad definition, however, requires two clarifications.

The first relates to the scope of the community. Although some national governments or regions have launched initiatives aimed at their smart transformation, in practice, the concept of a smart society is most often associated with smart cities. This is essentially due to the nature of services and infrastructure being administered at the city level, which lends itself more easily to smart administration and active citizen engagement. There are examples in several sectors, including traffic control, car parking, public lighting, water and electricity distribution (smart grids), waste management, health services, public safety and security, and cultural events. At a lower scale, smart administration can be applied to managing private infrastructure, such as homes (smart homes), company assets, hospitals or farms.

The second clarification concerns the technical scope of the term ‘smart’. We used the generic term ICT in the above definition, which,

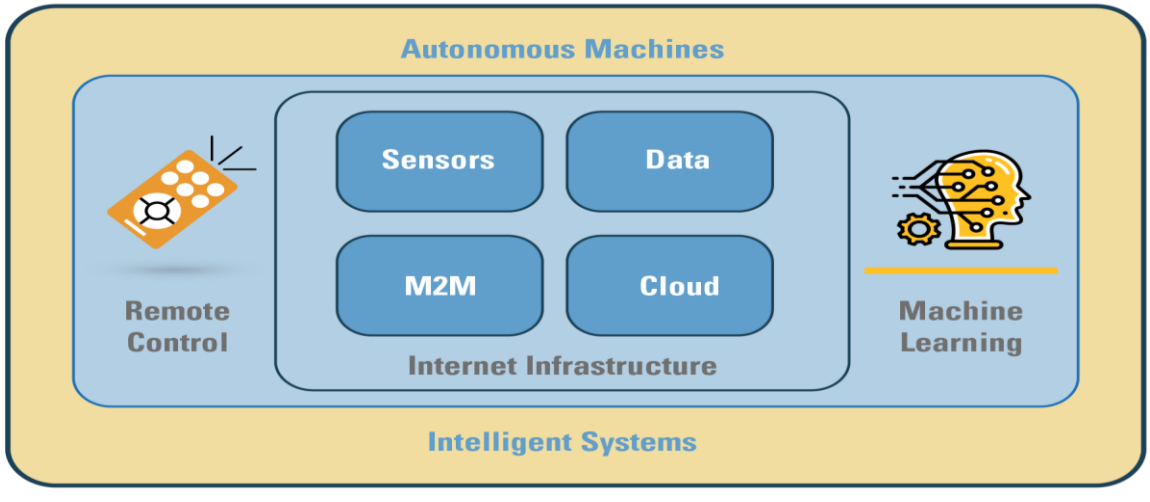
although correct, remains general. The term smart is closely associated with the capabilities offered by the so-called Internet of things (IoT), which can be considered as an ecosystem in which applications and services are driven by data collected from devices that sense and interface with the physical world.[7] The OECD considers four main elements underpinning the development of the IoT: data analytics, cloud computing, data communication and sensors or actuators. Cloud computing and data analytics also include improved machine learning applications, operating at a new level of artificial intelligence. Figure 1 illustrates the IoT ecosystem that could support a variety of smart applications.

The smartphones of end users and the sensors that are attached to various kind of objects, including street lamps, waste bins and traffic lights, generate big amounts of data that could be exploited by data analytics software to discover hidden patterns and allow for sophisticated and autonomous decision-making and advanced machine learning.[8] Table 1 summarizes the potential of IoT types in the digital economy, based on a variety of examples taken from public services, industry, agriculture, women's safety and gender equality.

Through IoT applications, the smart paradigm has a greater impact on the digital economy in all sectors, including industry, agriculture and health. There are a few niches within IoT that are undoubtedly geared towards women and promote gender equality.[9]

As with any emerging technology, however, particularly one that radically impacts on existing processes in service delivery and business conduct, many challenges need to be addressed, including digital security and privacy risks, interoperability of technologies and policy frameworks, investments, and jobs and skills. These challenges are also relevant for the digital economy at large as discussed in the previous section.

Figure 1. The IoT ecosystem: enablers and applications



Source: OECD, 2016a.

Table 1. IoT applications in public services, industry, agriculture, women's safety and gender equality

Health care	In an age where health-care systems predominantly have to deal with chronic non-communicable diseases due to lifestyles and ageing, smaller sensors, smartphone-assisted readouts, big data analysis and continuous remote monitoring can enable new ways of managing care.
Energy	Smart meters are capable of informing consumers of their energy use and patterns, and drive down their consumption, saving energy as a result. Decentralized energy generation and delivering it to the grid is a development that is enhanced by smart grids.
Street lighting	Smart street lighting offers savings because the status of each lamp is known in real time and maintenance can be scheduled when needed. New functions also become available, such as dimming or brightening lights depending on the weather, traffic flows, time of day or requests from emergency services.
Traffic control	The Split Cycle Offset Optimization Technique (SCOOT) system developed by Transport for London uses data on road usage for real-time control of traffic lights in the city, delivering an average 12 per cent improvement in traffic flow. It is believed that with fully automated vehicles, it might be possible to operate intersections without traffic lights, whereby vehicles would book a path over the intersection via a central control system without significantly reducing speed or having to stop. This would speed traffic flow, reduce emissions and save fuel that is wasted in acceleration.
Industry	IoT approaches allow firms to integrate sensing, analytics and automated control into business models. Some firms have called it the 'industrial Internet' and estimate gains of $10-15 trillion to global GDP over the next 20 years. By equipping machines with a range of sensors that enable predictive maintenance, firms are improving processes and becoming smarter and more efficient. Beyond internal cost savings, firms say IoT measures can improve: customer service and the speed and agility of decision-making; competitive advantage; innovation; consistent delivery across markets; sustainability; transparency/predictability of costs; revenue; and performance in new markets.
Agriculture	Autonomous machines and the use of big data are applied increasingly in agriculture. Robots can now sort plants based on optical recognition, harvest lettuce and recognize rotten apples. Cows could autonomously be milked using sensor-based IoT systems. Robots clean the stables and ensure that grass for feed is pushed back to the cows, so that it does not get wasted.
Women's safety	Going out alone, especially at night, can brings risks for some women. IoT can create wearable technology for reporting suspicious behaviour or attacks. Most of these technologies work by downloading an app to a smartphone and many also involve a device worn directly on the body. A range of products have been engineered to keep people safe or to track valuable possessions. Some of these pieces can be clipped out of sight or hidden in a piece of jewellery, but they all have one basic function, namely, to alert friends, family and the police when a person's safety is threatened. Most of these devices have multiple levels of intensity in order to track the user's current threat level and can be disabled at any time.
Gender equality	IoT is creating more jobs across the world. Specialty roles, such as coding and app development, have never been in such demand, which opens up a whole new world for women. Women coders and developers do exist, but it has been commonly a field for men.

Sources: OECD, 2016a; and Miller, 2016.

2. Digital Economy: Trends and Global Perspectives

2. Digital Economy: Trends and Global Perspectives

According to a recent report on digital transformation in G20 economies, the digital economy "holds many promises to spur innovation, generate efficiencies, and improve services throughout the economy".[10] At the same time, digitalization can be disruptive. It transforms how individuals interact with one another and with society more broadly, and changes the structure and business models of the economy. The digital economy contributes to enhanced productivity and growth, job creation, well-being and social inclusion, and accelerates progress towards achieving the SDGs. This presents important policy challenges, including those related to privacy, security, consumer policy, competition, innovation, jobs and skills.

A. Methodological approach

Figure 2 lists the main components of the supply and demand sides of the digital economy. Arab countries' transition to the digital economy will be more systematically discussed in chapter 3. There is no global unified digital economy index per se. Therefore, in discussing these components at the global level, we have referred to the most recent statistics, provided mainly by OECD, International Telecommunication Union (ITU) and e-government surveys,[11] noting that OECD is considered the most advanced and reliable source of information on the digital economy. The European Commission developed its own index based on the OECD's Handbook on Constructing Composite Indicators: Methodology and User Guide.

B. Highlights on key aspects of the supply side of digital economy

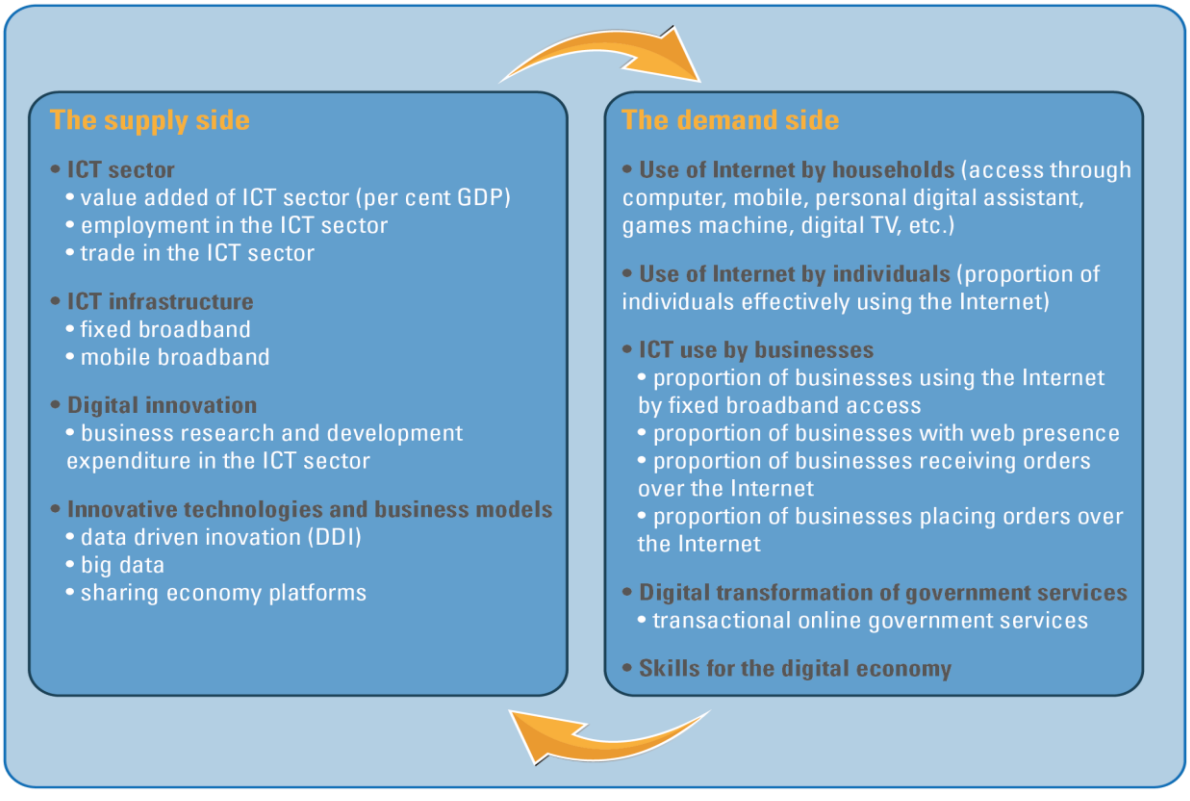
On the supply side, there are three key aspects to consider. First, there is the ICT sector, which covers goods manufacturing and service industries, and their contribution to the economy, trade and jobs. Second, there is ICT infrastructure, which allows individuals, public services and businesses to access and use quality, well-priced telecommunication and Internet services. Finally, there is digital innovation.

1. The ICT sector: scope, value added, employment and trade

(a) Scope and value added

The statistical definition of the ICT sector, as expressed in the international standard industrial classification (ISIC) of all economic activities,[12] which covers categories of activities, is summarized in table 2.

Figure 2. The supply and demand sides of the digital economy



Source: ESCWA.

Table 2. Statistical definition of the ICT sector

ISIC, Rev. 4	Description
261-264, 268	ICT manufacturing industries
261	Manufacture of electronic components and boards
262	Manufacture of computers and peripheral equipment
263	Manufacture of communication equipment
264	Manufacture of consumer electronics
268	Manufacture of magnetic and optical media
465, 582, 61, 62, 631, 951	ICT total services
465	ICT trade industries
4651	Wholesale of computers, computer peripheral equipment and software
4652	Wholesale of electronic and telecommunications equipment and parts
5820, 61, 62, 631, 951	ICT services industries
5820	Software publishing
61	Telecommunications
62	Computer programming, consultancy and related activities
631	Data processing, hosting and related activities; web portals
951	Repair of computers and communication equipment

Source: European Commission, 2015.

Since the 2007/2008 global economic crisis, the value added of the ICT sector has remained constant in OECD countries.[13] In 2015, the ICT sector accounted for 5.4 per cent of total value added of the gross domestic product (GDP) in OECD countries, representing $2.4 trillion; in 2013, it accounted for 5.5 per cent, indicating the stagnation of this sector. IT and information services accounted for 2.15 per cent, telecommunication services 1.55 per cent, ICT manufacturing 1.34 per cent and software publishing 0.33 per cent.

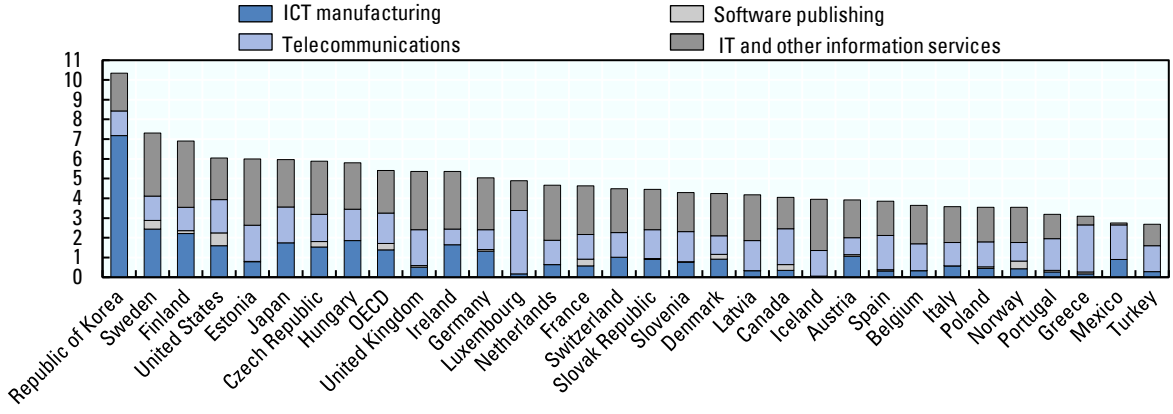
Figure 3 summarizes the ICT sector and the subsectors value added in OECD countries. Policymakers and decision makers in Arab countries need to make efforts to produce similar numbers and percentages.

It is also important to study the evolution of this sector over the past decade in OECD countries. ICT manufacturing decreased from 1.7 per cent of GDP in 2001 to 1.34 per cent in 2015 due to delocalization in non-OECD countries, mainly in China and other Asian countries. The same indicator grew only in the Republic of Korea and a few countries in Eastern Europe, benefiting from offshoring, but fell steeply in Finland and Ireland. Over the same period, the share of software publishing in total value added remained at 0.3 per cent while the share of IT services rose in all reporting economies, from 1.8 per cent in 2001 to 2.15 per cent in 2015, largely offsetting losses in other ICT sectors.

As a result of a steep fall in prices, the revenue from telecommunication services also decreased, from 2 per cent in 2001 to 1.55 per cent in 2015. Telecommunication services represent a lower percentage in OECD countries (only 30 per cent of the ICT sector total value added) compared with up to 80 per cent of the sector's total value added in many developing countries.

There are scarce data from developing countries, including Arab ones, on ICT sector value added and its breakdown.

Figure 3. Value added of ICT sector and subsectors (percentage GDP), OECD countries, 2015



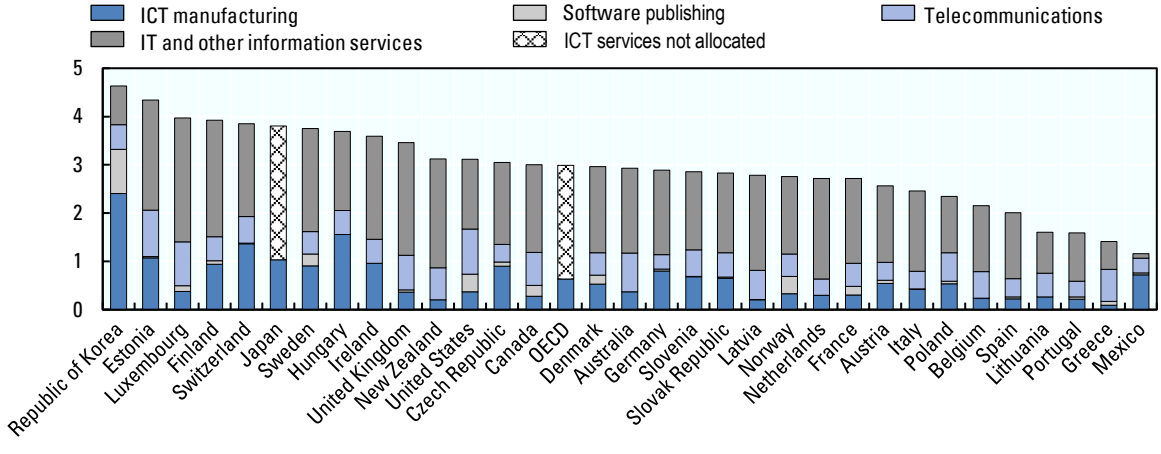
Source: OECD, 2017c. Available from http://dx.doi.org/10.1787/888933584716.

(b) Employment in the ICT sector

Employment in the ICT sector in OECD countries reached 14.4 million in 2013,[14] representing 3 per cent of total employment. This rate remained the same for 2015.[15] The Republic of Korea, Estonia and Luxembourg had the largest shares of ICT employment in total employment, at 4 per cent and more. The smallest shares were in Lithuania, Portugal, Greece and Mexico (less than 2 per cent of total employment). ICT services (software publishing, together with the telecommunications industry and IT and other information services) accounted for almost 80 per cent of ICT employment on average. This percentage remained more or less stable during the period from 2001 to 2015, decreasing in countries with a large ICT sector and increasing in countries with a smaller one. Figure 4 shows the percentage of employment in the ICT sector and subsectors in OECD countries. On average, IT and other information services and telecommunications accounted for nearly 80 per cent of total employment, although countries such as the Republic of Korea and, to a lesser extent, Hungary have higher percentages of employment in the manufacturing and software publishing subsectors.

ICT employment should also account for ICT specialists, even if employed outside the ICT sector per se. The data on ICT specialists complements that on ICT sector employment.[16] ICT specialists represented 3.6 per cent of total employment in OECD countries in 2016.[17] Statistics show that the share of ICT specialists in OECD countries has increased at a moderate rate over the period from 2003 to 2016, from about 4 per cent to 4.7 per cent in Canada, from 3.2 per cent to 4.1 per cent in the United States and, during 2003-2004, from 3.6 per cent to 3.8 per cent in Australia. ICT specialist jobs have been among the most dynamic occupations in recent years and several forecasts suggest that the demand for ICT professionals will grow even faster in the near future.

Figure 4. ICT sector and subsectors employment (percentage total), OECD countries, 2015



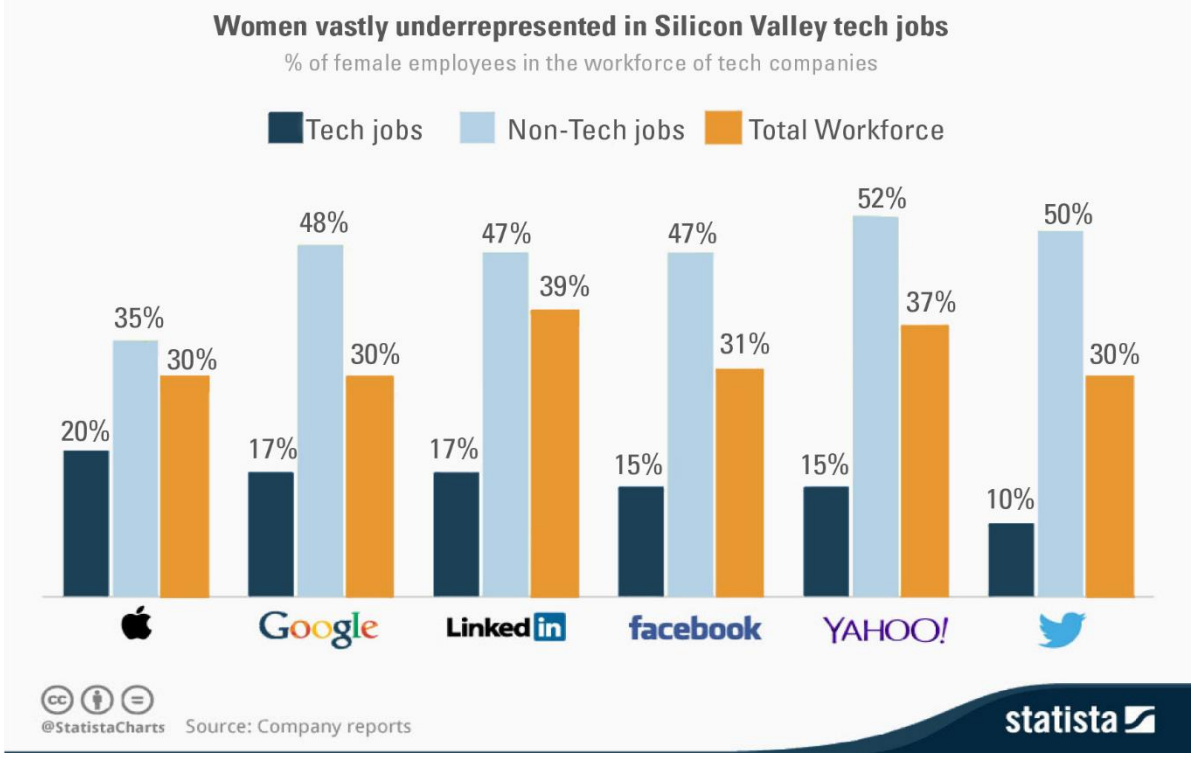
Source: OECD, 2017c.

In Europe, the majority of ICT specialist jobs are held by men, based on data provided by Eurostat.[18] It reported that, in 2015, men in European countries accounted for 84 per cent of ICT specialists, an increase of 6 percentage points since 2005. The countries with the most pronounced gender inequality in 2015 were the Czech Republic, Slovakia and Hungary, where the proportions of men in the ICT specialist workforce were 90 per cent, 89 per cent and 88 per cent, respectively. Bulgaria had the highest proportion of women ICT specialists (28 per cent), followed by Romania (27 per cent) and Latvia (25 per cent).

In 2016, the World Economic Forum published an article describing how women are vastly underemployed in Silicon Valley technology companies.[19] Figure 5 shows the percentage of women employees at such companies as Apple, Google, LinkedIn, Facebook, Yahoo and Twitter.

Apple has the highest proportion of women employees in technology roles, albeit only 20 per cent. At Twitter, only 10 per cent of technology positions are filled by women. Women still view the ICT sector as male-dominated, which discourages them from entering the field. Encouraging girls and women to choose ICT as a career, however, could change this perception and help more women become leaders in the industry.

Figure 5. Women in technology jobs in Silicon Valley (percentage), 2016



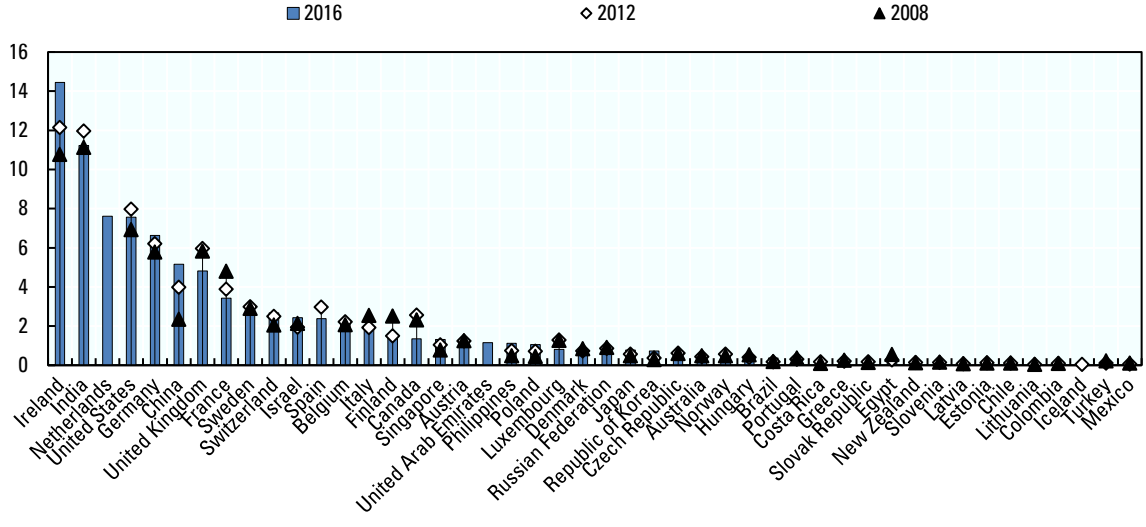
Source: Statista Charts, based on company reports, accessed from https://www.weforum.org/agenda/2016/04/where-are-the-women-in-computing/.

(c) Trade in the ICT sector

Trade in ICT goods and services highlights the sector's dynamics globally. Recent statistics show that exports of ICT goods are increasingly concentrated in a few economies.[20] In 2016, the top 10 exporters accounted for 85 per cent of world exports of ICT goods, up from 70 per cent in 2001. Partly due to offshoring production, Japan's share in world exports of ICT goods decreased from 10 per cent in 2001 to 4 per cent in 2016, while China's share grew from 6 per cent to 32 per cent. The Republic of Korea is the only OECD country whose share continues to grow (5.5 per cent in 2001, 6.8 per cent in 2007 and 7.6 per cent in 2016). The same report shows the increasing role of China in the field at the expense of the United States, Japan and the rest of the world. Only some Asian countries (Republic of Korea and Singapore) managed to slightly improve or keep their share intact.

In the period from 2010 to 2016, the value of OECD exports of ICT services increased by 40 per cent. In 2016, world exports of ICT services increased by 5 per cent, from $470 billion to $493 billion. As a result, the share of global exports of ICT services in total services increased by 2 percentage points, reaching more than 10 per cent in 2016. Global trade in ICT services is much lower in value than that of ICT goods ($400 billion in 2013 for services versus $1.6 trillion for goods), although it increased fourfold after 2001 while the latter only doubled.

Figure 6. ICT services exports (percentage total), OECD countries, 2008, 2012 and 2016



Source: OECD, 2017c.

Trade in ICT services is shown in figure 6, highlighting the role played by the five leaders, namely Ireland, India, the Netherlands, Germany and the United States. These economies account for a significant share in global exports of ICT services. Ireland, which benefits from the presence of a high concentration of transnational corporations relative to the size of its domestic market, continues to be the leading exporter of ICT services (more than 14 per cent of global services), followed by India (11 per cent), the Netherlands and the United States (both around 8 per cent) and Germany (around 7 per cent). China is also among the top 10 exporters of ICT services, along with France, Sweden, Switzerland and the United Kingdom. Together, these 10 countries account for two-thirds of total exports of global services.

2. Recent status of ICT infrastructure

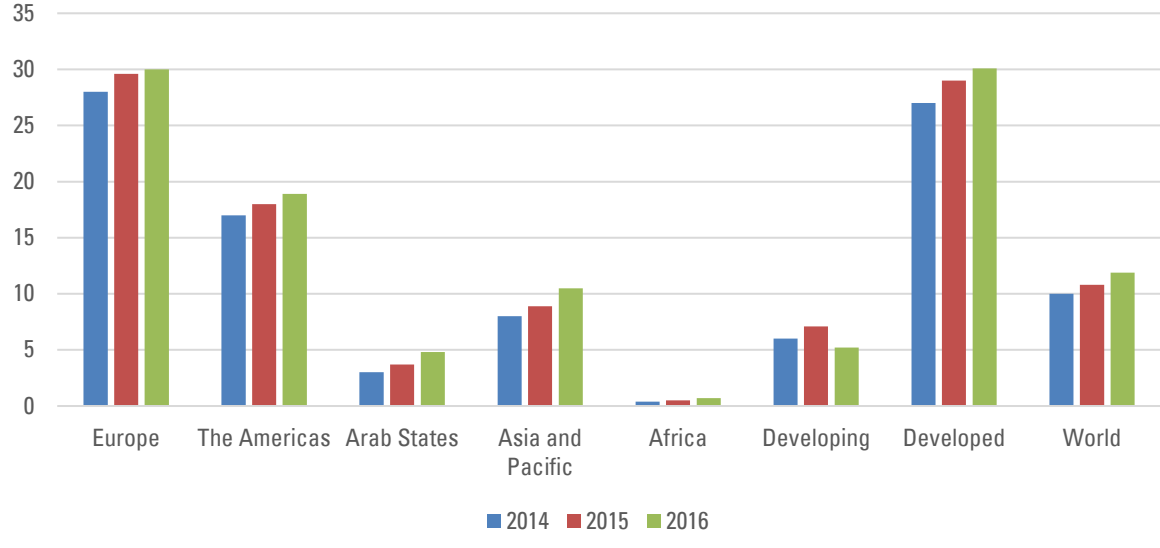
ICT infrastructure largely determines the level of use and sophistication of digital services accessed by citizens, businesses, government and public services. Without adequate ICT infrastructure, transition to a digital economy is not possible. In the early 1990s, fixed telephony infrastructure brought public access to the Internet as it began to spread outside academia, primarily in developed economies. A quarter of a century later, the online environment has changed dramatically due to the explosion in mobile access and the development of broadband access through fixed and mobile networks.

The development of mobile infrastructure in all countries has enabled the so-called digital divide to be partially bridged, at least in access to basic communication services. According to ITU statistics, at the end of 2016, seven billion people (95 per cent of the global population) lived in an area covered by mobile-cellular network, with mobile-broadband networks (3G or above) reaching 84 per cent of the global population.[21] The continuing digital divide and lack of digitization benefits are the result of:

- low levels of fixed broadband access in most developing countries and even in isolated and rural areas of some developed ones;
- high broadband download speeds of 10 megabits per second (Mbit/s) and above are primarily enjoyed by consumers in developed countries;
- most consumers in developed countries pay less than 2 per cent of their income on communications, which is not the case in the majority of developing countries.

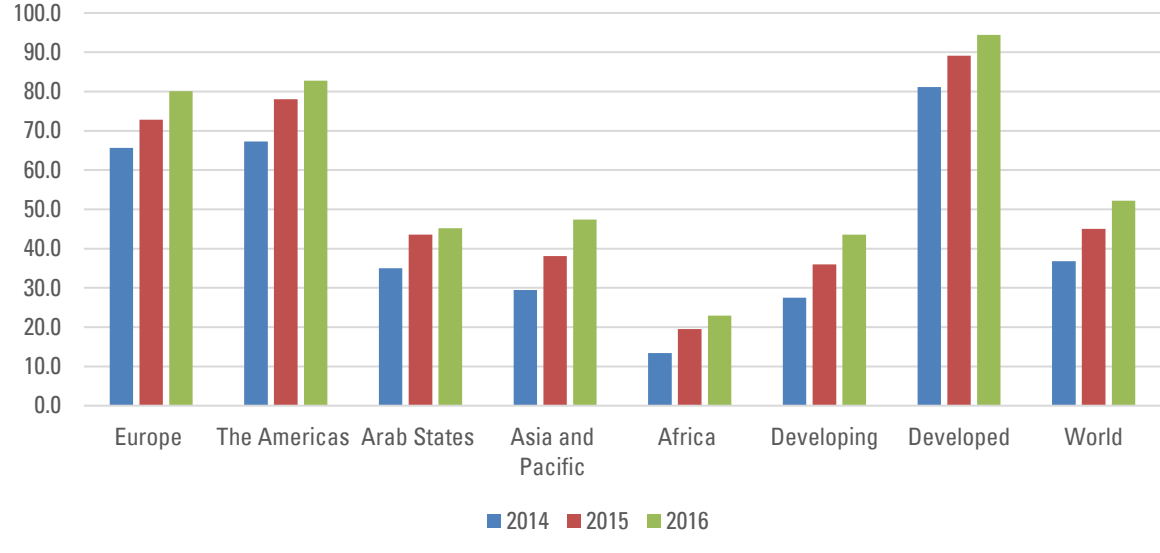
Figure 7 and 8 summarize broadband access in its fixed and mobile variants (measured by the number of subscriptions per 100 inhabitants) in developed, developing and major world regions for the past three years.

Figure 7. Fixed broadband subscribers (per 100 population), world and regions, 2014-2016



Source: Compiled by ESCWA based on ITU, 2014a; 2015a; and 2016a.

Figure 8. Mobile broadband subscribers (per 100 population), world and regions, 2014-2016



Sources: Compiled by ESCWA based on ITU, 2014a; 2015a; and 2016a.

Figure 7 shows that fixed broadband is still predominantly a developed country 'privilege', with subscriber percentages nearly four times higher than those of developing countries. Arab countries are even below the developing country average. Figure 8 illustrates less of a gap between developed and developing regions with regards to mobile broadband, with Arab countries slightly above the developing region average, driven up primarily by high rates in high-income Gulf Cooperation Council (GCC) countries.

Fixed and mobile broadband prices (based on purchasing power parity in US dollars) highlight major discrepancies between developed and developing regions. Differences are pronounced for fixed broadband. In 2015, the monthly average bill was still more than twice in developing countries ($67.30) than in developed countries ($27.80). A slightly lower ratio applies for mobile broadband; $30.80 for developing versus $15.90 for developed countries. In absolute terms, mobile is twice as cheap as fixed, and by the end of 2015, average mobile broadband prices corresponded to only 5.5 per cent of gross national income per capita worldwide.[22]

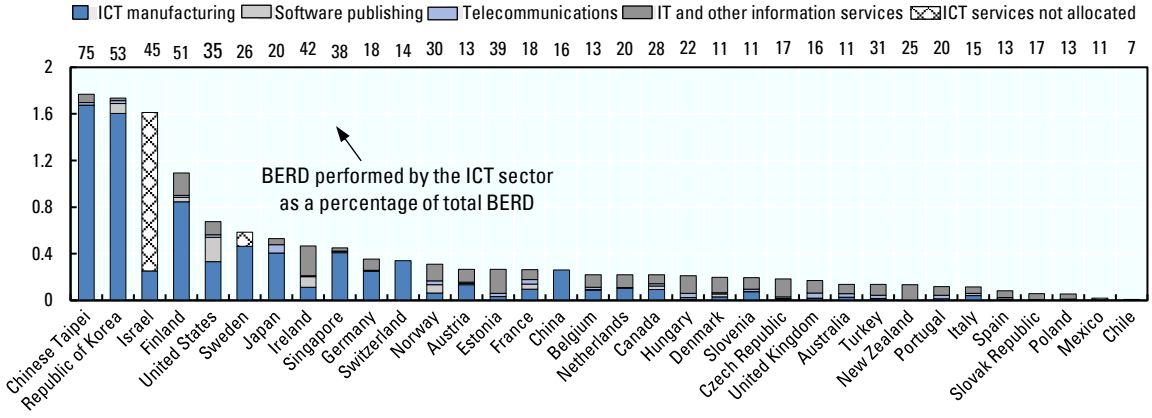
Quality of broadband, as measured by advertised bandwidth for fixed broadband, highlights the largest divide between developed and developing regions (reflecting fixed broadband is still in its early development in most developing countries). In early 2016, three out of four fixed broadband subscriptions had advertised speeds of 10 million bits per second (Mbit/s) and above in developed countries, compared with two out of four in developing countries.[23] Developed regions still account for a large majority of global Internet traffic, while smaller developing country networks must pay higher fees to connect with the main Internet backbones, which further limits their ability to lower tariffs for customers.[24]

3. Digital innovation: research and development expenditure and investment

The ICT sector plays an important role in business expenditure on research and development (BERD). Figure 9 summarizes such research as a percentage of GDP in OECD countries and its share of global BERD (upper value).

Figure 9 illustrates that countries leading ICT research and development efforts by their businesses (as a percentage of GDP) also have the same high percentage of ICT in their total BERD effort. In 2014-2015, Taipei in the Province of China Taiwan and the Republic of Korea devoted 71 per cent and 49 per cent, respectively, of their total BERD to ICT manufacturing. Despite the decrease in Nokia's activities, Finland continues to spend more than 41 per cent of its total BERD on ICT manufacturing, which is the same as Singapore, followed by Japan, Sweden and the United States, which all spent above 15 per cent of total BERD. In the majority of countries, more than 50 per cent of total ICT BERD goes towards IT and other information services. The highest shares of research and development expenditure on software publishing in total ICT BERD were observed in the United States and Norway, accounting for 33 per cent and 23 per cent, respectively. Telecommunication services account for a lower share of ICT BERD in most countries, except for Australia, Portugal and the United Kingdom, where it represents about 25 per cent of the total.

Figure 9. BERD in the ICT sector (percentage of GDP and of total BERD), OECD countries, 2015



Source: OECD, 2017c.

From this, one can conclude that it is not only innovation in the ICT sector that is important for creating improved products and services and decreasing ICT prices, which remain key driving forces for ICT adoption, but also digital innovation in all other sectors that will ultimately generate larger growth and have a bigger impact on the economy at large. Investing in the ICT sector alone is not sufficient to drive digital innovation; the effective use of ICT and data requires additional investments in complementary knowledge-based capital, particularly in skills and know-how, and in organizational change, including new business models and processes.

Digital innovation is inherently risky and capital intensive, and needs special venture capital financing, which operates effectively only in some developed countries. This highlights the need for the majority of countries – including developed ones – to provide support and financing for digital innovation through other means in addition to attracting and developing venture capital. Challenges in financing digital innovation often rank among the top barriers faced by businesses. This is because of the important role played by intangible knowledge-based capital, which is often firm-specific, non-separable and non-transferable. Private equity investors, particularly venture capital investors and business angels, can address the problem caused by information asymmetries by intensively scrutinizing firms before providing capital and monitoring them afterwards. These investors have been able to partly bridge the financing gap by providing new financing opportunities to innovative young firms, mainly in high-tech sectors. A large share of private equity investments is, therefore, ICT-related. In 2014, for instance, about 70 per cent of venture capital in the United States went into the ICT sector. In most countries, however, venture capital investments remain low and below their pre-crisis (2007) level. This can be a serious barrier to digital innovation.

4. New business models: digital-driven innovation and sharing economy

The digital economy is also boosted by technological developments and associated use patterns of ICT that drive digital innovation. Many mobile applications (or apps) used on smartphones are used to access a variety of useful services, engaging with friends and peers through social networking, and making electronic purchases and bank transactions. These apps contribute not only to the development of services but also to the production of data. Harnessing the large amount of data generated by these apps and other sensors (also known as big data) through data analytics contributes to data-driven innovation, driving value creation and fostering new products, processes and markets.

Another development is the emergence of sharing economy platforms. This is a vast concept that encompasses any kind of intermediation service – henceforth designated as a platform – offered via the Internet that helps match supply and demand of services, goods or even financing. Such platforms may be built on a for-profit basis, whereby the platform owner charges a fee generally paid by the suppliers, or on a non-for-profit basis.

(a) Data driven innovation and big data

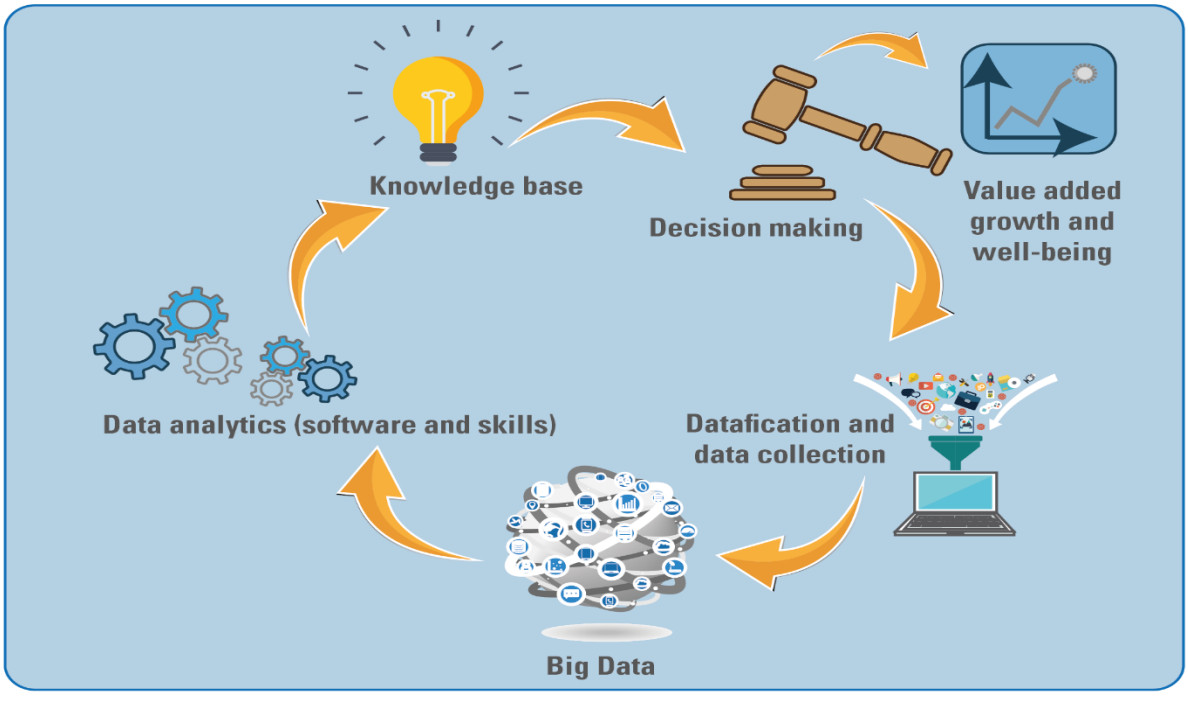
The McKinsey Global Institute recently reported that the "volume of data continues to double every three years as information pours in from digital platforms, wireless sensors, and billions of mobile phones",[25] while International Data Corporation estimates that global data storage worldwide will reach 16 zettabytes by 2017.[26]

The analysis of big data, increasingly in real time, is driving knowledge and value creation across society, fostering new products, processes and markets, spurring new business models and thereby enhancing economic competitiveness and productivity growth. The use of data and analytics to improve or foster products, processes, organizational methods and markets – hereafter referred to as data-driven innovation (DDI) – is a new source of growth.

DDI can be described as a sequence of phases, from so-called datafication to data analytics and decision-making. This process, however, is not a (linear) value chain, but a value cycle that involves feedback loops at several phases in the value-creation process. The stylized data value cycle is illustrated in figure 10.

DDI benefits are not limited to the business sector and can aid other social and public services towards achieving SDGs. DDI can boost productivity growth, transforming all sectors in the economy, even traditional ones, such as retail, manufacturing and agriculture. Examples of DDI for economic growth include Tesco, the United Kingdom supermarket chain, exploits huge data flows generated through their fidelity card programmes. The Tesco programme counts more than 100 market baskets per second and 6 million transactions per day. It successfully transformed Tesco from a local retailer to a multinational, customer- and service-oriented one with broad appeal across social groups.

Figure 10. Data-driven innovation value cycle



Source: Adapted from OECD, 2015c.

Agriculture is being further modernized through DDI, leading to huge productivity improvements and reduced environmental impacts. DDI in agriculture builds on geocoded maps of agricultural fields and the real-time monitoring of every activity, from seeding to watering, fertilizing and harvesting. Generated data can be stored and analysed using cloud computing. As a result, farmers are sitting on a wealth of agricultural data, which such companies as Monsanto, John Deere and DuPont Pioneer, are trying to exploit through new data-driven goods and services.

DDI can also contribute to the well-being of society by improving science and education, government and health-care services. Additionally, it can further inclusiveness and development, which are of particular interest to developing economies. This is a broad spectrum, covering such initiatives as United Nations Global Pulse, launched by the Executive Office of the Secretary-General in response to the need for more timely data to track and monitor the impacts of global and local socioeconomic crises. Global Pulse also aims to leverage big data analytics to support monitoring and progress towards SDGs. Table 3 lists examples of how big data analytics can help address each of the 17 SDGs.

Table 3. How big data analytics could help address each of the 17 SDGs

SDGs	Examples of big data helping in attaining SDGs
Goal 1. No poverty: End poverty in all its forms everywhere	Spending patterns on mobile phone services can provide proxy indicators of income levels
Goal 2. Zero hunger: End hunger, achieve food security and improved nutrition, and promote sustainable agriculture	Crowdsourcing or tracking of food prices listed online can help monitor food security in near real-time
Goal 3. Good health and well-being: Ensure healthy lives and promote well-being for everyone at all ages	Mapping the movement of mobile phone users can help predict the spread of infectious diseases
Goal 4. Quality education: Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all	Citizen reporting can reveal reasons for student drop-out rates
Goal 5. Gender equality: Achieve gender equality and empower all women and girls	Analysis of financial transactions can reveal the spending patterns and different impacts of economic shocks on men and women
Goal 6. Clean water and sanitation: Ensure availability and sustainable management of water and sanitation for all	Sensors connected to water pumps can track access to clean water
Goal 7. Affordable and clean energy: Ensure access to affordable, reliable, sustainable and modern energy for all	Smart metering allows utility companies to increase or restrict the flow of electricity, gas or water to reduce waste and ensure adequate supply at peak periods
Goal 8. Decent work and economic growth: Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all	Patterns in global postal traffic can provide indicators, such as economic growth, remittances, trade and GDP
Goal 9. Industry, innovation and infrastructure: Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation	Data from GPS devices can be used for traffic control and to improve public transport
Goal 10. Reduced inequality: Reduce inequality within and among countries	Speech-to-text analytics on local radio content can reveal discrimination concerns and support policy response
Goal 11. Sustainable cities and communities: Make cities and human settlements inclusive, safe, resilient and sustainable	Satellite remote sensing can track encroachment on public land or spaces such as parks and forests
Goal 12. Responsible consumption and production: Ensure sustainable consumption and production patterns	Online search patterns or e-commerce transactions can reveal the pace of transition to energy-efficient products
Goal 13. Climate action: Take urgent action to combat climate change and its impacts	Combining satellite imagery, crowd-sourced witness accounts and open data can help track deforestation
Goal 14. Life below water: Conserve and sustainably use the oceans, seas and marine resources for sustainable development	Maritime vessel tracking data can reveal illegal, unregulated and unreported fishing activities
Goal 15. Life on land: Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, halt and reverse land degradation and halt biodiversity loss	Social media monitoring can support disaster management with real-time information on victim location, effects and strength of forest fires or haze
Goal 16. Peace, justice and strong institutions: Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels	Sentiment analysis of social media can reveal public opinion on effective governance, public service delivery and human rights
Goal 17. Partnerships for the goals: Strengthen the means of implementation and revitalize the global partnership for sustainable development	Partnerships to enable the combining of statistics and mobile and internet data can provide a better and real-time understanding of today's hyperconnected world

Source: Compiled by ESCWA with data from the United Nations Global Pulse Initiative.

(b) Sharing economy platforms

Early commercial platforms, such as eBay, Craigslist, Etsy and AutoTrader, increased the geographical reach and scope of peer markets for consumers, and substantially lowered barriers for peers who wished to sell goods online by providing services, including advertising and search, easy and convenient payment mechanisms and dispute resolution and redress.

New business models have emerged and invaded all economic and social sectors based on digital technologies, disrupting classical economic activities and paving the way for the so-called sharing economy. These allow consumers to rent unused assets or resources and provide time-limited access to goods, skills and services from peer providers. The most prominent models today allow consumers to rent short-term accommodation and transport or mobility services from peer providers who own these assets. Using real-time geolocational data accessed through mobile apps, shared mobility services enable consumers to rent private cars, rides and parking spaces. Table 4 lists some sharing economy platforms by category of services provided.

The newness of the sector and large scope of activities of these platforms make it difficult to assess the impact on socioeconomic development. However, box 1 tackles the sharing economy potential for economic activity through examples of platforms that have already enjoyed success, such as Airbnb.

Table 4. Sharing economy platforms in selected economic sectors

Accommodation and physical space	Airbnb (short-term vacation stays), HomeAway, HomeStay, FlipKey, Wimdu, Villas.com, FlatClub, onefinestay, HouseTrip, Guesthop (support services for home sharers), DesksNearMe (workspace), Landshare (land, gardens)
Transportation and mobility	Uber, Hitch, Lyft, BlaBlaCar, Getaround, ParkingPanda (parking spots), Freecycle Network
Food consumption	Feastly (connects diners with chefs), LeftoverSwap, EatWith (matches diners and hosts), MamaBake (homecooked cakes), EatWithMe (homecooked food)
Retail and consumer goods	Ziplok, Tradesy, Neighbourgoods, eBay, Poshmark, Yerdle, Spinlister (sports equipment), Kidizen (kids clothing and toys); Rockbox (jewellery rental service); StubHub, viagogo, GetMeIn, Seatwave (secondary tickets)
Financial services	Prosper (lending), Kickstarter (funding)

Source: OECD, 2016c.

Box 1. New economic business model: Airbnb

Airbnb has become a popular platform for short-term accommodation. Since its inception in 2008 in San Francisco, Airbnb has extended its services into 34,000 cities in 191 countries with more than 2 million listings. In September 2016, The Wall Street Journal reported Airbnb had raised at least $555 million in new funding from Google Capital and Technology Crossover Ventures, valuing the company at $30 billion.

Airbnb is a peer-to-peer accommodation market place that connects hosts (vendors of rooms or accommodations) and travellers (guests) via its website and mobile application. Airbnb enables direct transactions between these two entities but does not own any rooms itself.

Airbnb's primary source of revenue comes from service fees charged to hosts and guests on every booking. Fees paid by the guest range from 6-12 per cent, depending on the price of the booking. Airbnb also charges the host 3 per cent for each guest for credit card processing.

Data disclosed by Airbnb for an OECD study on new forms of work in the digital economy gives an insight into the activities and revenue generated by its hosts in some key markets.

Between 2010 and 2014, the compound annual growth rate of active hosts and nights hosted in major Airbnb markets (United States, Germany, Spain, United Kingdom and Italy) was 154 per cent and 189 per cent, respectively. Over the same period, the annual number of rented nights per average Airbnb host also increased, from 41 to 67 nights. Rental via Airbnb can be a significant source of supplemental income.

Airbnb, like Uber for taxis, has sparked significant resistance from established players who feel they are disadvantaged by such platforms, which serve the same markets but may not be obliged to comply with the same rules. While an increasing number of jurisdictions are confronting these issues, there remains considerable uncertainty.

In San Francisco, Airbnb hosting was illegal in most circumstances. Hosts had been fined by the city and received eviction notices from landlords. This situation changed in October 2014, however, when the city's mayor Ed Lee signed the so-called Airbnb law, legalizing short-term rentals. The law requires renters to register as hosts, carry liability insurance and pay the city's 14 per cent hotel tax. In December 2016, Airbnb announced a deal with the cities of London and Amsterdam to ensure that its hosts stick to the local limits for short-term rentals unless the hosts have the proper licences, namely, 90 days per year in London and 60 days per year in Amsterdam.

Source: OECD, 2016d.

C. Key aspects of the demand side of digital economy

Demand primarily deals with the use of digital technologies, broken down into the following categories: the use by individuals and the skills and competencies they require to do so; ICT adoption and mainstreaming within businesses in general and small and medium-sized enterprises in particular, in addition to some socioeconomic sectors, such as health care, transport and education; and

e-government services, including enhanced access to public sector information and open government data. In all these categories, it is crucial that users have trust in digital technologies, knowing their data, transactions and physical processes controlled by digital technologies are secure and private.

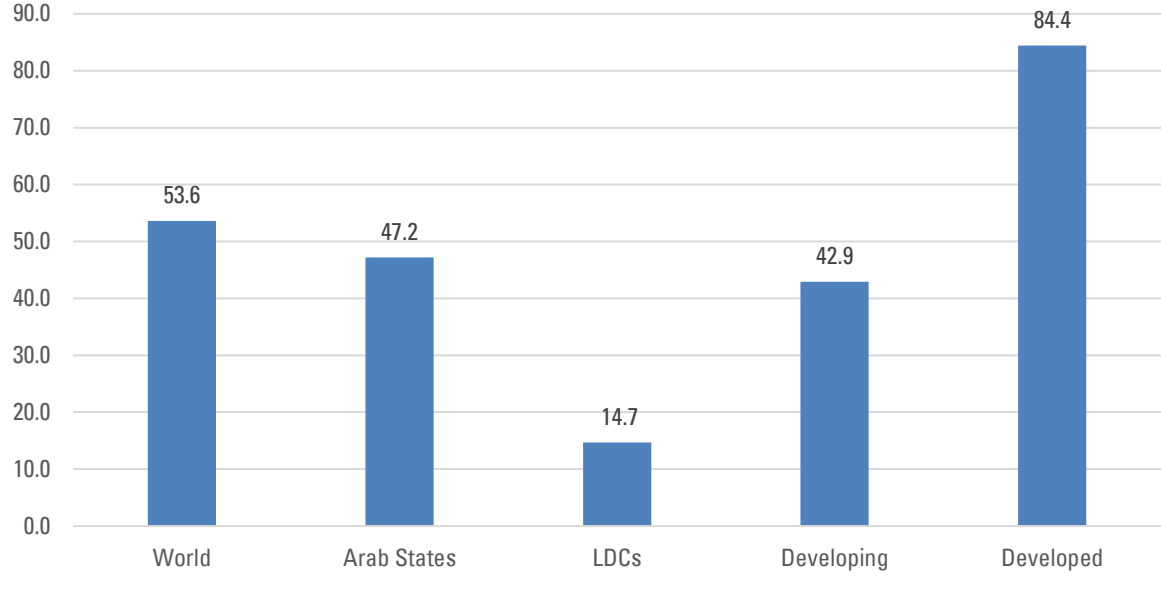
1. Internet use by households and individuals

Household access is a key indicator that measures potential Internet use. In developed countries, the proportion of households with Internet access is twice as high as in developing countries (figure 11).

This indicator measures the proportion of individuals who used the Internet from specified locations in the past three months through any device and from fixed or mobile networks. It says nothing about the intensity and nature of activities. Figure 12 shows Internet usage patterns of individuals using data from developed OECD countries with more sophisticated statistics.

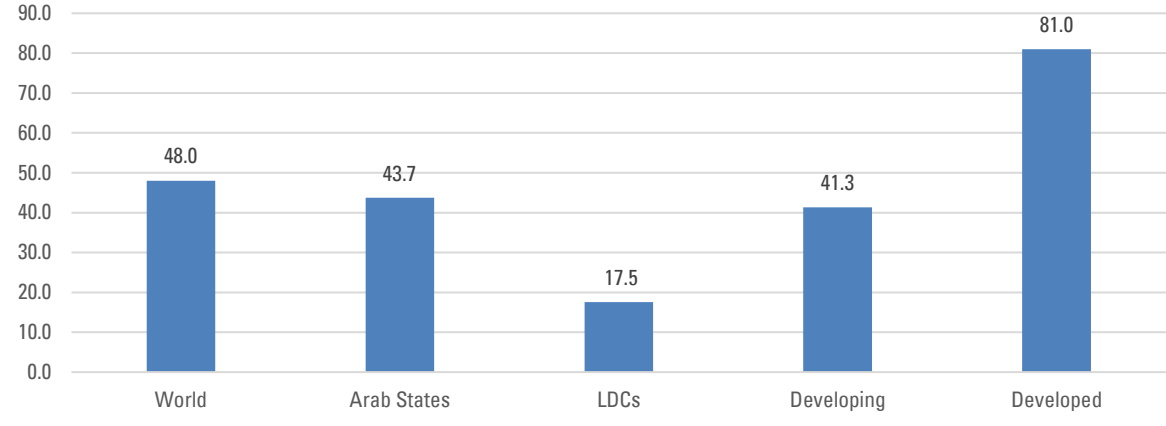
Likewise, the proportion of individuals in developed countries with access to the Internet is double that in the developing countries. Figure 12 shows these results based on data provided by the ITU for 2017.

Figure 11. Households with Internet access, 2017 (percentage)



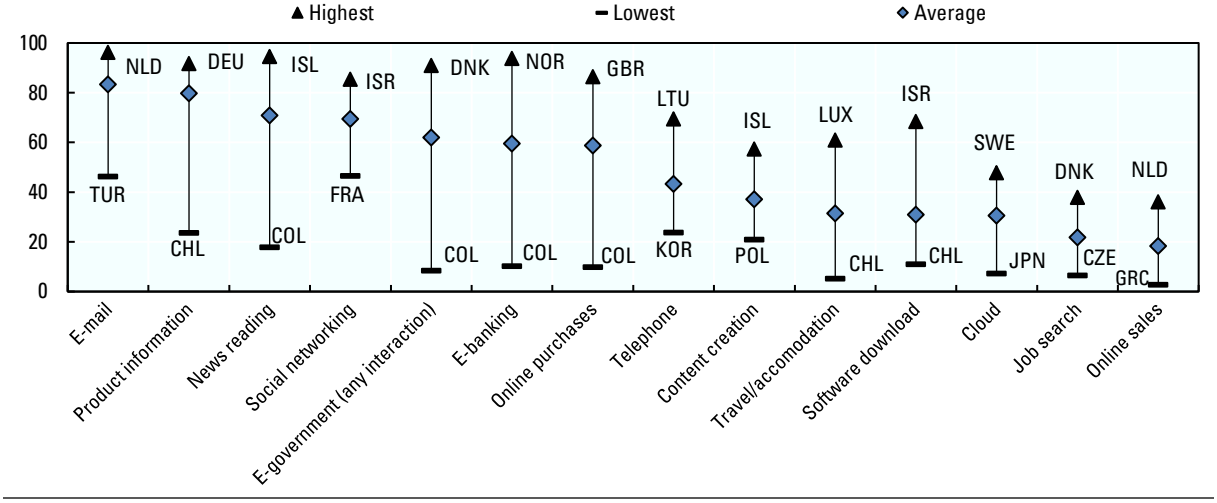
Source: ITU, 2017.

Figure 12. Individuals using the Internet, 2017 (percentage)



Source: ITU, 2017.

Figure 13. Selected activities of Internet users (percentage of users performing each activity), OECD countries, 2016



Source: OECD, 2017c.

The distribution of online activities among Internet users has been described in detail in the OECD Digital Economy Outlook 2016.[27] It says that an average of 83 per cent of Internet users reported sending e-mails, 80 per cent used the Internet to obtain product information, 70 per cent to read news, 69 per cent for social networks and 31 per cent for cloud technologies. Only 18 per cent sold products over the Internet, while 58 per cent ordered products online (figure 13).

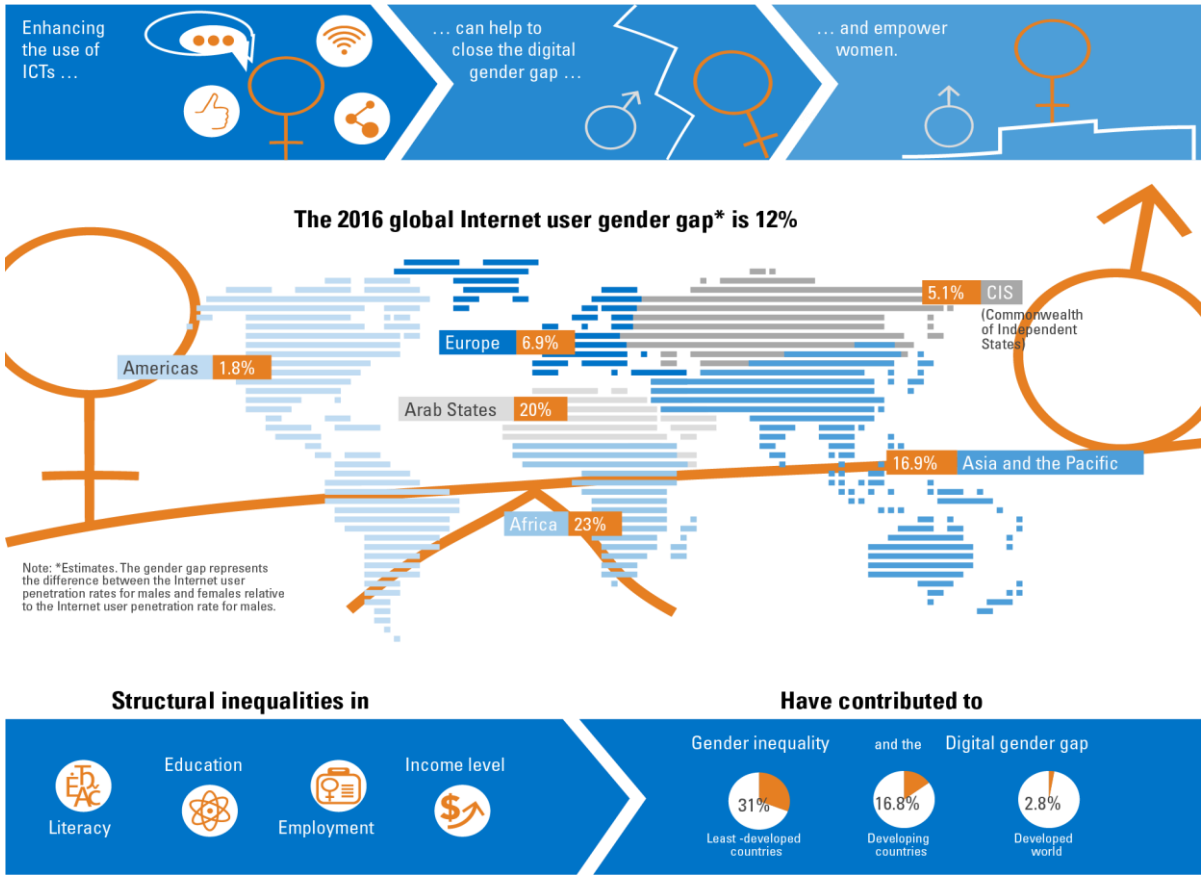
Activities such as sending e-mails, searching for product information and social networking show little variation across all countries. However, the share of Internet users performing activities usually associated with a higher level of education (for example, those with cultural elements or more sophisticated service infrastructure) tend to show larger cross-country variability. This is the case for e-banking, online purchases, news reading, cloud technologies and e-government.

Internet intensity and usage patterns are largely influenced by age, education and income levels as shown by detailed OECD statistical data and other sources:

- In 2016, the percentage of Internet users among youth aged 16-24 reached 95 per cent in most OECD countries (with some countries attaining 100 per cent) compared with less than 63 per cent for those aged 55-74. Among the latter group, the percentage of Internet use shows big variations across countries; more than 80 per cent in the Nordic countries, Luxembourg, the Netherlands and the United Kingdom, but only 30 per cent in Greece, 24 per cent in Mexico and 16 per cent in Turkey;[28]
- Education level plays an important role in determining the sophistication of activities carried out on the Internet. Internet usage by those aged 55-74 with a tertiary education are generally above or in line with those of the overall population, and in some countries, approach the usage rates among those aged 16-24;
- Differences in Internet uptake are linked primarily to age and education but also with the income level, which plays a role in the amount and sophistication of online activities. An analysis of citizen use of e-government services in Europe in 2014 showed that the income level of the country (GDP/capita) was a key determinant.[29] An analysis of the profile of online and offline voters in a budgeting vote in Rio Grande do Sul, Brazil, in 2011-2012, showed that higher income groups were predominantly represented among online voters.[30] Similarly, countries with markedly lower percentages of persons engaging in e-commerce have mostly lower GDP/capita levels than leading countries.[31]

Closing the digital gender divide is a pressing concern. There are more than 200 million fewer women online than men and the gap is widening, according to the ITU.[32] It estimates that the global digital gender gap for the year 2016 was about 12 per cent, ranging from 23 per cent in Africa to less than 2 per cent in the United States. The figure for the Arab region (20 per cent) falls between that for Asia and the Pacific and Africa. To remedy this is not just a moral imperative; it presents a significant opportunity for growth in today's digital economy. And it is an essential pathway for progress on SDG 5, to "achieve gender equality and empower all girls and women". The main contributors to this digital gender gap are structural inequalities in literacy, education, employment and income. Enhancing the use of ICT will not only bridge this gap but empower women to overcome these structural inequalities. Figure 14 illustrates ITU estimates of the gender digital gaps in different regions.

Figure 14. Gender digital gaps in the world



Source: ITU, 2016b, p. 4.

2. ICT use by business

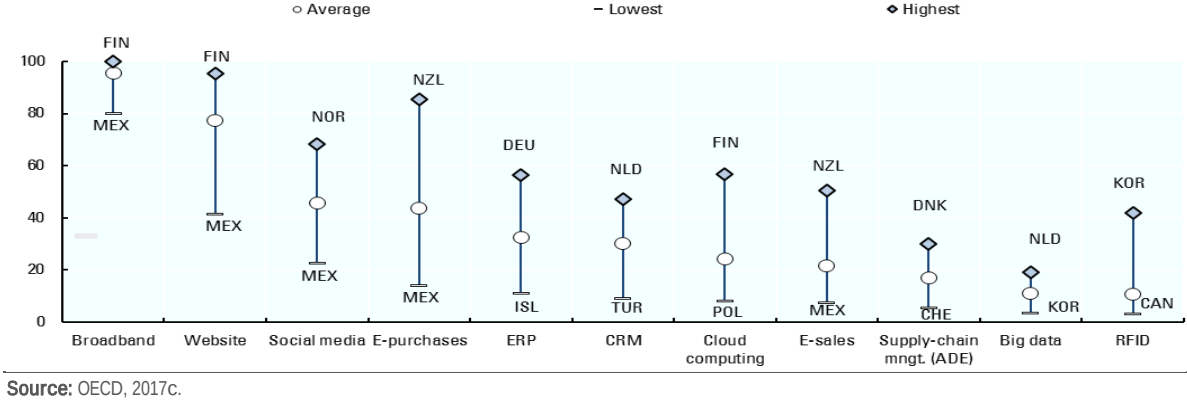
There are international indicators that measure ICT use by business, but such data is scarce and often not up to date in developing countries. Figure 15 shows the dominant patterns of ICT use by business based on advanced data from OECD countries.

Fixed broadband access has become almost universal among all enterprises with 10 and more employees in OECD countries. Virtually all large firms and more than 95 per cent of small firms are connected to broadband. Nonetheless, the gap between large and small firms remains significant in some countries, such as Greece, Mexico, Poland and Turkey. Figure 15 shows that more than 77 per cent of all enterprises in OECD countries had a website or homepage in 2016, but with wider variations between countries; more than 95 per cent in Finland and 41 per cent in Mexico. Significant gaps appear in other categories of use, with large variations observed particularly in e-

purchases. Use of more sophisticated ICT technologies for supply chain management, where implementation requires changes in business organization, and radio frequency identification, remain limited.

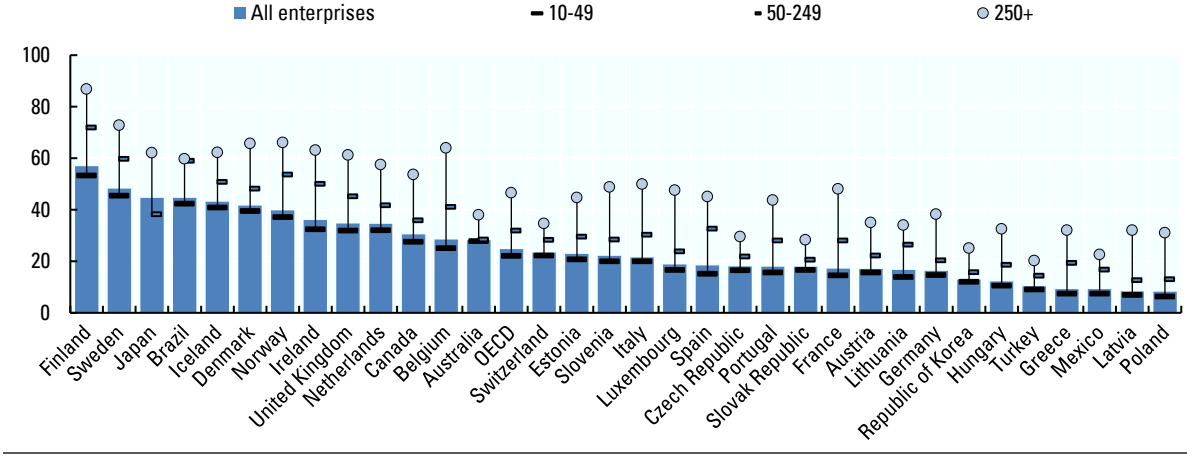
Cloud computing gives firms more flexibility in accessing software, computing power, storage capacity and other services. Figure 16 shows that, in 2016, more than 24 per cent of businesses in OECD countries used cloud computing services, with large variations among countries; 57 per cent in Finland and only 8 per cent in Poland. In nearly all countries, large enterprises with 250-plus employees are more likely to use these services than smaller enterprises. The uptake is higher among large businesses (close to 50 per cent) compared with small or medium-sized enterprises, which record about 22 per cent and 32 per cent, respectively.

Figure 15. Selected ICT tools and activities in enterprises (percentage of enterprises with 10+ employees), OECD countries, 2016



Source: OECD, 2017c.

Figure 16. Enterprises (by size) using cloud computing services, OECD countries, 2016 (percentage)



Source: OECD, 2017c.

3. Digital transformation of government services

Over the past two decades, government efforts to digitize their services have increased in all countries, developed and developing. As highlighted by the latest United Nations e-government survey, web presence is available in all 193 surveyed countries.[33] Figure 17 shows more complex transactional online services that have steadily evolved since the previous survey in 2014.

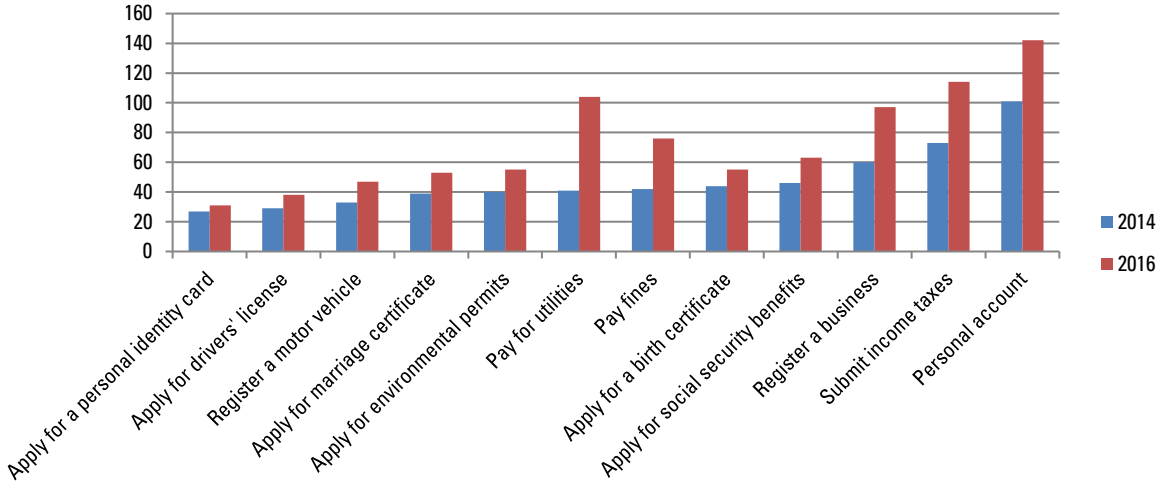
The same survey, which evaluates government online presence through the Online Service Index (OSI),[34] shows a positive trend, with 32 countries in 2016 obtaining a very high OSI value (> 0.75), versus only 22 in the 2014 survey and 56 countries versus 44 in 2014 with a high OSI value (> 0.5 and < 0.75). Two Arab countries, namely, Bahrain and the United Arab Emirates, are in the very high OSI group, while seven others, namely, Kuwait, Lebanon, Morocco, Oman, Qatar, Saudi Arabia and Tunisia, are in the high OSI group.[35] The Arab perspective is detailed in the next chapter.

Digitization efforts by governments have the potential to improve citizen participation, increase service efficiency and generate economies of scale.

The survey is methodologically (and in practice) geared towards an analysis of the supply side of e-government services and not particularly towards citizen use or the effectiveness and impact of such services.[36] The e-government survey is essentially a desk survey, covering 193 countries, and is therefore limited in what it can say about the status of services in any given country, though it remains an essential tool to measure (and influence) government digitization efforts.

In box 2, the World Bank defines the impact of e-government services.

Figure 17. Transactional online government services, 2014 and 2016 (number of countries)



Source: United Nations, 2016.

Box 2. E-government services: impact on citizens and government

Digital technologies can help improve government capability and citizen participation by:

Informing citizens, particularly poor citizens (including women) in remote locations through mobile phones, has helped them make better decisions on a variety of issues.

Streamlining processes to reduce discretion and opportunities for rent-seeking, ensuring that public resources are collected and spent efficiently, without leakage.

Receiving feedback from service users, including women, to regularly track satisfaction, identify problems and improve service quality.

Improving service provider management through better monitoring so that government workers report for duty and are more productive.

Source: World Bank, 2016.

4. Skills for the digital economy

One major result of the digital economy and increasing digitization in all economic and social endeavours is the shrinking of routine tasks. This applies to an increasing number of jobs where workers must process complex information from many sources, take appropriate decisions and develop innovative and creative ideas and concepts. This puts the onus on the education system to ensure that children emerge from their schooling with a set of basic skills in reading, mathematics and science that they can readily apply in the workplace.

Every three years since 2000, the OECD has conducted the Programme for International Student Assessment (PISA), a worldwide study in member and non-member countries to assess the performance of 15-year-old pupils in mathematics, science and reading.[37]

The study found that Singapore outperforms all other participating countries/economies in science. Japan, Estonia, Finland and Canada were the four highest-performing countries, with significant developments in science and technology over the period. Even though gender differences in science performance tended to be small, in 33 countries and economies, there was a larger share of boys in the top performers in science. Finland was the only country in which girls were more likely to be top performers.[38]

The Programme for the International Assessment of Adult Competencies (PIAAC) assesses the capability of adults in a technology-rich ICT environment. Its survey measures the proficiency of adults aged 16-65 in key information-processing skills, namely, literacy, numeracy and problem-solving in technology-rich environments, and gathers information and data on how adults use their skills at home, at work and in the wider community.[39]

The latest two PIAAC surveys of 2012 and 2015 show that even in developed countries, only 45 per cent of adults have acceptable skills for a technology-rich environment, with less than 10 per cent reaching the highest level. Global

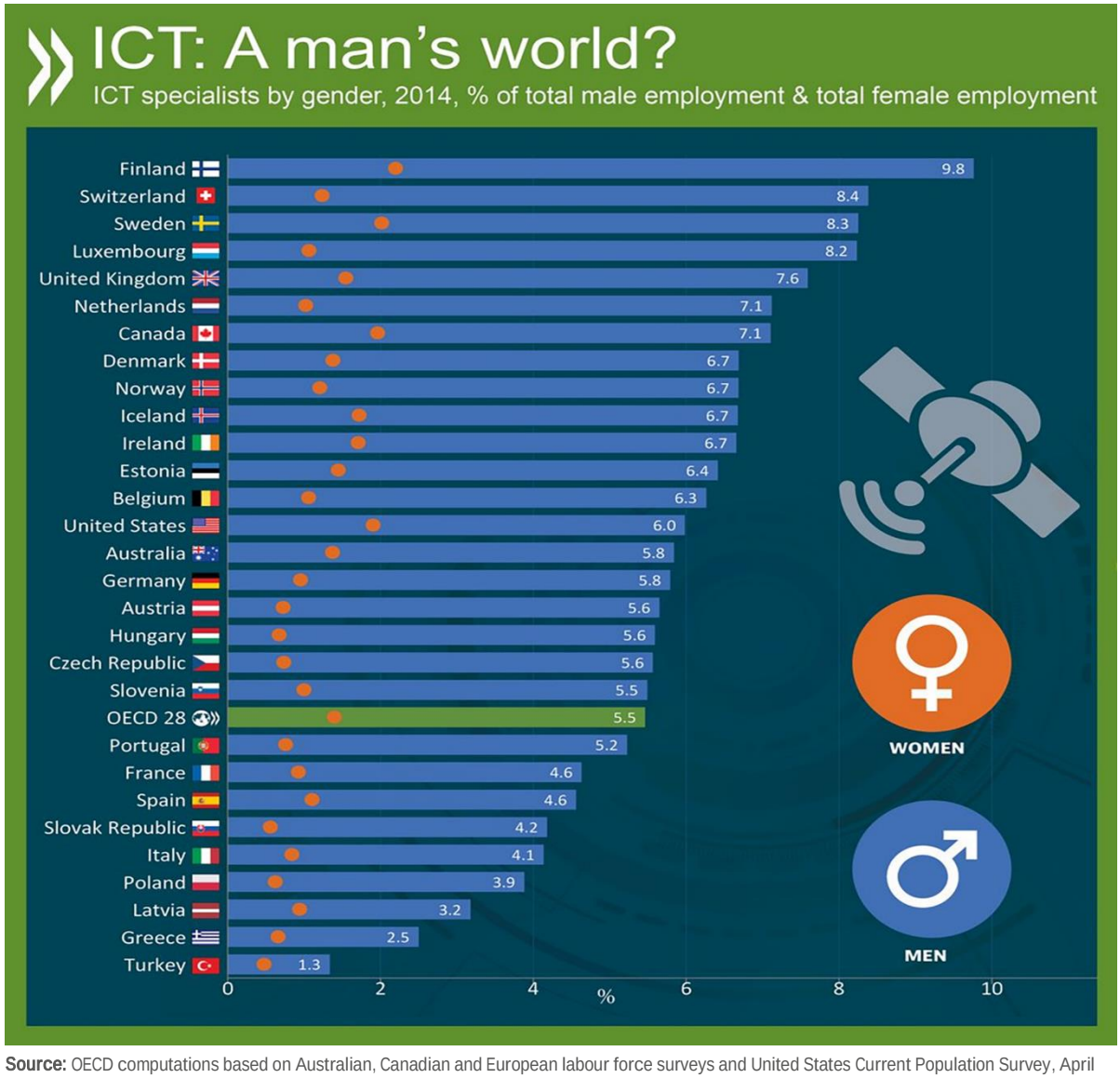
averages conceal wide differences between countries, often related to age and education. The global OECD average of adults climbs to almost 50 per cent among the tertiary educated, and falls as low as 10 per cent among people having 2 achieved less than upper-secondary grade.[40] Similarly, the average of adults with acceptable levels shows near identical patterns, being much higher among younger adults (25-34 years) with more than 45 per cent while the global average of those aged 55-65 years is only 12 per cent.[41]

In 2014, only 3.6 per cent of all workers were ICT specialists. This global average conceals differences among countries, from more than 12 per cent in Finland to barely 1.3 per cent in Turkey.[42]

Regarding gender distribution, results show that the proportion of ICT specialists is 5.5 per cent among male workers but only 1.4 per cent among female workers.[43]

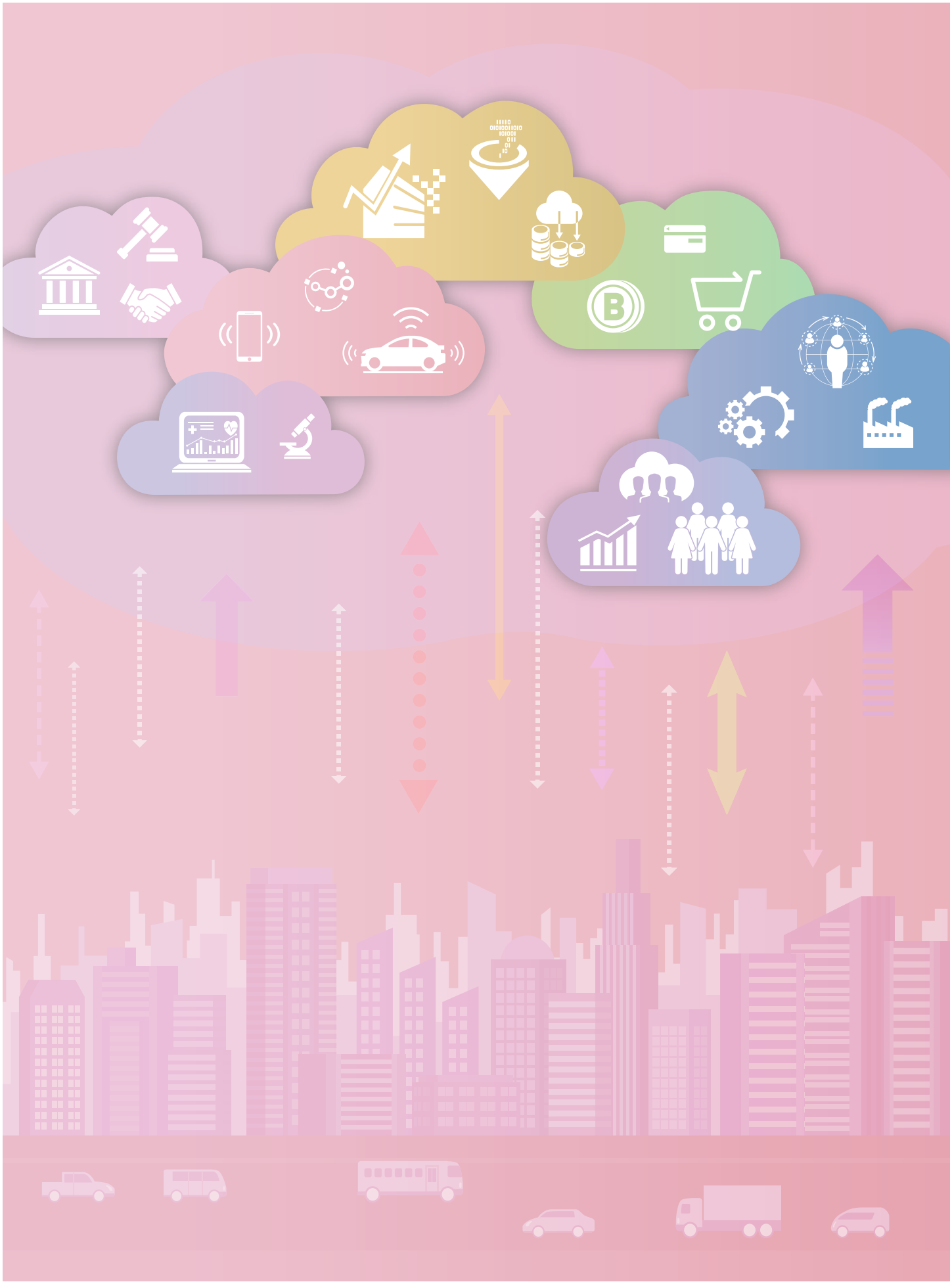
Even the most advanced countries do not seem to produce enough ICT specialists. In some G20 economies, the proportion of tertiary graduates in computer science was reported to average 2-5 per cent.[44]

Figure 18. ICT specialists by gender (percentage of total employment)



Source: OECD computations based on Australian, Canadian and European labour force surveys and United States Current Population Survey, April 2016, accessed from https://twitter.com/OECD/status/890193697995882497.

3. Status of the Transition towards the Digital Economy in Arab Countries



3. Status of the Transition towards the Digital Economy in Arab Countries

To measure the digital economy in Arab countries, this report uses a customized methodology that relies on a mixture of indicators, as there is no particular index dedicated to this area.

A. Methodological approach

To gauge the progress of the Arab region in its transition towards the digital economy, six aspects have been studied, namely:

- The ICT sector: innovation and finances;
- ICT infrastructure and affordability;
- Human capacity and research;
- ICT use by individuals, businesses and governments;
- Economic impact;
- Social impact.

Analysis of these aspects is based predominantly on two international indexes, the Networked Readiness Index (NRI) of the World Economic Forum and the Global Innovation Index (GII) of INSEAD, along with other specific indicators where data is available. This analysis will help identify issues and challenges faced by Arab countries in their transition towards digital economy.

In the absence of comprehensive statistical data in the majority of developing and Arab countries (including high-income GCC countries), these indices have been used notwithstanding their methodological limits.

Tables 5 and 6 summarize the ranks of Arab countries (global and per pillar) in the last NRI and GII editions. A table showing the structure of each index is presented in annexes 1 and 2. Although GII is not specifically related to the digital economy, it includes many relevant indicators because ICT is one of the main technological drivers behind any innovative economy.

Tables 5 and 6 highlight a familiar pattern in the Arab region. GCC countries, due to their high income, low population (except for Saudi Arabia) and the often voluntary approach of their leaders to adopt ICT technologies, clearly lead the pack among Arab countries. Some other Arab countries have good resources, particularly in human capacity, education and even infrastructure. However, political instability and conflict in certain Arab countries, such as Libya, Syrian Arab Republic and Yemen, have had an impact on their rankings. Overall, despite the good showing of some GCC countries, particularly the United Arab Emirates, most

Arab countries are in the lower half of the tables among surveyed countries.[45]

Based on the main indicators used in NRI and GII, five clusters have been identified for assessing Arab countries in their transition towards the digital economy. ICT infrastructure and affordability, enabling environment, human capacity and research, ICT use, and economic impact have been selected based on having similar indicators or assessing similar aspects.

Table 5. Networked Readiness Index (rank: global and per pillar), Arab countries, 2016 (139 countries surveyed)

Pillar	Environment		Readiness			Usage			Impact	
	1	2	3	4	5	6	7	8	9	10
Country (global rank)	Political and regulatory	Business and innovation	Infrastructure	Affordability	Skills	Individual	Business	Government	Economic	Social
United Arab Emirates (26)	**25**	**13**	28	*116*	22	**19**	27	**2**	26	**2**
Qatar (27)	**18**	**15**	29	*120*	5	**23**	25	**5**	28	**10**
Bahrain (28)	36	**26**	31	40	31	**14**	37	**3**	*48*	**13**
Saudi Arabia (33)	29	**25**	36	*101*	49	**21**	42	**11**	40	36
Oman (52)	53	58	46	*96*	76	39	*94*	34	*95*	46
Jordan (60)	39	**38**	*92*	*94*	59	*70*	**41**	**47**	61	53
Kuwait (61)	63	72	**30**	*89*	77	**32**	72	81	*102*	*84*
Morocco (78)	70	87	*102*	**20**	*110*	67	*105*	**41**	*110*	59
Tunisia (81)	*90*	*112*	82	**24**	85	78	*107*	**55**	*93*	78
Lebanon (88)	*126*	**49**	77	*109*	**55**	**46**	*97*	*124*	83	*114*
Egypt (96)	*102*	*113*	97	**47**	*111*	**80**	*129*	**67**	**58**	*103*
Algeria (117)	123	*133*	**80**	99	89	103	*133*	*130*	124	*132*
Mauritania (136)	135	135	136	118	138	118	135	134	116	134

Source: World Economic Forum, 2016.

Table 6. Global Innovation Index 2016 (rank: global and per pillar), Arab countries (128 countries surveyed)[46]

Pillar	1	2	3	4	5	6	7
Country (Global rank)	Institutions	Human capital and research	Infrastructure	Market sophistication	Business sophistication	Knowledge and technology outputs	Creative outputs
United Arab Emirates (41)	**22**	41	**23**	42	**24**	*86*	*70*
Saudi Arabia (49)	*72*	**32**	39	38	66	*75*	47
Qatar (50)	**34**	59	**16**	68	*78*	*88*	49
Bahrain (57)	55	68	**29**	*91*	59	61	*74*
Kuwait (67)	75	72	48	50	*127*	51	64
Lebanon (70)	*91*	76	84	*99*	63	74	**51**
Morocco (72)	74	61	**45**	*98*	*125*	72	67
Oman (73)	**41**	**52**	**51**	*90*	*124*	*95*	79
Tunisia (77)	70	**45**	70	*123*	*107*	89	81
Jordan (82)	**63**	86	79	*115*	*116*	79	78
Egypt (107)	*123*	**82**	**82**	110	*122*	94	97
Algeria (113)	113	**79**	**86**	117	118	100	122
Yemen (128)	126	111	128	111	128	124	125

Source: Compiled by ESCWA based on data from Cornell University, INSEAD and WIPO, 2016.

B. The ICT sector: innovation and financial aspects

The NRI environment pillars show a positive result for business innovation in most GCC countries, Jordan and Lebanon, but a negative one for the political environment in Egypt, Lebanon and Tunisia that is having an adverse impact on the business environment in the latter two. The GII institutions pillar shows strong scores in some GCC countries (Oman, Qatar and the United Arab Emirates) and a relatively strong score in Jordan. The two GII pillars related to business and market sophistication contain indicators relevant to the digital economy. The market sophistication pillar, for example, addresses credit, investment, trade, competition and market scale. These two pillars reflect major weaknesses in most Arab countries. The United Arab Emirates is the

exception, showing relatively good results in business sophistication.

The business sophistication pillar addresses knowledge workers, innovation links and knowledge absorption. Of the total 25 indicators (see details in annex 2), this report focuses on those addressing credit, knowledge-intensive employment, university-industry collaboration and inward foreign direct investment (FDI) stocks as summarized in table 7.

Table 7. Ease of getting credit, knowledge-intensive workforce, global expenditure on research and development (GERD) performed by businesses and inward FDI stocks

Country	Ease of getting credit (distance to frontier, best 100) 2017	Knowledge-intensive services (per cent workforce) 2014	University-industry collaboration (best 1-7) 2015	Inward FDI stock (million U$) 2015
Egypt	50.00 (82)	36.25 (2013)	2.43	94,266
Saudi Arabia	50.00 (82)	28.09	4.20	224,050
United Arab Emirates	45.00 (101)	36.09	4.72	111,139
Bahrain	45.00 (101)	n/a	3.27	27,660
Morocco	45.00 (101)	6.79 (2008)	3.23	48,696
Tunisia	45.00 (101)	20.94 (2012)	2.92	32,911
Kuwait	40.00 (118)	n/a	3.10	14,604
Lebanon	40.00 (118)	31.86 (2007)	2.88	58,608
Oman	35.00 (133)	n/a	3.62	20,027
Qatar	30.00 (139)	18.24 (2013)	5.44	33,169
Algeria	10.00 (175)	17.57 (2013)	2.26	26,232
Jordan	0.00 (185)	n/a	3.82	29,958
Yemen	0.00 (185)	n/a	n/a	697

Sources: Compiled by ESCWA.

1. Getting credit

Getting credit, particularly for innovative small and medium enterprises, is not an easy task in most Arab countries, including GCC ones. The two best-performed Arab countries, Egypt and Saudi Arabia, were equally ranked 82 in the last edition of the World Bank's Doing Business report 2017 All Arab countries are significantly underperforming in this area compared with their relative global NRI rank. For instance, the United Arab Emirates, the highest performing Arab country at 26 in the global rankings (see table 5), fills position 101 of the index on getting credit.

Political and economic instability in some Arab countries have had a negative impact on the getting credit index. Among the 19 Arab countries surveyed by the latest Doing Business report of 2017, only seven occupy a place in the upper half of the table,[47] with none, bar the United Arab Emirates, among the first quintile.

Some Arab countries experienced significant falls in their rankings between 2015 and 2017 (see table 8).

2. Knowledge workers

Egypt and the United Arab Emirates rated highly for knowledge-intensive services, as did some other Arab countries, though not among the leading ones. Certain Arab countries lacked data for this indicator, including Lebanon and Morocco. In the Arab region, this indicator needs to be interpreted with caution. Although it points to a pool of qualified employees capable of occupying knowledge-intensive positions, the public sector's role as a major job provider in many of the Arab countries should not be overlooked.

Table 8. Ease of Doing Business Index rankings, Arab countries, 2015-2017

Country	Ease of Doing Business Index global rank 2015	Ease of Doing Business Index global rank 2017	Difference
Algeria	154	156	-2
Bahrain	53	63	-10
Egypt	112	122	-10
Iraq	156	165	-9
Jordan	117	118	-1
Kuwait	86	102	-16
Lebanon	104	126	-22
Libya	188	188	=
Mauritania	176	160	+16
Morocco	71	68	+3
Oman	66	66	=
State of Palestine	143	140	+3
Qatar	50	83	-33
Saudi Arabia	49	94	-45
Sudan	160	168	-8
Syrian Arab Republic	175	173	+2
Tunisia	60	77	-17
United Arab Emirates	22	26	-4
Yemen	137	179	-42

Sources: World Bank, 2015 and 2017a. A total of 189 countries were surveyed in 2015, 190 in 2017.

3. University-industry collaboration

The quality of university-industry collaboration is gauged through an indicator borrowed from the World Economic Forum executive opinion survey, inquiring about the extent to which people collaborate and share ideas between companies and universities/research institutions. Answers are rated on a scale from 1 to 7, 1 indicating “not at all” and 7 “to a great extent”.

The business community seems to rate this collaboration as highly effective in Qatar (ranked 9 globally) and the United Arab Emirates (ranked 21), which puts them among the leading industrialized economies.[48] Saudi Arabia and Jordan also enjoyed favourable opinions and are in the first half of the table. All other Arab countries fall below the median value, including Egypt, its business communities negatively perceiving the state of collaboration with universities. Again, one should interpret these results with a degree of caution. Although they provide a good indication of how the business community feels about its relationship with academia, given the low volumes of research and development performed by businesses in most Arab countries (see table 11), the results may indicate a positive potential for good relations, and point to a significant problem when business perceptions are poor, particularly in countries with a longer industrial history, such as Egypt, and, to a lesser extent, Algeria.

4. Foreign direct investment

Inward stocks shown in table 7 highlight the important role played by GCC countries, essentially Saudi Arabia and the United Arab Emirates, as major investment destinations in the region, although Egypt, Lebanon and Morocco also make sizeable contributions.

A more detailed analysis of FDI flows towards Arab countries over the past 10 years highlights a steep fall from the heights reached before the financial crisis of 2007/2008 and following the 2011 Arab uprisings. FDI inflows to Arab countries in 2015 represented 50 per cent of the values reached in 2008-2009, and Arab countries’ current share of global FDI flows stands at only 2.23 per cent, down from 6 per cent and above reached in 2008-2009.[49]

For further analysis, it needs to be ascertained which sectors are more attractive for FDI flows in the Arab region. Between 2003 and 2012, the sectors of natural resources, real estate and construction received nearly 50 per cent more FDI flows than tradable non-resource manufacturing and commercial services.[50] There has been a substantial decrease in high-quality FDI that creates employment and promotes transfers of technology and managerial know-how to host economies in non-oil tradable manufacturing and services, and can therefore facilitate the transition to higher value-added production and export, economic diversification and increased competitiveness. This makes the Middle East and North Africa (MENA) region one of the least integrated developing regions in global value chains.

5. Innovation

The digital economy is a major driver of innovation, not only through ICT adoption that increases productivity, but also through the

transformation this adoption induces in business processes and organization. The opposite, namely that innovation can be a major driver and lubricant of the digital economy, is also true. Based on research conducted by ESCWA and presented in its report Innovation Policy for Inclusive Sustainable Development in the Arab Region,[51] innovation surveys in Arab countries are virtually absent, with the exception of Egypt. This is a source of concern as ICT adoption by businesses is not enough in itself to drive impact. Evidence from developed countries highlights that its impact will be heightened if businesses also invest in computerizing data, improve their processes and train staff on new methods of work. More detailed surveys and data are needed in the Arab countries on these activities and on innovation in processes and organization (in addition to goods and services). Such information would improve the development of the digital economy in the region and provide policymakers with better guidance.

Key components of ICT-driven innovation are start-ups introducing new products and markets leveraging the power of digital platforms to introduce new services and efficient mediation between producers and consumers. Low levels of venture capital for innovative startups have been observed in the region (when data is available). FDI is another source of concern as, according to UNCTAD, the inflows towards Arab countries following the 2007/2008 financial crisis and Arab uprisings of 2011 have steadily decreased. These inflows are directed primarily towards the real estate and natural resources sectors, bringing little meaningful technology transfer, and intra-Arab FDI is still small.

C. ICT infrastructure and affordability

Both NRI and GII highlight that infrastructure is a relatively strong point for Arab countries. This is particularly, but not exclusively, the case with high-income GCC countries. The GII infrastructure pillar is broader in scope (beyond the ICT sector) and addresses ecological sustainability, which is not a strong point of many Arab countries. Nonetheless, they enjoy high scores in this pillar as it includes the two e-government survey indicators.[52]

The region does not score nearly as well on the affordability index. Many Arab countries, including members of the GCC, are driven down the list by relatively high prices and insufficient competition. This is particularly true for most GCC countries (except, relatively, Bahrain), Jordan and Lebanon. Only Egypt, Morocco and Tunisia score well regarding affordability for ICT services.

Table 9 provides an overview of access to fixed and mobile infrastructure in Arab countries, based on the latest ITU statistics.

The above table shows the percentage of subscriptions of Arab citizens at national level in fixed and mobile infrastructures. The high level of mobile connectivity (more than 100 per cent) of almost all Arab counties (12 out of 19 listed) is worth observing, with an average of 106.4 per cent, which is slightly above the world average. Development of mobile infrastructure in the region is due to the high level of investment allocated to services by this sector. As for fixed telephony subscription, the Arab country average is 7.7 per cent, which compares with

a world average of 13.6 per cent and 38.5 per cent for developed countries.

As discussed earlier in this report, the results confirm that fixed broadband is predominantly a developed country privilege, with subscriber percentages nearly four times higher than those for developing countries. Arab countries are below even developing country averages despite major differences among countries. For mobile broadband, the differences between developed and developing regions are much less, with Arab countries standing slightly higher than the developing region average, driven up primarily by high subscription rates in high-income GCC countries, but also in other countries.

Table 9. Subscriptions in fixed and mobile telephony, Arab countries, 2016

Country/region	Fixed telephony subscriptions (per 100 inhabitants) 2016	Mobile telephony subscriptions (per 100 inhabitants) 2016
Algeria	8.24	117.02
Bahrain	20.8	216.93
Egypt	7.11	113.7
Iraq	5.53	82.16
Jordan	4.55	196.31
Kuwait	10.96	146.55
Lebanon	21.05	96.37
Libya	21.49	119.78
Mauritania	1.27	86.52
Morocco	6.02	120.72
Oman	9.8	159.22
Palestine	9.26	76.81
Qatar	19.34	147.1
Saudi Arabia	11.96	157.6
Sudan	0.34	68.63
Syrian Arab Republic	15.21	54.23
Tunisia	8.59	125.82
United Arab Emirates	23.43	204.02
Yemen	4.65	67.17
Arab countries	7.70	106.40
Developed countries	38.10	127.30
Developing countries	8.50	98.70
World	13.60	103.50

Source: Compiled by ESCWA based on the ITU statistics database.

D. Human capacity and research

Pillars on skills in NRI and human capital and research of GII reveal issues essential to the digital economy.

The NRI skills pillar is gauged through four indicators, two of them survey indicators (on the business community appreciation of the quality of the education system in general and of mathematics and science in particular) while the remaining two measure secondary education enrolment and adult literacy rates.

Only one Arab country emerges with a strong skills rankings, namely, Qatar. Overall, NRI provides a mixed picture of skills in Arab countries, with many in the lower half of the table.

The GII pillar provides a much more comprehensive overview of human capital and research, and results in a more balanced view for some Arab countries.[53] This is the result of a richer set of indicators (12 in total) that address not only education but also research and development efforts (see table 10).

Table 10. GII human capital and research pillar indicators

Education:
- Government expenditure on education (per cent, GDP);
- Government expenditure on education per pupil – secondary level (per cent, GDP per capita);
- School life expectancy (primary to tertiary education, years);
- PISA average scales in reading, mathematics and science;
- Pupil-teacher ratio, secondary.
Tertiary education:
- School enrolment, tertiary (per cent gross);
- Tertiary graduates in science, engineering, manufacturing and construction (per cent of total tertiary graduates);
- Tertiary inbound mobility ratio (per cent).
Research and development:
- Researchers (full-time equivalent) per million/population;
- Gross domestic expenditure on research and development (GERD) (per cent GDP);
- Average expenditure of top three global companies on research and development (million U$);
- Average score of the top three universities at the Quacquarelli Symonds **World University Rankings**.

Source: Compiled by ESCWA based on information from Cornell University, INSEAD and WIPO, 2016.

Although we might consider some GII subindicators (tertiary inbound mobility, global research and development expenditure in the top three global companies and world university ranking) as being too biased towards developed countries, objective measures such as the OECD's PISA test, research and development spending as a percentage of GDP and the number of researchers per million population are less prone to bias and particularly effective measurements.

The last PISA round took place in 2015. Results of the six participating Arab countries, and for OECD countries and Israel and Turkey are summarized in table 11.

All six participating Arab countries obtained mean scores below the OECD average in all three subjects. The United Arab Emirates managed, however, to obtain slightly better scores than Turkey. Arab girls obtain better science scores, and by large margins, in Algeria, Jordan, Qatar and the United Arab Emirates, contrary to the global OECD trend. In reading, Arab girls again outperform boys, confirming by much larger margins the same global OECD trend in all six Arab countries, though less so in Tunisia (only 25 points difference in favour of girls) and Lebanon (14 points). Boys in Lebanon and Tunisia follow the global OECD trend for better performance in mathematics, but girls obtain better scores (though by lower margins) in the other four Arab countries.

Table 11. PISA mean scores in science, reading and mathematics: OECD average, Israel, Turkey and participating Arab countries, 2015

	Science			Reading			Mathematics		
	Both sexes	Boys	Girls	Both sexes	Boys	Girls	Both sexes	Boys	Girls
OECD average	493	**495**	491	493	479	**506**	490	**495**	488
Israel	467	**469**	464	479	467	**490**	470	**474**	466
United Arab Emirates	437	424	**449**	434	408	**458**	427	424	**431**
Turkey	425	422	**429**	428	414	**442**	420	**423**	418
Qatar	418	406	**429**	402	376	**429**	402	397	**408**
Jordan	409	389	**428**	408	372	**444**	380	373	**387**
Lebanon	386	**388**	386	347	339	**353**	398	**408**	386
Tunisia	386	**388**	385	361	348	**373**	367	**370**	364
Algeria	376	369	**383**	350	376	**435**	360	356	**363**

Source: OECD, 2016g. Higher gender mean values are highlighted in bold.

It is interesting to compare previous PISA rounds in Arab counties. Since the last round that focused on science in 2006, there have been improvements in Qatar (plus 73 and 64 points, respectively, in mean scores for boys and girls) but a deterioration in Jordan (minus 19 and 8 points, respectively, for boys and girls mean scores).[54]

The last round that focused on reading was in 2009. Since then, there has been an improvement in Qatar (plus 29 and 39 points, respectively, for boys and girls), a deterioration in Tunisia (minus 40 and 46 points for boys and girls, respectively) and a mixed result for Jordan (minus 5 points for boys but plus 10 for girls).[55]

Mathematics was the focus of the 2012 round. Since then, there has been an improvement in Qatar (plus 28 and 24 mean points for boys and girls, respectively) but regression for the four other Arab participating countries: minus 26 and 17 for Tunisia; minus 12 and 11 for Algeria; minus 7 and 6 for the United Arab Emirates; and minus 2 and 8 for Jordan for boys and girls, respectively.[56]

PISA results offer many detailed and useful insights into the inclusiveness and fairness of education systems, the performance of students from immigrant backgrounds, policies that make the system more efficient, and the capabilities of students to work in teams and their social values.

Box 3 provides information on what students expect from ICT jobs as revealed through PISA.

Box 3. Professional expectations of Arab students from ICT jobs

As well as being a comprehensive capability test, the Programme for International Student Assessment (PISA) is equally a survey of student attitudes towards science and their expectations for science-related careers. The 2015 survey focused on science. It found that 24.5 per cent of students aged 15 in member countries of the Organisation for Economic Co-operation and Development (OECD) expected to be working in science-related occupations at the age of 30, with the highest share in health (11.6 per cent), science and engineering (8.8 per cent) and information and communications technologies (ICT) (2.6 per cent). The remaining 1.5 per cent nominated science-related technician and associate professional roles. Some 56.7 per cent expected to work in other occupations while the remaining 18.8 per cent had vague career expectations.

In all participating Arab countries, students had higher expectations of careers in the two dominant areas, namely health and science and engineering, with combined percentages ranging from 25.5 per cent in Algeria to 42.6 per cent in Jordan.

However, regarding ICT jobs, expectations were significantly below the OECD average for girls (0.4 per cent). Tunisia, Qatar and the United Arab Emirates had the highest ICT career expectations at 1.5 per cent for the former and 1.4 per cent for the latter two, while Lebanon (0.6 per cent) and Algeria and Jordan (0.2 per cent) had significantly lower levels of expectations. The gender bias in favour of boys is most pronounced in Tunisia (2.7 per cent versus 0.4 per cent for boys and girls, respectively) and the United Arab Emirates (2.3 per cent versus 0.6 per cent for boys and girls, respectively. Lebanon, though from a lower base, had a higher preference among boys (1 per cent versus 0.2 per cent for boys and girls, respectively) to become future ICT professionals.

These figures are cause for concern as they indicate a lack of awareness and motivation among youth, who are far more technology savvy than older generations and should, presumably, be better equipped to target a career in the ICT sector.

Source: OECD, 2016g.

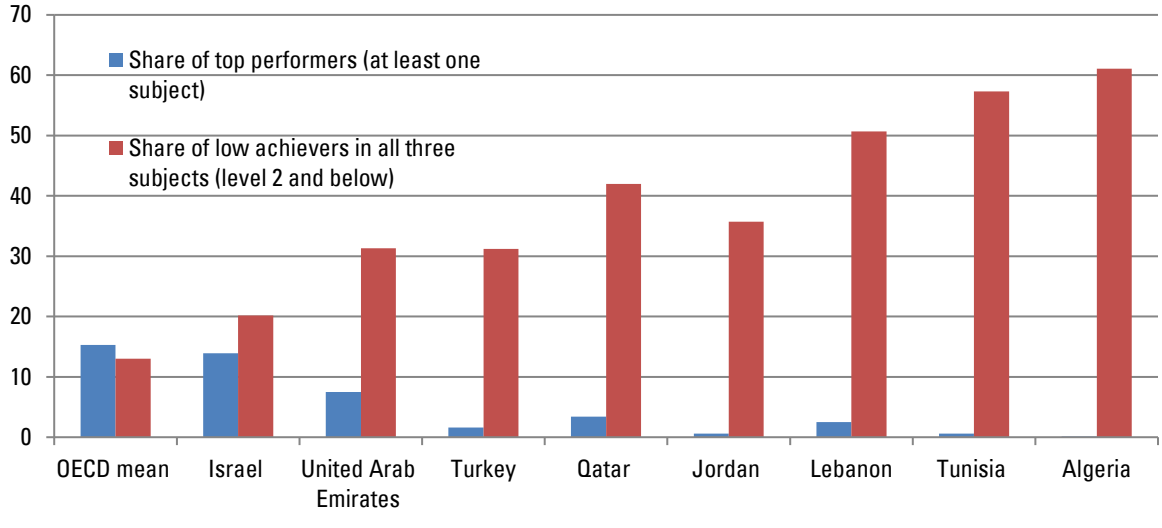
Figure 19 highlights that the major challenge for Arab countries lies not in the absolute lower mean score values in all three subjects compared with more advanced OECD countries but in the high percentage of low achievers.[57] This points to shortcomings in Arab education systems still plagued by rote learning and memorization methods to the exclusion of developing independent thinking, a problem that has long been identified.[58] Policymakers need to address this situation if Arab countries are to harness the benefits of a digital economy by equipping youth with better skills in order to perform more demanding jobs where non-routine tasks will be dominant.

Figure 20 shows the percentage of tertiary graduates in ICT specialties. Only Tunisia, Morocco (though for the latter, data is for 2010) and Oman achieved more than 10 per cent. The proportion of male graduates is higher in most Arab countries, particularly in Tunisia, Qatar and Bahrain, with the exceptions of Oman, and to a lesser extent Mauritania and the Sudan, where the proportions of female graduates were higher.

Table 12 and 13 summarize available data for Arab countries on GERD and full-time equivalent (FTE) researchers from the original UNESCO source used by GII. They highlight shortcomings in Arab countries.

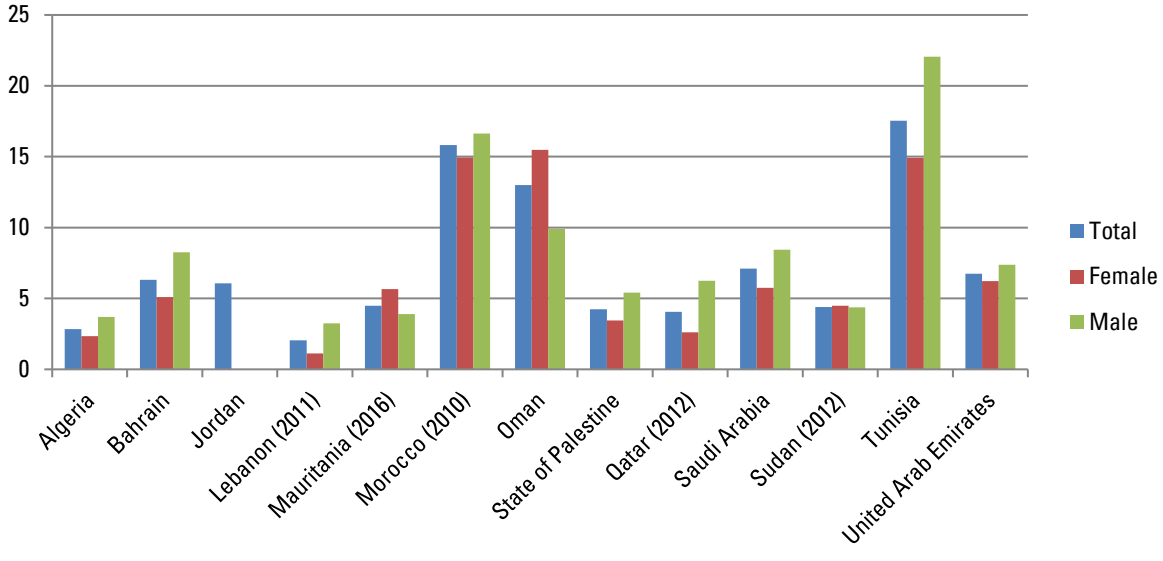
GERD levels (as a percentage of GDP) are low to very low in all Arab countries and much below the developed country mean value of 2 per cent (and higher in some developed countries). Another problem area is the business share, which is still small compared with developed countries, where it reaches 70 per cent. Only the United Arab Emirates manages a similar research and development effort by its businesses (74.3 per cent).

Figure 19. PISA 2015 top performers and low achievers in at least one subject, OECD mean, Israel, Turkey and participating Arab countries (percentage)



Source: OECD, 2016g.

Figure 20. Tertiary graduates in ICT programmes, Arab States, 2015 or otherwise indicated (percentage)



Source: UNESCO Institute for Statistics, n.d.

Table 12. GERD (percentage GDP) and financing sources (percentage), Arab countries, latest available year

Country	GERD	Financed by business enterprises	Financed by government	Financed by higher education	Financed from abroad	Financed by unspecified source
Algeria (2005)	0.07	-	-	-	-	-
Bahrain (2014)	0.1	21.8	41.5	21.2	12.4	1.1
Egypt (2014)	0.68	8.1	91.7	-	0.2	-
Iraq (2014)	0.04	1.8	98	-	-	-
Jordan (2008)	0.43	-	-	-	-	-
Kuwait (2013)	0.3	1.4	92.5	0.17	1.2	-
Morocco (2010)	0.71	29.9	23.1	45.3	1.7	-
Oman (2013)	0.17	24.5	48.6	24.4	0.01	2.3
Qatar (2012)	0.47	24.2	31.2	36.6	2.4	-
Saudi Arabia (2014)	0.07	-	-	-	-	-
Sudan (2005)	0.3	-	-	-	-	
Tunisia (2014)	0.64	18.5	77.5	-	4	-
United Arab Emirates (2014)	0.7	74.3	25.7	-	-	-

Source: UNESCO Institute for Statistics, n.d.

Note: Dash (-) means zero or not available (depending on context).

Table 13. Researchers (FTE per million inhabitants) by sector (percentage), Arab countries, latest available year

Country	Researchers	Business enterprises	Government	Higher education	Private non-profit
Algeria (2005)	168	-	13	87	-
Bahrain (2014)	362	0.4	7.7	91	-
Egypt (2014)	682	5.5	36.2	58.2	-
Iraq (2014)	68	2.1	29	69	-
Kuwait (2012)	128	-	100	-	-
Morocco (2012)	857	9.3	3.4	87.2	-
Oman (2012)	170	20.2	45.6	34.2	-
Palestine (2010)	322	-	29.4	55.8	14.7
Qatar (2012)	597	28	33.4	38.6	-
Tunisia (2014)	1,803	3.6	6.6	89.7	-

Source: UNESCO Institute for Statistics, n.d.
Note: Dash (-) means zero or negligible.

The number of FTE researchers per million inhabitants is equally low in many Arab countries. Only Tunisia has a relatively good value, namely 1,803, compared with 4,000-5,000 and above in developed countries.

Both GERD and FTE researchers are mainly localized in universities and government, which is the opposite pattern in developed countries and emerging economies.

E. ICT use by individuals, businesses and governments

The three NRI pillars detail ICT use among individuals, businesses and governments.

1. ICT use by individuals

ICT use by individuals is gauged through six indicators drawn from access indicators (mobile telephone, mobile broadband and fixed broadband subscriptions), use by individuals and households (Internet users, households with personal computers and Internet access) and survey indicators on the extent of social network use. Infrastructure investment in the mobile sector in Arab countries has paid off and ICT use by individuals is strong in nearly all surveyed Arab countries. However, fixed broadband subscription is generally low in most Arab countries and above the threshold of 10 per cent (per 100 inhabitants) in only eight

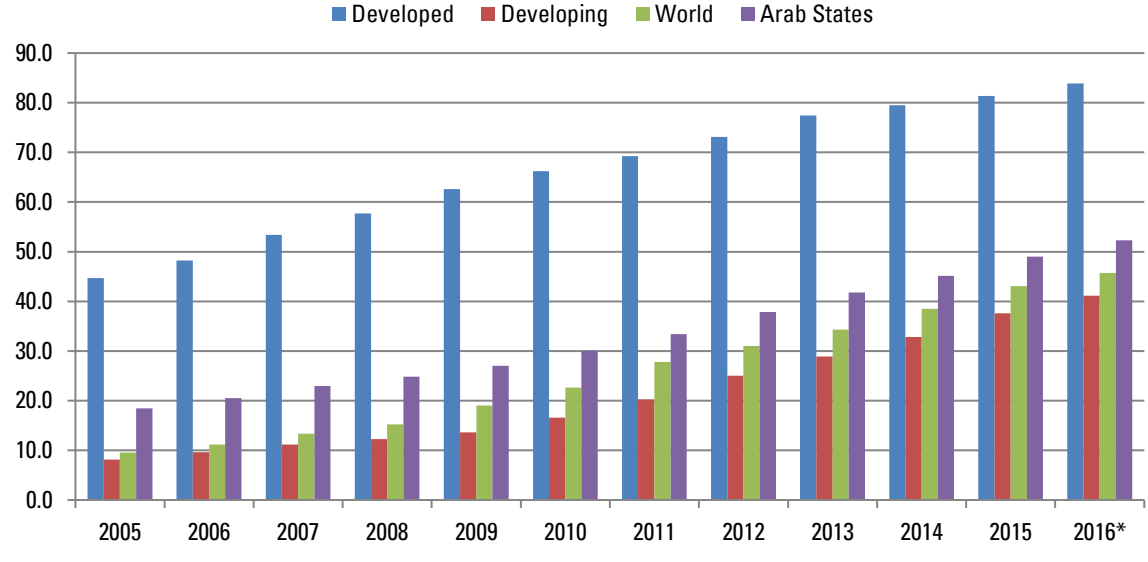
countries, namely, Bahrain at 20.8 per cent, Kuwait (10.96), Lebanon (21.05), Libya (21.49), Qatar (19.34), Saudi Arabia (11.96), Syrian Arab Republic (15.21) and United Arab Emirates (23.43). These rates are well below the 38.10 per cent average in developed countries (see table 9).

These results are confirmed by the ITU data analysis presented in figure 21, which shows that developing countries have made significant advances, more than quadrupling their percentage over the past decade and managing to partially catch up with developed countries. This has been due largely to improvements in mobile broadband and the quality and throughput (download and upload speeds) of Internet access. The Arab country average is above that for the world and developing countries.

Figure 22 highlights the evolution of the proportion of individuals who effectively use the Internet at global, developed, developing and Arab countries level.

This growth over recent years has essentially been driven by mobile broadband (many GCC countries are among the world leaders, with rates standing at more than 100 per cent of their population), with the use of social networks particularly high in many Arab countries. Table 14 below shows gender-disaggregated data for selected Arab countries (where data is available), represented by the percentage of males and females using the Internet as reported in the ITU database.

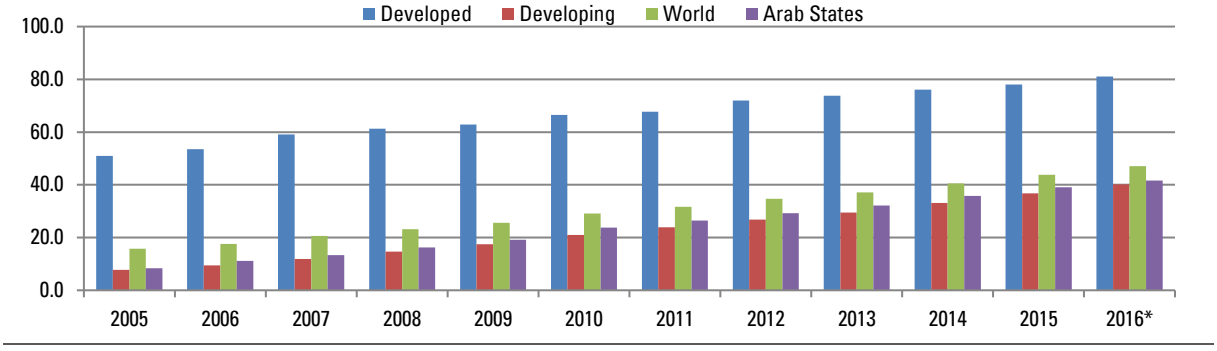
Figure 21. Households with Internet access in developed, developing and Arab countries and worldwide, 2005-2016 (per 100 population)



Source: Compiled by ESCWA based on the ITU database.

* Data for 2016 is estimated.

Figure 22. Internet use by individuals in developed, developing and Arab countries and worldwide, 2005-2016 (per 100 population)



Source: Compiled by ESCWA based on the ITU database.

* Data for 2016 is estimated.

Table 14. Male and female Internet usage

Country	Latest year	All individuals	Gender	
			Male	Female
Bahrain	2016	98.0	97.5	99.0
Egypt	2015	37.8	40.8	34.8
Morocco	2016	58.3	63.1	53.5
Oman	2016	69.8	72.1	67.3
State of Palestine	2014	53.7	59.6	47.5
Qatar	2015	92.9	94.1	91.7
Saudi Arabia	2016	73.8	76.7	69.8
Sudan	2016	14.1	16.9	11.0
United Arab Emirates	2016	90.6	90.6	90.6

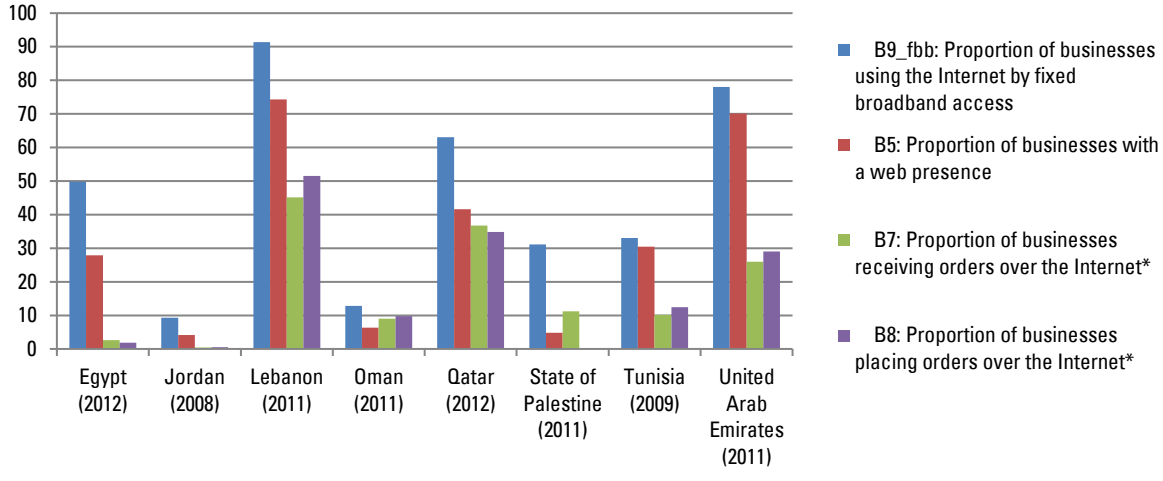
Source: ITU World Telecommunication/ICT Indicators database, available from http://www.itu.int/en/ITU-D/Statistics/Documents/Statistics/2017/Individuals%20using%20the%20Internet%20by%20gender.xls.

2. ICT use by businesses

ICT use by businesses remains weak in the Arab region. Figure 23 summarizes the most recent available data.

Research published by McKinsey in October 2016 confirms that business adoption of digital technologies is still low, while a recent survey revealed that just 18 per cent of small and medium-sized enterprises in the United Arab Emirates, 15 per cent in Saudi Arabia and 7 per cent in Egypt have an online presence.[59] But more customer journeys, channels and internal processes and activities are being digitized and there is promising momentum in this space. Box 4 below illustrates some examples of digitized business services in the region.

Figure 23. ICT use by businesses, Arab countries, latest available year



Source: UNCTAD, 2017.
* Indicator data of the United Arab Emirates are for 2008.

Box 4. Selected digitized businesses in the Arab region

The petroleum companies ENOC and EPPCO in Dubai have developed a radio-frequency identification-enabled prepaid fuelling system that enables cashless and cardless automated fuel payments. Some of the biggest oil companies in the GCC are exploring ways to make their oilfields smarter by digitizing operations with big data and analytics, sensors and control systems.

The regional online private car-booking service Careem is another success story. While the global market is dominated by giants, such as Uber from the United States and Didi in China, Careem is able to compete regionally with a localized strategy focusing on business-to-business integration and additional features, such as scheduled bookings.

Bank Audi in Lebanon has launched Novot, an artificial intelligence-based humanoid robot. The autonomous mobile robot welcomes and guides customers, and promotes the bank's products and services. Novot lifts customer experience to a new level and makes customer journeys at bank branches interactive and intuitive.

Souq.com, the region's first unicorn (a start-up with a market capitalization of more than $1 billion) is the Middle East's leading e-commerce marketplace. It has facilitated the connection of 75,000 Middle Eastern businesses with customers they would never have been able to reach previously.

Established players are also taking the opportunity to digitize their businesses. Telecommunications service providers Etisalat and Du in the United Arab Emirates have launched several smart cities and Internet of things (IoT) services.

The Saudi Telecom Company (STC) offers IoT-based fleet management tracking cars and trucks.

Source: Benni et al., 2016.

3. ICT use by governments

The 2016 United Nations E-Government Survey notes Arab country efforts to adopt ICT for e-government services. Digital technologies not only offer opportunities to businesses and households, they enable citizens to access public services, strengthening government capability and serving as a platform for collective action to solve problems. Globally, governments have invested heavily in digital technology over the past two decades, making it easier in many countries for businesses to file taxes and for the poor to get an official identity that enables them to receive welfare payments and vote in elections. Digital technologies have also enabled governments to receive regular feedback from service users, improving service quality.

However, assessing whether ICT can lead to better service delivery for citizens in the Arab region is a challenging exercise.

(a) Citizen expectations

The question is quite subjective and needs a more rigorous definition of citizen expectations and an assessment of how smart authorities are in gauging and fulfilling these. There is no universal definition of a good/acceptable online service but general trends, as highlighted by the United Nations E-Government Survey,[60] point towards efforts by many governments to improve transparency through open government data, augment the number and complexity of transactional online services (see figure 17) and leverage e-government to ensure service integration among administrations and improved participation and feedback from citizens. However, no specific indicators addressing those issues on a country basis, nor any comprehensive field surveys measuring citizen satisfaction levels and effective adoption of online services, are provided by the survey.

(b) Lack of data

For most developing and Arab countries, lack of data is a major issue. Table 15 presents Arab country OSI rankings alongside the five related NRI indicators. The first two NRI indicators do not address online government services but, more generally, whether a government has a 'clear implementation plan to use ICTs to improve the country's overall competitiveness' and 'how successful it is in promoting the use of ICTs'. The third indicator is central to online service while the fourth focuses on Internet use in schools. The fifth indicator addresses the subjective impact, questioning whether 'the use of ICTs by the government improved the quality of government services to the population'.

The OSI highlights the good performance of Bahrain and the United Arab Emirates, which are ranked in the very high OSI category.[61] Kuwait, Lebanon, Morocco, Oman, Qatar, Saudi Arabia and Tunisia are ranked in the high OSI group. The United Arab Emirates' rank among Arab countries is enhanced by the opinion of its business community through the five NRI-related indicators. Globally, however, the United Arab Emirates comes 27th in the E-Government Development Index and 13th in the OSI, which may lead to the conclusion that there is exaggerated optimism among its business community. The same can be said about Qatar and, to a lesser extent, about Saudi Arabia.

Table 15. OSI value and public services opinion survey indicators (NRI), Arab countries, 2016

	OSI value (0-1)	Importance of ICTs-to government vision (1-7) (rank)	Government success in ICT promotion (1-7) (rank)	Impact of ICTs on access to basic services (1-7) (rank)	Internet access in schools (1-7) (rank)	ICT use and government efficiency (1-7) (rank)
United Arab Emirates	0.8913	6.1 (1)	6.2 (1)	6.1 (4)	6.0 (9)	6.1 (1)
Bahrain	0.8261	5.2 (9)	5.1 (12)	5.4 (26)	5.3 (34)	5.4 (10)
Morocco	0.7391	4.3 (50)	4.3 (49)	3.8 (95)	3.5 (110)	4.0 (65)
Tunisia	0.7174	3.6 (90)	3.8 (83)	3.8 (100)	3.4 (112)	3.6 (92)
Saudi Arabia	0.6739	5.3 (7)	5.3 (9)	5.2 (33)	4.4 (63)	5.5 (8)
Qatar	0.6739	5.9 (3)	5.8 (4)	6.0 (8)	5.9 (18)	6.0 (3)
Kuwait	0.6522	3.2 (113)	3.3 (116)	4.1 (71)	4.0 (81)	3.7 (89)
Oman	0.5942	4.5 (39)	4.4 (44)	4.6 (50)	3.9 (84)	4.5 (46)
Lebanon	0.5145	2.7 (134)	2.7 (134)	3.4 (117)	3.9 (85)	3.0 (125)
Egypt	0.4594	3.2 (112)	3.6 (99)	3.5 (108)	2.6 (132)	3.4 (112)
Jordan	0.4565	4.5 (36)	4.4 (40)	4.8 (43)	4.6 (56)	4.4 (47)
Algeria	0.0652	3.1 (119)	3.4 (115)	3.2 (124)	2.8 (128)	3.3 (116)
Mauritania	0.0652	3.1 (124)	3.1 (123)	3.0 (129)	2.1 (136)	3.0 (123)

Sources: United Nations, 2016, for OSI; and World Economic Forum, 2016, for remaining indicators.

Kuwait, despite its respectable OSI, suffers from a negative opinion among its business community about government ICT use; the same can be said for Lebanon, though it has a much lower OSI value. Conversely, Jordan and Oman seem underrated in their OSI value relative to the higher opinion held by their business communities.

Looking at the business community opinion on the two core questions of access to services (third indicator) and impact on government efficiency (fifth indicator), only Qatar and the United Arab Emirates emerge with very high scores. Bahrain scores very high for the latter but less so for the former. A significant number of Arab countries score very low on these two issues and others.

What do these partial – and far from perfect – data tell us about public service delivery in Arab countries and whether it has benefited from the digital economy?

- The voluntary approach of some high-income GCC countries has definitely improved the levels and sophistication of services offered to citizens, but better measures of participation, use and

satisfaction levels are required. The United Arab Emirates emerges as the Arab country whose government is closest to becoming a 'smart' one thanks to technical efforts and a guiding vision;

- Based on available data, there has been some improvement in access to services by citizens in most Arab countries due to technical, financial and other external factors;
- The absence of data on Arab countries affected by conflict and/or severe political instability is a major concern. Results show that these countries have lower OSI values[62] and face the challenge of providing displaced populations with basic services amid infrastructure destruction and continuing conflict in some instances; neighbouring countries Lebanon and Jordan, as receiving countries, are also affected in this regard. One might argue that ICT is a luxury in such circumstances, but on the contrary, ICT, including advanced IoT and data-driven innovations, could help provide essential services to these populations and alleviate their sufferings;
- The NRI executive opinion survey indicators are limited. Furthermore, the effectiveness of a government's digital transformation depends on so-called analogue complements (see box 5), which are hard to measure and address broader socioeconomic and sociopolitical domains.

Box 5. Useful analogue complements for smart government and society

Digital technologies are necessary but not sufficient for the smart transformation of government and society. Arab States must address the following challenges when undertaking holistic government reforms to achieve smart transformation:

- Management and administration: Centralization coupled with slow bureaucratic procedures and the absence of a civil service mentality, and the lack of training programmes on dealing with constituents and customers, are major challenges in most Arab public services. In many countries, low salaries for government staff and the use of the public service as employer of last resort do not provide incentives to improve performance and reduce overstaffing. This is compounded by low levels of transparency and innovative thinking, limited partnerships with the private sector to address socioeconomic challenges, and an overreliance on outsourcing for e-government projects, with insufficient emphasis on developing indigenous expertise within government;
- Cultural and social: Resistance to altering practices and trying innovative solutions are barriers to change, along with a prevailing mindset of people based on negative social and cultural traditions. Limited citizen engagement and the predominance of a one-way relationship, from government to citizens, limit potential feedback from the latter;
- Economic: Barriers include low budgets for management and technological reforms, particularly outside Gulf Cooperation Council (GCC) countries, and insufficient flexibility and freedom to accept innovation in government procedures. Increasing corruption in government and lack of timely data for feasibility and cost-benefit analyses also hinder reform;
- Infrastructure/connectivity: Poor affordability and limited Internet access, particularly in rural and poor areas in most non-GCC countries, are technical barriers for using e-government and other online services.

Source: ESCWA, 2017b.

F. Economic impact

The benefits of digital technologies filter through to the whole economy. For businesses, the Internet promotes the inclusion of firms in the world economy by expanding trade, raises the productivity of capital and intensifies competition in the marketplace, which in turn induces innovation. Digital technologies create opportunities to accelerate growth, and firms that use these technologies intensively and effectively will be able to reduce their costs and outperform competitors. However, there is a lack of reliable statistical data to measure the impact and growth of the digital economy in the Arab region, such as the ICT-sector share in total value added and jobs created.

1. ICT sector contributions to national economies

The ICT sector is a key economic pillar of the digital economy. Economically, the sector has developed satisfactorily in the region in recent years. Several studies show that proper investment in the ICT sector leads to considerable benefits for economic growth, for various service sectors, such as health and education, and for social cohesion. However, appropriate indicators must be developed to measure ICT contribution to national economic growth. In Arab countries, the sector's contribution to economic growth can be measured using telecommunications indicators. This is due to the ICT-sector value added in Arab countries being primarily concentrated in telecommunications services, reaching up to 80 per cent of the ICT-sector total value added in many developing countries, compared with only 30 per cent in developed OECD economies. Only a few Arab countries, Saudi Arabia being one, report details of their ICT-sector value added in the way developed countries do. Saudi Arabia's Communications and Information Technology Commission (CITC) (telecom regulator) report for the year 2015 estimates the telecom services share to be 76 per cent of the ICT-sector added value, with IT services (12 per cent), hardware (9 per cent) and software (3 per cent) sharing the remainder.

This large share of telecom services in the largest Arab economy, at the expense of industry and service activities, is common in developing and Arab countries. In some developing countries, to counter the lack of data about the ICT-sector value added, the telecom-sector share is correlated with ICT spending; it indicates similar values, an 80 per cent and more share for the telecom sector in many developing countries. However, although the telecom sector provides the most important and useful services via near-universal access to digital technologies in most Arab countries, this sector is still a rent-seeking one with monopolistic or duopolistic players imposing relatively high prices and low investment in advanced fixed broadband infrastructure, such as fibre optics.

Table 16. Telecommunications revenue (percentage of GDP) in selected Arab countries, 2010-2015

Country	2010	2011	2012	2014	2015
Jordan	6.1	5.8	5.4	4.7	4.1
Morocco	4.6	4.6	4.3	3.8	3.5
Tunisia	4.4	3.9	3.9	3.7	3.4
Bahrain	3.7	4.2	3.6	3.4	3.4
Yemen	2.9	3.3	3.4	..	..
Algeria	3.1	3	2.9	3	2.9
Oman	2.8	2.5	2.4	2.4	2.6
United Arab Emirates	2.4	2.1	2	2.2	2.3
Saudi Arabia	3.1	3	2.7	2.7	2.1
Sudan	3.3	3.1	2.1	1.5	1.6
Qatar	1.4	1.1	1.1	1.1	1.2
MENA average	2.9	3.4	2.7	2.6	2.2
Global average	2.7	2.6	2.6	2.6	2.4

Source: Compiled by ESCWA based on World Bank, 2017b.

Table 16 shows telecommunications revenue in selected Arab countries from 2010 to 2015. Over that period, revenues varied from 1 to 6 per cent of national GDP. The regional average has been higher than the global average over the entire period, except for 2015 where it decreased to 2.2 per cent compared with a 2.4 per cent world average. The majority of revenue was from mobile voice and data services. Bahrain, Jordan, Morocco and Tunisia had the highest revenue, while rates in Qatar, Saudi Arabia and United Arab Emirates were relatively low because of their high GDP.

Between 2010 and 2015, telecommunication revenues fell in almost all Arab countries, particularly in Jordan, Morocco, Tunisia, Saudi Arabia and the Sudan, reducing their GDP contributions.

2. Employment in the ICT sector

ITU provides a database of full-time employment in the ICT sector. However, it does not accurately reflect reality because it includes only employees who work directly for telecommunications operators and service providers; it fails to take into account numerous other jobs related to telecommunications service development and distribution, such as prepaid cards. According to these data, the number of full-time employees in the region's telecommunication sector did not show any significant growth from 2010 to 2015, and even a reduction in some countries, including Egypt, Jordon, Morocco, Saudi Arabia and United Arab Emirates. Egypt still led the way with 62,251 full-time staff in 2015, followed by Algeria with 41,353, Syrian Arab Republic with 27,300 and Saudi Arabia with 22,887. No data

from Iraq, Qatar and Yemen were available after 2010, while Kuwait and Lebanon had data only for 2015.

Full-time employment in the ICT sector as a percentage of the total labour force was still insignificant in all Arab countries in 2015, with the highest of 0.58 per cent in Kuwait. This compared with an average 3 per cent in developed countries.

The ICT-services sector is still an important source of revenue and decent jobs for young people and women in local economies, and allows many developing and Arab countries to become part of the globalized digital economy. The ILO's Global Initiative on Decent Jobs for Youth seeks digital skills and tech hubs to improve opportunities in the digital economy.[63] This aim is to stimulate country-level action, scale up efforts and increase impact. The initiative focuses on interventions that are locally owned, ensure clear coherence with national development priorities and rely on rigorous evidence of what works in different settings. This collaborative enterprise attempts to join efforts on youth employment and help member States target and deliver a crucial goal of the 2030 Agenda for Sustainable Development.

There is little available data to make a scientific analysis of women's representation in the sector. However, there is anecdotal evidence that points to progress in selected countries, such as the United Arab Emirates.[64] According to the World Bank, the Arab region is home to 13 of the 15 countries worldwide with the lowest rate of female participation in the workforce. The United Arab Emirates seems to buck this trend, however, with regard to women's participation in tech leadership. Women in the United Arab Emirates comprise 66 per cent of the public-sector workforce, 30 per cent of whom perform leadership roles. Women form 27.5 per cent of the country's cabinet and all members play key roles in supporting technology and innovation. Here, women are not a stark minority in the technology sector; they are a part of all major tech initiatives and, in many instances, lead them.[65]

The NRI's ninth pillar measures the digital economy's impact on the wider economy via four indicators, namely:

(a) impact of ICTs on business models;
(b) ICT patents, applications per million population;
(c) impact of ICTs on organizational models;
(d) knowledge-intensive jobs as a percentage of the workforce.

Indicators (a) and (c) are drawn mainly from the executive opinion survey that gauges business community sentiment and whether ICT has led to new business and organizational models.

No Arab country performed highly in this pillar relative to its global rank. Many countries, including Bahrain, Kuwait and Oman, underperformed, the only exception being Egypt, driven up by its solid proportion of workers in knowledge-intensive jobs.

Qatar, Saudi Arabia and the United Arab Emirates enjoy remarkably positive opinions among their business community on the two survey questions. Qatar is ranked third and

seventh worldwide measuring ICT impact on business and organizational models, respectively. The United Arab Emirates is ranked closely behind at seventh and tenth places, respectively. Again, this optimism might reflect potential rather than actual impact.

3. Patents in the ICT sector

The ICT patents indicator used by the NRI economic impact pillar shows negligible values for most Arab countries. Only Qatar shows a significant double-digit value, with 17.1 ICT patents per million population.[66] Other countries lag way behind, with the United Arab Emirates at 2.4 and Saudi Arabia 1.5, and the remainder below the threshold of 1. There is a huge gap between Arab and developed countries, where the 10 leading country values range from 153.1 for Sweden to 52.3 for Germany. Israel is fourth globally at 117.5. According to the World Intellectual Property Organization, patents filed in nearly all Arab countries are by non-residents.[67]

The sixth and seventh GII pillars on knowledge and innovation outputs include 27 indicators, many of which address digital technology impact on the economy. This is a much richer data set than the one provided by NRI, with many of the indicators based on hard data, not opinion surveys.[68]

Table 17. Telecommunication employees (FTE) in selected Arab countries, 2010-2015

Country	2010	2011	2012	2013	2014	2015	Total labour force (per cent)*
Algeria	-	31,268	31,976	32,660	33,433	41,353	0.33
Bahrain	2,570	2,708	3,141	3,000	3,100	3,180	0.42
Egypt	64,015	63,233	65,619	64,166	63,518	62,251	0.20
Iraq	17,464	-	-	-	-	-	0.19
Jordan	4,739	4,600	4,596	4,214	4,304	4,159	0.18
Kuwait	-	-	-	-	-	12,500	0.58
Lebanon	-	-	-	-	-	7,840	0.37
Morocco	12,901	12,943	11,557	11,437	11,196	11,243	0.09
Oman	3,720	3,959	3,819	3,834	4,007	4,010	0.18
State of Palestine	3,022	3,442	-	-	-	-	-
Qatar	2,502	-	-	-	-	-	0.14
Saudi Arabia	23,406	23,721	23,745	23,721	22,019	22,887	0.18
Syrian Arab Republic	26,628	26,612	25,877	26,899	27,154	27,300	0.56
Tunisia	10,957	10,936	10,795	10,971	11,057	10,529	0.26
United Arab Emirates	11,337	10,798	7,961	7,419	6,254	6,286	0.10
Yemen	9,532	-	-	-	-	-	0.12

Source: Compiled by ESCWA based on the ITU Statistics database.

* The calculation is based on the national total labour force provided by the World Bank, available at https://data/worldbank.org/indicator/SL.TLF.TOTL.IN.

Table 18. Computer software spending, ICT services exports, gTLD and country-code TLD registration, Wikipedia edits and YouTube uploads, Arab countries, indicated year

	Computer software spending (per cent GDP) 2015	ICT services exports (per cent total trade) 2014	Generic top-level domains (per thousand population 15-69) 2015	Country-code top-level domains (per thousand population 15-69) 2015	Wikipedia monthly page edits (per million population 15-69) 2014	Video uploads on YouTube (scaled by population 15-69) 2015
United Arab Emirates	0.26 (57)	n/a	11.91 (38)	6.83 (45)	1,889.24 (54)	26.60 (47)
Saudi Arabia	0.33 (29)	0.07 (120)	3.35 (62)	0.69 (86)	1,469.75 (65)	34.39 (33)
Qatar	0.24 (61)	0.37 (102)	4.73 (56)	4.03 (57)	2,058.25 (52)	26.64 (46)
Bahrain	0.34 (27)	3.28 (20) 2013	5.99 (52)	1.51 (74)	1,547.68 (62)	28.15 (43)
Kuwait	0.32 (30)	3.82 (16)	8.84 (43)	0.48 (93)	1,452.23 (66)	30.36 (39)
Lebanon	n/a	2.72 (32)	7.38 (46)	0.33 (98)	876.27 (78)	12.67 (58)
Morocco	0.26 (56)	2.91 (27) 2013	1.72 (87)	0.89 (82)	390.44 (92)	12.35 (60)
Oman	n/a	0.19 (114)	1.99 (80)	0.16 (104)	637.37 (86)	7.71 (63)
Tunisia	0.31 (36)	1.71 (56) 2013	2.87 (67)	0.25 (101)	499.87 (89)	7.79 (62)
Jordan	0.28 (49)	n/a	7.15 (47)	0.35 (97)	1,037.91 (70)	12.40 (59)
Egypt	0.25 (59)	1.71 (55)	1.33 (91)	0.04 (119)	439.07 (90)	7.67 (64)
Algeria	n/a	0.32 (106) 2013	0.52 (109)	0.10 (112)	399.68 (91)	4.49 (66)
Yemen	n/a	3.36 (19) 2013	0.40 (111)	0.02 (121)	117.46 (106)	0.67 (71)

Source: Compiled by ESCWA based on Cornell University, INSEAD and WIPO, 2016.

Note: Figures in red indicate the highest rank among the selected Arab countries.

As noted for table 6, Arab country performance in the GII innovation component is particularly weak. The United Arab Emirates severely underperforms in the creative pillar compared with Bahrain, Lebanon, Qatar and Saudi Arabia. Results shows particular weaknesses in knowledge and technology outputs for almost all Arab countries surveyed. Only Lebanon performs well in creative outputs due to a particularly good result in the goods and services subpillar that addresses media, press and publishing.[69]

For a more detailed analysis of the economic impact of the digital economy in the region, this report focuses on the six aforementioned indicators that address computer software spending, ICT services exports, generic top-level domains (gTLDs), country-code TLDs, Wikipedia edits and video uploads on YouTube. Table 18 summarizes Arab country values (and ranks) for these indicators.

4. Spending in computer software

As shown in table 18, spending on computer software is reasonable in Arab countries, particularly in Bahrain, Kuwait, Saudi Arabia and Tunisia. However, lack of data in some Arab

countries remains a significant issue that needs to be addressed by policymakers in order to better measure the economic impact of the digital economy at national level.

(a) Trade in the ICT sector

Table 19 shows that ICT service exports, as a percentage of total trade, delivered good results for several countries in the region, including Kuwait with 3.82 per cent, Yemen with 3.36 per cent, Bahrain with 3.28 per cent, Morocco with 2.91 per cent and Lebanon with 2.72 per cent. These countries rank alongside other developing countries that are leveraging ICT services as a good source of exports. Not all these exports are high tech. They include a good many telecommunications services, which encompass all call-centre-related businesses.

Assessing the contribution of digital technologies to a national economy should include considering the export volume of ICT goods. These can be gauged from the World Bank database as a percentage of the total number of goods exported. Data on selected Arab countries is summarized in table 19, which provides data from 2007 to 2014, thereby illustrating the evolution of this sector over the past decade.

Data in the table shows steady performance in ICT goods exports in only two Arab countries, namely, Tunisia and Morocco. Jordan and Lebanon have had some good, though inconsistent, performances in recent years, and Bahrain seems to have recently improved. The absence of data for the United Arab Emirates since 2009 is particularly frustrating for a country that is at the forefront of the region's transition to the digital economy. Tunisia is the best performed Arab country in this field based on 2013 results, with a value just under half the world average.

Table 19. ICT goods exports, Arab countries, 2007-2014 (percentage of total goods exports)

	2007	2008	2009	2010	2011	2012	2013	2014
Bahrain	0.06	0.11	0.39	0.25	0.57	1.44	2.39	1.71
Egypt	..	0.34	0.17	0.14	0.23	0.24	0.42	2.84
Jordan	6.88	3.77	1.56	1.29	1.47	1.61	1.39	1.89
Kuwait	0.16	0.18	0.29	..	..	..	0.05	0.06
Lebanon	1.22	1.14	2.86	7.11	0.95	0.65	0.86	1.04
Morocco	5.13	3.24	4.12	3.77	3.26	3.08	2.87	2.71
Oman	0.28	0.27	0.28	0.10	0.14	0.11	0.09	..
Palestine	0.54	0.63	0.88	1.35	0.97	0.73	0.58	0.42
Qatar	0.04	..	0.04	..	..	..	0.00	0.00
Saudi Arabia	0.08	0.03	0.07	0.11	0.11	0.12	0.22	..
Syrian Arab Republic	0.00	0.01	0.01	0.02	..	..	..	..
Sudan	..	0.01	0.03	0.01	0.01	0.01	..	..
Tunisia	3.14	3.86	4.66	6.53	7.38	6.70	5.85	..
United Arab Emirates	2.72	1.95	..	..	..	..	..	..
Yemen	0.05	0.05	0.05	0.04	0.01	0.01	0.01	0.08
World	12.19	11.27	11.97	11.79	10.69	10.55	10.48	10.83

Source: Compiled by ESCWA based on the World Bank database, available from http://data/worldbank.org.

(b) Top-level domains

The indicator on the number of gTLD registrations per thousand population is based on the WHOIS database, which lists all registered domains and is also used worldwide to research registered Internet users, Internet Protocol (IP) address blocks and autonomous systems. This number indicates the dynamics of Internet domain name activity within a given country. Such activity is still weak in most Arab countries. As shown in table 18, only the United Arab Emirates manages a double-digit ratio (11.91 per thousand). Globally, the top 20 countries are at 37 and above, reaching 100 among the top three countries. As for country code top-level domain (ccTLD) registrations, only Bahrain, Qatar and the United Arab Emirates manage rates above 1 per thousand, compared to the top 20 countries which hover above 34 and the top five countries which reach 100.

(c) Leveraging on the emerging sharing economy and data-driven innovation models

The number of Wikipedia edits and YouTube uploads are used to assess economic impact and provide insights into Internet activities that may involve local content creation. Only five countries, all from the GCC and all with small populations apart from Saudi Arabia, show meaningful Internet content creation activity as gauged by these two indicators. Qatar scores best for Wikipedia edits while Saudi Arabia leads in YouTube uploads. The other four countries are not far behind for both indicators and rate substantially better than other Arab countries. Qatar's score of 2,000 Wikipedia edits per million/population compares less favourably with the top 25 countries, the United States reaching 5,150 and Iceland 13,500.[70] Saudi Arabia's rating of almost 35 for YouTube uploads is below the average of 50 among the 20 leading countries which include the United States with a score of 100.

The indicators for Wikipedia and YouTube highlight that Arab countries are still generally content consumers on the Internet despite some good efforts at content creation from some GCC countries.

Policymakers should measure the quality and dynamism of Arab digital talent. Although there are many examples of digital startup activities in some Arab countries driven by young entrepreneurs, they have had little concrete impact. Despite some niche successes, they still have a limited user base compared with global and Asian platforms. Table 20 presents examples of digital platforms from the region alongside global and Asian platforms.

The indicators discussed in this section and previous ones mainly address the enabling environment and include indicators on business and market sophistication. They illustrate the low economic impact of the digital economy in nearly all Arab countries. Despite some laudable creative efforts, Arab countries are predominantly users of ICT technologies, reflected in trade figures, Internet activity, patents and workforce employed in the sector. The optimism of the business community towards the impact of ICT in creating new business and organizational models in some GCC countries is somewhat overstated and should be considered only as opinion; hard data prove that it reflects, at best, good potential that needs to be materialized.

Table 20. Major digital platforms: Middle East, world and Asia

Digital lifestyle	Middle East offering	Users (millions)	Global leaders	Users (millions)	Asian leaders	Users (millions)
Search	-	-	Google	1,400	Baidu	300
Social media	-	-	Facebook	1,712	Tencent	812
Communication	-	-	WhatsApp	1,000	WeChat	1.120
Video	-	-	YouTube	1,000	Youku	500
Music	Anghami	4	Spotify	100	QQ Music	800
E-commerce	Souq.com	6	Amazon.com	304	Alibaba.com	434
Payment	CashU	1	PayPal	179	AliPay	300
Online fashion	Namshi	5	Zalando	18	Zalora	5
Travel and hospitality	-	-	Airbnb	50	Tujia	40
Job market	Bayt	18	LinkedIn	450	Daije.com	32
Transport	Careem	4	Uber	8	Didi Chuxing	250
Education	Skill Academy	8	Coursera	17	-	-
Social commerce	Cobone	3	Groupon	50	Meituan.com	20

Source: Elmasry et al., 2016.

G. Social impact

The last NRI pillar gauges the social impact of the digital economy. This is still a work in progress for this index. Three indicators in the survey of the business community seek opinions on the extent to which ICT has impacted the access to basic services (health, education, financial), improved the quality of government services and is used in schools for learning purposes. In addition to these three survey questions, NRI uses the complementary index of the 2016 United Nations E-Government Survey, namely the E-Participation Index. One can observe that this pillar largely correlates with government usage and, not surprisingly, Arab countries who obtain good scores in the latter receive the same good scores under this pillar, as shown in table 5. This is particularly the case for

Bahrain, Qatar and United Arab Emirates. Saudi Arabia underperforms due to the low opinion of the business community on Internet access in schools and a relatively low E-Participation Index value.

The social impact of digital technologies was extensively discussed during the Arab High-level Forum on the World Summit on the Information Society and 2030 Agenda for Sustainable Development, hosted by ESCWA in Beirut during 8-12 May 2017. Experts confirmed the tremendous role that digital technologies can play in advancing access to education and health, promoting social inclusion, increasing job opportunities, connecting societies and reducing inequalities. The digital transformation of governments can have a positive impact on societies throughout the whole process, including: digitizing information and automating services; transforming procedures and cross-agency collaboration; engaging citizens and actors in decision-making; building trust; and contextualizing with local conditions of communities. The required level of digital government capacity can be achieved through ICT innovation. The transformation towards smart transport sectors in the Arab region and the use of digital technologies, such as cloud computing and IoT, can contribute to achieving related SDGs in transport, health and the environment, including adaptations to climate change. Smart systems can generate huge volumes of data, making the case for big data and analytics, while smart transport solutions reduce fuel consumption and benefit the environment. In the health sector, smart digital technologies can help identify epidemic outbreaks and offer emergency medical services in disaster areas.

The main components of a smart city are people and communities, and its goals are socioeconomic rather than technological. Smart city programmes should be translated into smart applications that address constituents' day-to-day needs. These applications include transport systems, the environment, education and health care. Legislation defining the framework for smart cities should be implemented. As per ESCWA recommendations, there should be collaboration between social and technology divisions on smart cities to ensure benefits for member countries. ICTs are emerging as potentially powerful elements for the social and economic development of youth. Social networks have become tools for changing the behaviours of Arab youth and are contributing to the internalization of social, cultural and family values. They have impact, both positive and negative, on youth behaviours and attitudes. Parents, mentors and schools must protect children online while also encouraging them to benefit from the Internet.

Recent reports confirm a huge digital divide between men and women in many countries of the Arab region despite the position of women being continuously consolidated within society. ICT is a perfect tool to improve the situation of Arab women and consolidate their role in development efforts within their countries. Box 6 shows selected examples of initiatives in the region towards this objective.

Box 6. Empowering women through ICT: selected initiatives from the Arab region

Women Entrepreneurs for a Resilient Future in the Middle East and North Africa (WeMENA) empowers and equips women in the region. Through a business model challenge, WeMENA accelerates innovative solutions that will help eight cities build resilience and better adapt to chronic stresses and shocks. Contestants in this challenge receive business training, guidance from mentors in the United States high-tech hub, Silicon Valley, and beyond, and the chance to compete for a share of $150,000 in cash awards. In 2017, WeMENA covered Alexandria, Amman, Beirut, Byblos, Cairo, Casablanca, Ramallah and Tunis. One of its main pillars is technology and smart cities, where ventures use cutting-edge technology to build more robust services to customers, improve financial inclusion in their communities and help the government improve services delivery to those in need by leveraging data. In 2017, 200 women entrepreneurs applied to take part in the competition, and four projects were selected as winners, namely, Alternative Solutions, Jaleesa, Natakallam and UpFuse.

Women in Technology (WIT) for the Middle East and North Africa (MENA) region was funded by the Middle East Partnership Initiative (MEPI) of the United States Department of State, managed by the Institute of International Education (IIE) West Coast Centre and implemented in collaboration with local partners in nine countries, namely, Bahrain, Iraq, Jordan, Lebanon, Morocco, Oman, Saudi Arabia, United Arab Emirates and Yemen.

WIT is an initiative that aspires to improve women's legal and social status, support educational and spiritual development, and promote social justice, human rights and equality through technology. It works with a diverse range of partner organizations, supporting and complementing their women's empowerment initiatives. The programmes focus on promoting social cohesion and community development through civic engagement. WIT provides women in the region with basic digital literacy, teaching them how to use a computer, browse and work on basic software and programmes. It shows them how to use social media to communicate, how to protect themselves and their children and how to get their voices heard in their communities, especially in rural areas that tend to be more conservative. Since its launch in 2005, WIT has trained more than 11,000 women and built the capacity of nearly 60 women's organizations in the Middle East.

Source: Compiled by ESCWA, based on information available from http://www.we-mena.org/; http://www.witmena.org/; https://www.up-fuse.com; https://www.jaleesa.co; and https://natakallam.com/.

4. Strategies for the Digital Economy at the National and Regional Levels

4. Strategies for the Digital Economy at the National and Regional Levels

Digital strategies play a tremendous role in leveraging ICT for inclusive development and growth in developed and developing countries alike. Traditionally, ICT-related policies tended first to focus on availability and usage and then on the ICT sector, but recent policies have become more horizontal, covering business creation and productivity growth, public administration, employment and education, health and aging, the environment and development. National digital strategies are now cross-sectoral by nature and, in many instances, designed explicitly to boost countries' competitiveness, economic growth and social well-being.

A. The role of digital strategies at the national level

National digital strategies do not appear from a vacuum. They often build on existing strategies related to ICTs, such as for broadband, e-government and cybersecurity. Digital strategies often complement other national strategies, such as those for national innovation or development, which play a central role in building skills, research and development, investment (foreign or domestic) and entrepreneurship.

Political will at the highest level is key for the success of any national digital strategy. It ensures that adequate human and financial resources are allocated to implementing this strategy and that implementation is followed up at the highest levels in a whole-of-government approach. Such a holistic approach ensures that regulatory and enabling environment factors are taken into account at the input side, and that digital economy benefits permeate all socioeconomic endeavours at the output side. Such an approach applies to national strategies involving any new technology for development, particularly in developing and Arab countries, and is not exclusive to digital strategies.

Designing an agenda for the digital economy that will service growth and inclusive well-being is still being refined, even in developed countries. Box 7 illustrates this through the OECD Going Digital initiative.

B. National digital strategy structure

An analysis of national digital strategies from developed and emerging/developing countries has produced an outline of the main purposes of such strategies globally and the main components that should be addressed. In general, these strategies cover both the supply and demand side of the digital economy.

Box 7. OECD's Going Digital initiative

The Going Digital initiative launched by the OECD for 2017-2018 recognizes that even advanced economies are still in transition to a digital economy and society, and that many public policies are a legacy of the analogue era that assumed a physical state and are ill-adapted to the digital era. Likewise, policymakers sometimes lack understanding of the changes under way and seek to tinker with existing policies rather than develop new approaches.

The initiative aims to examine how the digital transformation affects policymaking across many areas, including competition; consumer policy; digital economy policy (privacy, security, infrastructure and economic impact); science, technology and innovation; industry and entrepreneurship; insurance and private pensions; financial markets; fiscal affairs and taxation; statistics; economic policy (monetary, fiscal and structural); education and skills; employment and social affairs; public governance; and trade. It also aims to support countries to establish a whole-of-government approach for navigating the digital transformation. The initiative focuses on three main pillars:

- A framework for understanding the various dimensions of the digital transformation. This describes the key drivers of digital transformation having a wide impact across the economy and society, and affecting many policy areas. A preliminary list of vectors for change has been identified; and they are enabled by mutually reinforcing digital technologies, such as the Internet, digitization, big data analytics, cloud computing, artificial intelligence and physical-digital technologies;
- In-depth analysis of the digital transformation in specific policy areas and across the economy. Specific issues are addressed, such as the impact of the digital transformation on international trade, the development of a digital skills strategy and the implications of digitalization on tax policies;
- Cross-cutting modules and key questions. This third pillar would involve focused research in priority areas to gain insights into the prominent questions that policymakers face in the digital era. Many of these issues intersect with more than one policy area. A preliminary list includes jobs and skills in the digital economy; the implications of the digital transformation on competition and market structure; measuring the digital transformation; making the digital transformation work for society and well-being; and the implications of digital technologies on policy design, implementation and reform.

Source: OECD, 2017a.

At the supply side, they should seek to further develop telecommunications infrastructure (access to broadband and telecommunication services, for example) and preserve the open Internet; and promote the ICT sector, including its internationalization.

At the demand side, these strategies are expected to strengthen e-government services, including enhanced access to public sector information and data (open government data); strengthen trust (digital identities, privacy and security); encourage the adoption of ICTs by businesses, and small and medium-sized enterprises in particular, with a focus on key sectors such as health care, transport and education; advance e-inclusion, with a focus on the ageing population and disadvantaged social groups; promote ICT-related skills and competencies, including basic and specialist skills; and tackle global challenges such as Internet governance, climate change and development co-operation. The first two items aim to ensure a quality broadband infrastructure

for better access to the Internet at an affordable price for all, and to promote development of digital technologies and the ICT-sector industry.

The remaining items aim to develop the demand side. They relate more to digital services, triggering demand for network roll-out and eventually more impact on the economy.

1. Components of the supply side

On the supply side of the digital economy, national digital agendas should focus on its two main elements, the ICT sector and ICT infrastructure.

(a) Promote the ICT sector. The first supply-side objective in all national digital strategies is increased support for the ICT sector, typically in the areas of research and development; promotion of standards; venture capital investments; foreign direct investment; and export of ICT goods and services;

Box 8 offers examples of governments promoting the ICT sector in their digital agendas.

(b) All national digital strategies should include pillars to improve ICT infrastructure and broadband capacity. This is done by developing national telecommunication infrastructure and services. Typical objectives could include increase broadband capacity and speed; increase broadband coverage to better connect remote areas; and improve the resilience of existing broadband infrastructure. Other strategies add further objectives, which include expand mobile broadband and allocate spectrum efficiently; and explore new technologies constantly.

The overall objective of Sweden's national digital strategy, ICT for Everyone, is to achieve world-class broadband by 2020, with access guaranteed for 90 per cent of all households and businesses at a minimum speed of 100 megabits per second (Mbps). To reach this target, the Swedish Government plans to establish good market conditions and eliminate obstacles to development. This includes the adoption of relevant regulation.

2. Components of the demand side

On the demand side of the digital economy, national digital agendas should focus on the following components:

(a) Open data, open government and e-government. Today's national digital strategies recognize that governments can act as catalyst for the digital economy. This is obvious in all open data initiatives, where the public sector can stimulate data-driven innovation by opening up public sector information and data. E-government initiatives are also used to stimulate the adoption of a range of applications needed for e-health and e-commerce. A major trend in national strategies is the effort to promote trust in the digital economy by establishing digital identities for all citizens, and electronic document verification systems, including e-billing systems;

Box 8. Promoting the ICT sector in selected digital agendas

- Poland's strategy for innovation and economic efficiency, Dynamic Poland 2020, aims to promote the international expansion of the ICT sector, with a focus on outsourcing related activities;
- Hungary's national info-communications strategy cites investments to promote the digital economy, including through the development of information and communications technology (ICT) services eligible for export;
- Plan France numérique emphasizes the importance of attracting foreign direct investment;
- Luxembourg's Digital Lëtzebuerg aims to maintain a positive environment for existing ICT companies while attracting new digital businesses;
- Digital Agenda for Europe promotes interoperability and standards across European Union member countries to ensure that new IT devices, applications, data repositories and services interact seamlessly anywhere;
- The Business Development Bank of Canada is due to make investments worth 300 million Canadian dollars in ICT companies, according to Digital Canada 150. The strategy also anticipates funding to the Canada Accelerator and Incubator Programme to support digital entrepreneurs, and 15 million Canadian dollars annually to internships in small and medium-sized enterprises;
- Japan's national digital strategy aims to support the development of internationally cutting-edge network technologies, in particular ultra-high-speed network transmission technologies; data processing and analysis technologies, including pattern recognition technologies; device, sensor and robotics technologies; software development and non-destructive testing; and highly developed multilingual speech translation systems;
- Egypt's national digital strategy aims to attract investments to expand existing ICT companies and generate job opportunities.

Source: ESCWA.

Digital identity is a key component of Italy's Strategy for the Digital Agenda 2014-2020, with the Government spending 50 million euros to guarantee safe and secure access to digital services provided by public administration and private entities for all citizens and businesses, while ensuring a high degree of usability with mobile devices.

In the United Kingdom, the Information Economy Strategy anticipates the Government to work closely with industry, privacy advocates and consumer groups to develop an Identity Assurance solution for Government services that leverages existing capabilities and sets informed industry standards.

(b) Trust, digital privacy and security. Although protecting privacy features prominently in many national digital strategies, this is not reflected in budget allocations. This may be linked to the persistent perception that privacy is a legal matter under the purview of specialized enforcement authorities rather than a strategic horizontal objective. Measures linked to cybersecurity appear frequently in national digital economy strategies, including references to research and development support measures. Cybersecurity measures may include public information on cyberrisk and measures to combat cybercrime;

Australia's national digital strategy, for instance, describes several actions to address digital security concerns, including the development of a national plan to combat cybercrime and the release of digital citizenship best practice principles.

(c) ICT adoption in education, health care and transport. Many national digital strategies aim to promote adoption of digital technologies and the Internet in these key sectors of society. Promoting ICT adoption in education ranks high among national digital strategies, with one frequently stated aim being to capitalize on the digital revolution to improve the effectiveness of the education system and ensure the development of basic and advanced ICT skills. Measures range from a focus on infrastructure (better connecting education institutions, for example) to promoting ICT-related curricula, teacher training and online learning environments (massive open online course, for example);

Australia's national digital economy strategy aims to provide schools, registered training organizations, universities and higher education institutions with the connectivity to develop and collaborate on innovative and flexible educational services, the resources to extend online learning to the home and workplace, and the facilities to offer students and other learners the opportunity for online virtual learning.

E-health care is another prominent area in many national digital strategies. As with education, some measures focus on ensuring high-quality broadband connectivity across the health-care system. But in most cases, measures aim to further develop telemedicine or the use of electronic medical health-care records. Italy's Strategy for the Digital Agenda 2014-2020, for example, has allotted investments worth 750 million euros to improve the cost-quality ratio of health-related services by reducing waste and inefficiency. Measures include electronic health records for all citizens, electronic pharmaceutical prescriptions and online booking, with a view to optimizing health-related resources and reducing waiting times.

(d) E-inclusion: ICT adoption by households. The promotion of ICT adoption by households and individuals aims to advance social policy objectives, such as e-inclusion. This objective still requires ICT supply-side policies, such as expanding broadband access to underserved areas, especially those homes for disadvantaged social groups. However, supply-side measures are often supplemented by initiatives to increase the level of digital literacy and raise awareness about risks and opportunities online.

3. Other components of national digital agendas

(a) Digital skills and jobs. All national digital strategies recognize that improving skills and competencies is a means to further e-inclusion. Key actions identified by the Digital Agenda for Europe to further e-inclusion relate to developing skills and competences essential for the digital economy. Action 10 proposes "digital literacy and competences as a priority for the European Social Fund regulation (2014-2020)". Other measures include "promoting a higher participation of young women and

women returners in the ICT workforce through support for web-based training resources, game based eLearning and social networking";

(b) ICTs and global challenges. Few national digital strategies have an international dimension. Among those that do, key issues are Internet governance, climate change and development cooperation. Germany has called for multi-stakeholder engagement around issues addressed in the Digital Agenda 2014-2017 and active involvement in international policy debates held at ITU, the Internet Governance Forum and OECD. Germany's agenda also addresses development cooperation issues, such as the need for 'cybercapacity-building' and 'cybersecurity capacity-building' in developing countries. It also calls for the Government to consider the potential of digital technologies in Germany's Africa strategy.

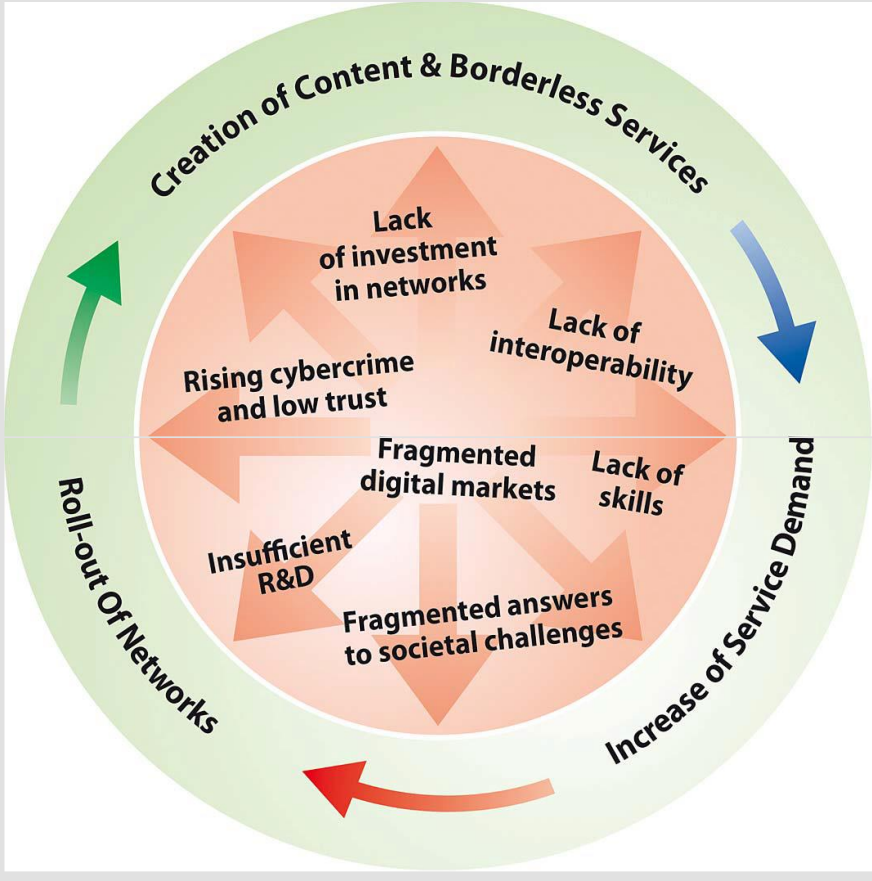
C. The role of digital strategies at the regional level

A digital agenda at regional level will help the business sector and population in general to get the most out of digital technologies and their Internet use. The Digital Agenda for Europe, launched in 2010, is one of seven initiatives of the European Union 2020 strategy for smart, sustainable and inclusive growth. The strategy aims to address seven factors identified as hindering a virtuous circle of the digital economy (presented in box 9) in the world's largest developed region.

In the absence of an Arab regional strategy, we focus on a good example in the field, namely the Digital Agenda for Europe, which has the following priority areas:

- Building a vibrant single digital market by making online and cross-border transactions straightforward, building digital confidence, reinforcing the single market for telecommunications services, and opening up access to content;
- Ensuring effective interoperability and improving and upholding standards;
- Ensuring trust and security in the digital world through legislation to ensure a reinforced and high-level network and information security policy to combat cyberattacks against information systems, along with specific measures allowing faster reactions to cyberattacks. This also can be reinforced through close cooperation with stakeholders to strengthen global risk management in the digital and physical sphere and conduct internationally coordinated actions against computer-based crime and security attacks;
- Promoting fast and ultra-fast Internet access through universal broadband coverage with increasing speeds, developing Next Generation Access networks through fibre optics, and an open and neutral Internet;

Box 9. The virtuous circle of the digital economy as presented in the Digital Agenda for Europe



Source: European Commission, 2010.

- Investing more in research and development by intensifying efforts and efficiency, driving ICT innovation by exploiting the single market, and leveraging industry-led initiatives for open innovation;
- Enhancing digital skills and literacy and inclusive digital services;
- Spreading ICT-enabled society for European Union. This includes leveraging ICT for the environment, developing sustainable health care and ICT-based support for dignified and independent living, promoting cultural diversity and creative content, developing e-government services and intelligent transport systems for efficient travel and better mobility.

The European Union's Digital Agenda is a good example of concerted regional effort among economically integrated countries. The Agenda is a good framework to leverage the benefits of the digital economy at regional level and could

be a great example for other regions (or subregions) to follow, including the Arab region, after due adaption to the local situation and specific priorities for development. Among the key issues it addresses is the creation of a digital single market (of more than 500 million inhabitants) and pooling resources among developed and technologically advanced countries. Amid global competition, no single country, not even a European one, can make it alone in this highly capital- and knowledge-intensive sector. Arab countries should reflect on this lesson.

D. Selected digital strategies from the Arab region

Arab countries were among the first to acknowledge the importance of developing national and regional strategies to build an information society linked to socioeconomic development and attaining the SDGs. Many Arab countries have prepared and/or updated their national strategies. These digital strategies will help Arab governments leverage the digital economy transformation to address, for example, unemployed youth, stagnant growth and, for some, political instability and conflict, and return them to the path of inclusive and sustainable economic growth.

1. National strategies

The following are examples of digital/development strategies in Arab countries.

Jordan's digital economy action plan REACH2025 was launched in 2016.[71] The initiative is based on Jordan's strengths and opportunities to make the country relevant in the global digital economy. Its vision is to build a digital economy that empowers people, sectors and businesses to raise productivity and ensure growth and prosperity, creating an attractive business destination for investments and international partnerships. With its action plan, Jordan seeks to streamline the digital transformation across the country's entire economy, moving away from seeing ICT as an isolated sector towards digitizing the economy with emphasis on niche markets and global value chains. The core elements of the plan include smart specialization and growth; public sector innovation; startups and entrepreneurship; skills, capacity and talent; an enabling business environment; and smart digital economy infrastructure. REACH2025 aims to accelerate GDP growth by an additional 3-4 per cent, adding up to 150,000 jobs and establishing as many as 7,000 new businesses in the digital economy.

In 2010, the United Arab Emirates launched its Vision 2021, which has eight main sectoral themes.[72] One of these, namely, 'united in knowledge', stresses the importance of innovation, research, science and technology in productive and competitive knowledge-based economies, and in developing the ICT sector and communications infrastructure. In line with this vision, the United Arab Emirates has also prepared a 2021 strategy for the ICT sector to achieve the following:

- Promote connectivity for rapid economic growth and massive industrialization;

- Increase social awareness, and a sense of duties and responsibilities;
- Institutionalize qualitative life in the country;
- Strengthen the national drive of women's empowerment;
- Protect basic human rights.

In 2013, Bahrain completed its Vision 2030, which is an integrated economic vision that covers all sectors and is based on the principles of sustainability, competitiveness and justice.[73] The vision includes the ICT and science, technology and innovation (STI) sectors, and is consistent with the SDGs on industry, innovation and basic structures, and with partnerships to achieve the goals. In line with this vision, Bahrain's digital strategy focuses on several pillars that promote the digital economy, including the following: better society participation and engagement; increased business-sector ICT and small and medium-sized enterprise readiness; improved national e-literacy and government IT skills; improved levels of data protection; improved efficiency of government and its performance; improved quality of services and their management through enhanced e-government channels and user participation; and better innovation and entrepreneurship.

In Egypt, the ICT 2030 Strategy includes several initiatives to strengthen the sector's contribution to economic growth.[74] By developing the sector and its industries, Egypt seeks to establish a digital economy that provides wide access to information and digital rights for citizens, and promotes national, competitive and creative industries. The strategy includes subaction plans on cloud computing and Arabic digital content. Egypt has also developed the National ICT Strategy 2012-2017: Towards a Digital Society and Knowledge-based Society, and a sustainable development strategy under Vision 2030, covering economic and knowledge development, innovation and scientific research. Egypt's ICT 2030 Strategy focuses on three main pillars, namely, transforming Egypt into a digital society, developing the ICT industry and establishing Egypt as a global digital hub.

The Moroccan Government has prepared Digital Morocco 2020 to support technology innovation and renewal. The strategy focuses on human capital and digital trust, and supplants the Digital Morocco 2013 strategy that covered various economic and social issues, such as the IT industry. The Government has also developed a scientific and technology research strategy.

According to the requirements of its Vision 2030, Saudi Arabia has listed various digital initiatives in its National Transformation Programme 2020,[75] including efforts to improve the efficiency and effectiveness of the health-care sector using information technology and digital transformation and establish emerging technology companies with added value to contribute to the increase of local content.

The Digital Oman Strategy (eOman) focuses on six main pillars, namely, society and human capital development; enhanced e-government and e-services; ICT industry development; standards and regulations; enhanced national infrastructure; and promoting awareness.

Box 10. Targets of the Qatar e-Government 2020 strategy

Qatar e-Government 2020 Targets		
Better serve individuals and business	**Create efficiency in government administration**	**Increase government openness**
100 per cent of government services are available online by 2020	80 per cent adoption of government shared services	20 per cent increase per annum in users participating in forums moderated by government
80 per cent of all services are available "end-to-end" online	80 per cent adoption of shared infrastructure	10 per cent increase per annum in availability of government data sets
80 per cent of all transactions are conducted online		

Source: http://portal.www.gov.qa/wps/oortal/about-hukoomi/integrated-e-government.

Qatar's e-Government 2020 strategy focuses on three main pillars, namely, to better serve individuals and businesses; create efficiency in government administration; and develop a more open government with enhanced participation of citizens and residents. The targets of the strategy are summarized in box 10.[76]

2. Regional plans

Regional and international developments on the information society in the past decade, especially the outcomes of the World Summit on the Information Society that gave additional impetus to the ICT sector, called for an Arab ICT strategy for the period 2007-2012 under the auspices of the League of Arab States. The strategy aimed to create a competitive market for the Arab information society as an integral part of the global information society, improving the quality of the ICT-based services for Arab citizens and developing an ICT-based industry to create new jobs and prepare the entry of goods and services from this industry to world markets. The strategy focused on promoting interaction between all stakeholders to use ICT in the sustainable development process. Undoubtedly, the strategy was pioneering in creating markets and developing industry, as outlined in its first and second strategic goals. It is, however, difficult to conduct studies revealing qualitative successes in this field, as acknowledged by ESCWA and the League of Arab States and indicated by published data and statistics. ESCWA is supporting the League of Arab States to update the strategy.

In 2005, ESCWA developed a Regional Plan of Action for Building the Information Society. The main objectives of the plan were to build a sustainable and inclusive information society in the region, in line with the World Summit on the Information Society Geneva Plan of Action; propose a comprehensive strategic framework; foster partnerships and propose a modality for implementation; and achieve the development goals.

ESCWA is working on the design and production of two new strategic frameworks, the Arab Digital Agenda and the Arab Roadmap on Internet Governance, which will result in new or updated national strategies and action plans, and programmes to assist Arab countries transition towards a digital economy and achieve the SDGs. ESCWA will continue to support member governments leverage the opportunities of the digital and Internet economy by enhancing the capacities of policymakers to narrow ICT and Internet policies, reduce barriers to ICT and Internet adoption, and promote ICT use, particularly the Internet, to accelerate socioeconomic development and progress towards the SDGs.

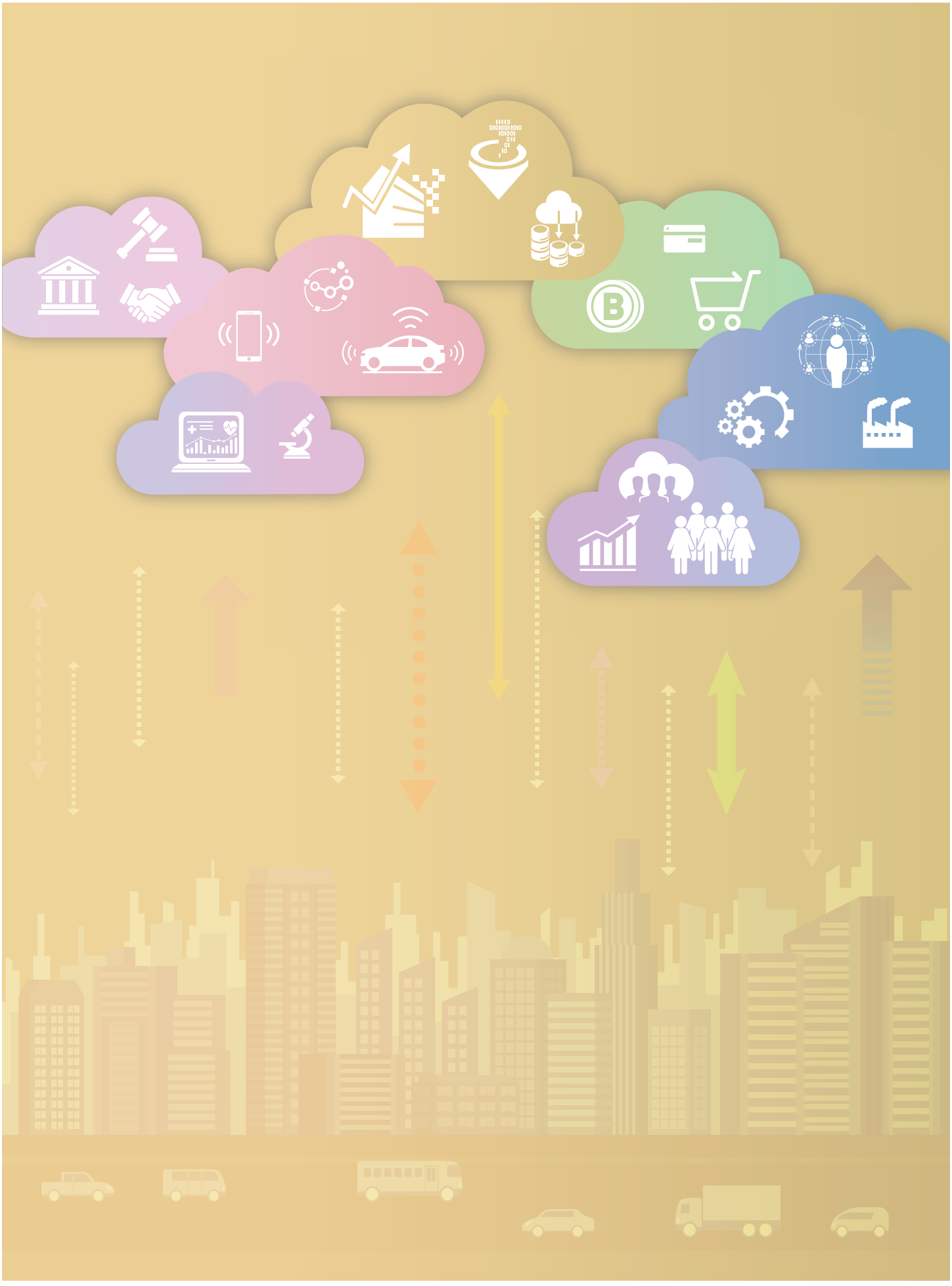
ESCWA is planning to review the Regional Plan of Action and the ICT strategy 2007-2012 as it seeks to harness the potential of ICT and the digital and Internet economy to promote the achievement of the SDGs and meet the related challenges in the Arab region that emerged from the Post-2015 Development Agenda.

The new Arab Digital Agenda will be the reference framework for the regional integration of ICT, the Internet and the digital economy. It will support member States in developing their digital plans to help realize the post-2015 development goals.

The Arab Roadmap on Internet Governance will provide decision and policymakers from all stakeholders in the region with a strategic framework and priorities/objectives that are customized for the Arab region in the fields of information society, the ICT sector and Internet governance.

These frameworks will help policymakers identify the regional/national priorities and develop their national digital agendas.

5. Recommendations



5. Recommendations

These recommendations take into consideration international best practices and the specificities of the region. Variations among the Arab countries mean that applying these recommendations to a GCC country will differ from how they are applied in a non-oil country or a country in transition. Arab countries are at varying levels of maturity and readiness for the digital economy. The differentiation between these subregional groups is not part of this study; the main goal of the recommendations is to provide a general blueprint for actions to accelerate the growth of the region's digital economy, upon which detailed action plans can be customized for the national or subregional level.

The main target groups of these recommendations are policymakers, mainly in governments, and other actors working in policy advocacy or analysis. Some of the recommendations are related to institutions and experts working on measurements.

The recommendations are grouped into two major sections: the first is related to thematic policy issues, the second to measurement.

A. Recommendations related to thematic policy issues

1. **Devise digital agendas at national and regional levels to promote the digital economy in the Arab region**. At national level, the structure and architecture of the digital economy and its components need to be compatible with country needs and its level of infrastructure and digital maturity. A national agenda for the digital economy must focus on the local attributes of the wider economy and society rather than those of other countries; policymakers must resist the temptation to imitate the experiences of other countries. Digital agendas should also focus on promoting gender equality in access to resources, capacity-building and literacy, and other projects that empower individuals in the digital economy. Digital agendas should focus on keeping pace with modern technology developments, such as the Internet of things, cloud computing, big data, digital signature, digital money and digital authentication.
2. **Involve the private sector in the transition towards digital economy**. Advancing towards the digital economy must be designed by public policymakers but part of it must be implemented by the private sector. This can take a public-private partnership approach or an ordinary free market model, according to a proper and suitable economic governance structure.
3. **Improve fixed high-speed broadband access technologies to provide a quality experience for users**. Beyond penetration rates, quality of access is of extreme

importance for the digital economy. Quality relates to speed of Internet access and download volumes. Due to bad quality infrastructure (copper in the case of digital subscriber lines) and limited investment in advanced technologies, such as fibre optics, fixed broadband speed and bundles offered for download volumes are limited in many Arab countries. These constraints heavily limit the applications enjoyed by Arab Internet end-users and, therefore, the potential of the digital economy; video streaming or high-definition TV over the Internet, for instance, are practically impossible in most Arab countries.

4. **Open avenues to develop new digital economy markets involving, for instance, 'triple-play' bundles of broadband/telephony/television offers**. Such markets are non-existent or, at best, nascent in many Arab countries, thereby limiting competition and allowing established operators to benefit from comfortable situations with little incentive to develop networks. Opening new markets cannot be achieved without increasing investments in advanced fixed broadband infrastructure and instigating competitive market structures that will not only provide benefits for end-users but ignite necessary core network convergence.
5. **Improve access to credit and venture capital by young and innovative entrepreneurs – both women and men – in the ICT sector**. The key problem in the Arab region is not the availability of funds; this should rarely be an issue in high-income GCC countries and many non-GCC countries with significant private capital. The problem lies in risk aversion and reluctance to take equity in young, 'non-connected' firms. This problem can be addressed only by providing public incentives and guarantees to holders of financial assets to invest in risky digital start-ups. Some Arab countries have embarked on such an approach,[77] but more can be done.
6. **Improve research and development expenditure in ICT by all stakeholders, particularly the business sector**. Arab countries willing to develop their ICT sector and enhance its role in business and, therefore, in the digital economy, need to set quantitative targets, with associated support measures and monitoring of global research and development expenditure in ICTs (global and business expenditures on research and development).
7. **Bolster patent protection and effective competition law, which are needed to protect and reward inventors and to avoid abuse of monopoly situations**. The digital economy is characterized by low intrinsic barriers but might easily result in dominant positions by successful platforms (Airbnb, Amazon, Facebook, Google and Uber, for example). The essential problem lies not in the dominant position of a given platform at a given point in time but in ensuring the capability of potential newcomers with better ideas to challenge it, and avoiding situations where a dominant platform can abuse its monopoly by extending benefits to other areas. In Arab countries, patent filing is still negligible, and few successful digital platforms have emerged, but the quality of their patenting protection (and activity level, particularly by

residents) and an effective competition environment must be closely monitored if countries want to develop digital champions in the future, particularly in areas filled with strong and well-connected players.

8. **Mobilize concrete political will, to deploy smart policies through smart governments, smart cities and smart citizens and to improve e-participation, aiming at improving public service delivery and combating corruption**. Most Arab governments have made efforts to improve their online services. However, apart from the small-population and high-income United Arab Emirates and Bahrain, none has achieved a very high level of service delivery that qualifies their governments to be 'smart'. Countries with fewer resources and those confronted by dire social, economic and sometimes conflict situations, face enormous challenges towards becoming smart and overcoming corruption and lack of transparency. The Arab region is no exception. Hence, the political will is paramount in this policy domain. Improving e-participation by empowering smart citizens is crucial. Only then can they make effective use of online services and actively participate, providing feedback and suggestions to improve established services and define new ones to better meet their needs.
9. **Promote and expand basic and smart e-government programmes, eventually aiming for smart cities, smart homes, smart governments and smart citizens**. Smart services play an important role in a myriad of vital daily services, including water distribution, sewage collection, public transport, electricity and telecommunications, schools and health infrastructure (smart water networks, smart transport, smart power grids and smart street lights). Also, cities are the best environment to apply IoT technologies that can lead to better and smarter services. It is important to seek quick wins, which require the collaboration and integration of all stakeholders (the Arab Forum of e-Government Directors should be promoted and supported). Quick wins that leverage existing (and not necessarily expensive) technologies in association with simple behaviour change can be sought by Arab cities to develop important, high-impact areas. It is essential to establish unique national identifying numbers in each of the Arab countries, for vehicles, the address system, and land and company identification.
10. **Set up proper capacity-building and change management plans, which are as important as adopting technology and related technical implementations**. Any smart city transformation programme cannot succeed without associated capacity-building for senior city officials, employees and citizens, including youth, women, the elderly and students, all of whom should contribute to change: city officials through visible leadership to support the smart-city strategy, employees to implement it and citizens and businesses to develop digital skills. Changes to management are also required as it is never easy to adapt to a new way of living, especially in communities where there is a wide digital divide, including a digital gender gap. Capacity-building/changed management should,

therefore, be associated within a consistent framework addressing skills, supporting processes, an enabling environment, institutional structure and stakeholder awareness. All are needed to support a smart city transformation programme and related technical initiatives.

11. **Put forward national strategies and laws to protect human and data privacy**. The lack of such protection will discourage people from utilizing digital economy services. Data breaching and the perception of data breaches need to be addressed as well.
12. **Devise policies and prepare plans and initiatives to empower women**. It is essential to consider gender dimensions in national plans, including disseminating the benefits and opportunities of digital services and increasing the number of women in the ICT sector, both in high-tech start-ups and small and medium-sized enterprises, and improve their representation at managerial or senior levels in technology sectors.

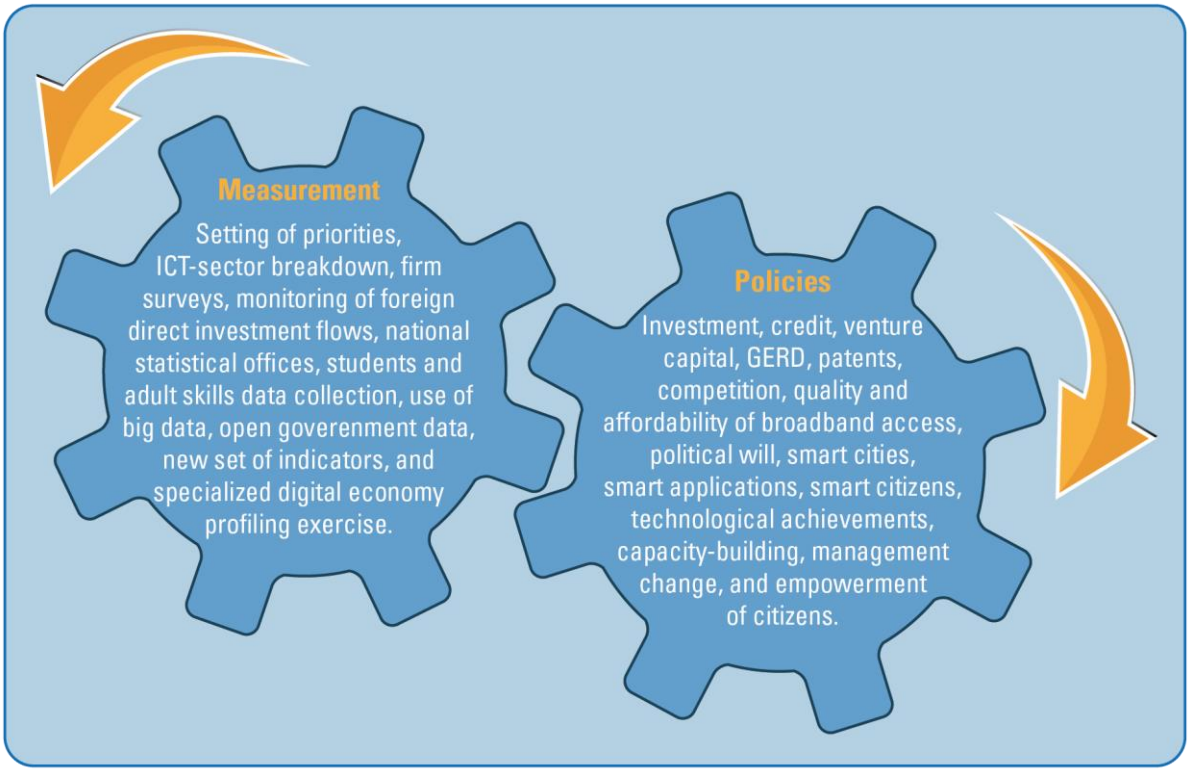
B. Recommendations related to measurement issues

1. **Develop detailed digital economy statistics upon which policy priorities and targets will be based**. A detailed breakdown of the sector's value added between its major components (telecom services, ICT manufacturing, IT services and software) and jobs by qualification level (inside as well as outside the ICT sector) from developed countries would be necessary.
2. **Improve the collection of sex-disaggregated data**. Fully understanding the impact of the digital economy on men and women can improve the process of policy development and decision-making. It will also bring focus to the gender divide in the Arab region and its impact on the digital economy, and inform plans and recommendations towards achieving gender equality.
3. **Generalize business surveys to gauge the level of ICT adoption and use in order to devise industrial policy that leverages ICT for growth**. Surveys can include broadband access, presence and activities on the Internet (website and commerce in both its business-to-consumer and business-to-business variants) and adoption of customer relations and/or supply-chain management systems, and ICT investments at large.
4. **Closely monitor FDI flows quantitatively and qualitatively, and gear them towards areas that result in technology transfer**. The experience of developing countries, mainly Asian countries that have achieved technological catch-up with developed countries, shows that channelling FDI flows towards sectors identified as national priorities with associated technology transfer was an important factor behind their success.
5. **Improve the efforts of national statistical offices in Arab countries to measure Internet usage patterns by individuals and by sex**. Measuring use should include expenditure on ICT goods and services. This is an important measure that helps evaluate the digital economy's impact

on overall expenditure patterns of individuals and households.

6. **Improve data collection on student and adult skills and those of ICT specialists (all disaggregated by sex)**. Arab country participation in the PISA tests is a step in the right direction, but more Arab countries should participate in the future and exploit the rich data they generate to address shortcomings and improve the quality of their education systems. Gaining knowledge of adult skills through the PIAAC tests might be a more complex endeavour for Arab countries as none currently are taking part. Simpler statistical surveys might be a useful and less complex stop-gap measure to obtain, in particular, ICT specialist numbers by sex, industry and specialties.
7. **Improve the collection and analysis of big data and open data**. Big data and open data can provide information on population subgroups, differentiating between men and women, youth and the elderly, youth and adults, and people with disabilities. This allows for a more detailed understanding of the digital economy, leading to the tailoring of services and products, and greater inclusiveness, social well-being and economic growth.

Figure 24. Recommendations to overcome digital economy policy and measurement challenges in the Arab region



Source: ESCWA.

Annex 1. The Networked Readiness Index composition

1st pillar: Political and regulatory environment

1.01 Effectiveness of law-making bodies*
1.02 Laws relating to ICTs*
1.03 Judicial independence*
1.04 Efficiency of legal system in settling disputes*
1.05 Efficiency of legal system in challenging regulations*
1.06 Intellectual property protection*
1.07 Software piracy rate (per cent software installed)
1.08 Number of procedures to enforce a contract
1.09 Number of days to enforce a contract

2nd pillar: Business and innovation environment

2.01 Availability of latest technologies
2.02 Venture capital availability*
2.03 Total tax rate (per cent profits)
2.04 Number of days to start a business
2.05 Number of procedures to start a business
2.06 Intensity of local competition*
2.07 Tertiary education gross enrolment rate (per cent)
2.08 Quality of management schools*
2.09 Government procurement of advanced technologies*

3rd pillar: Infrastructure

3.01 Electricity production (kWh/capita)
3.02 Mobile network coverage (per cent population)
3.03 International Internet bandwidth (kb/s per user)
3.04 Secure Internet servers/million population

4th pillar: Affordability

4.01 Prepaid mobile cellular tariffs (PPP $/min)
4.02 Fixed broadband Internet tariffs (PPP $/month)
4.03 Internet and telephony competition, 0-2 (best)

5th pillar: Skills

5.01 Quality of education system*
5.02 Quality of math and science education*
5.03 Secondary education gross enrolment rate (per cent)
5.04 Adult literacy rate (per cent)

6th pillar: Individual usage

6.01 Mobile phone subscriptions/100 population
6.02 Individuals using Internet (per cent)
6.03 Households with personal computer (per cent)
6.04 Households with Internet access (per cent)
6.05 Fixed broadband Internet subscriptions/100 population
6.06 Mobile broadband subscriptions/100 population
6.07 Use of virtual social networks*

7th pillar: Business usage

7.01 Firm-level technology absorption*
7.02 Capacity for innovation*
7.03 PCT patents (applications/million population)
7.04 ICT use for business-to-business transactions*
7.05 Business-to-consumer Internet use*
7.06 Extent of staff training*

8th pillar: Government usage

8.01 Importance of ICTs to government vision*
8.02 Government Online Service Index, 0-1 (best)
8.03 Government success in ICT promotion*

9th pillar: Economic impacts

9.01 Impact of ICTs on business models*
9.02 ICT PCT patents (applications/million population)
9.03 Impact of ICTs on organizational models*
9.04 Knowledge-intensive jobs (per cent workforce)

10th pillar: Social impacts

10.01 Impact of ICTs on access to basic services*
10.02 Internet access in schools*
10.03 ICT use and government efficiency*
10.04 E-Participation Index, 0-1 (best)

Source: World Economic Forum, 2016.
* World Economic Forum Executive Opinion Survey indicator.

Annex 2. The Global Innovation Index composition

1. Institutions

1.1 Political environment

1.1.1 Political stability*

1.1.2 Government effectiveness*

1.2 Regulatory environment

1.2.1 Regulatory quality*

1.2.2 Rule of law*

1.2.3 Cost of redundancy dismissal, salary weeks

1.3 Business environment

1.3.1 Ease of starting a business*

1.3.2 Ease of resolving insolvency*

1.3.3 Ease of paying taxes*

2. Human capital and research

2.1 Education

2.1.1 Expenditure on education, per cent GDP

2.1.2 Government expenditure on education/pupil, secondary

2.1.3 School life expectancy, years

2.1.4 PISA scales in reading, math and science

2.1.5 Pupil-teacher ratio, secondary

2.2 Tertiary education

2.2.1 Tertiary enrolment, per cent gross

2.2.2 Graduates in science and engineering, per cent

2.2.3 Tertiary inbound mobility, per cent

2.3 Research and development (R & D)

2.3.1 Researchers, FTE/Million pop

2.3.2 Gross expenditure on R&D, per cent GDP

2.3.3 Global R&D companies, average expenditure, Top 3, mn US$

2.3.4 QS university ranking, average score top 3*

3 Infrastructure

3.1 Information and communication technologies (ICTs)

3.1.1 ICT access*

3.1.2 ICT use*

3.1.3 Government's online service*

3.1.4 E-participation*

3.2 General infrastructure

3.2.1 Electricity output, kWh/cap

3.2.2 Logistics performance*

3.2.3 Gross capital formation, per cent GDP

3.3 Ecological sustainability

3.3.1 GDP/unit of energy use, 2005 PPP$/kg oil equivalent

3.3.2 Environmental performance*

3.3.3 ISO 14001 environnemental certificates/billion PPP and GDP

4 Market sophistication

4.1 Credit

4.1.1 Ease of getting credit*

4.1.2 Domestic credit to private sector, per cent GDP

4.1.3 Microfinance gross loans, per cent GDP

4.2 Investment

4.2.1 Ease of protecting investors*

4.2.2 Market capitalization, per cent GDP

4.2.3 Total value of stocks traded, per cent GDP

4.2.4 Venture capital deals/trillion PPP$ GDP

4.3 Trade and competition

4.3.1 Applied tariff rate, weighted mean, per cent

4.3.2 Intensity of local competition†

4.3.3 Domestic market scale, bn PPP$

5 Business sophistication

5.1 Knowledge workers

5.1.1 Knowledge-intensive employment, per cent

5.1.2 Firms offering formal training, per cent firms

5.1.3 GERD performed by business, per cent GDP

5.1.4 GERD financed by business, per cent

5.1.5 Females employed with advanced degrees, per cent total employment

5.2 Innovation linkages

5.2.1 University/industry research collaboration†
5.2.2 State of cluster development†
5.2.3 GERD financed by abroad, per cent
5.2.4 JV-strategic alliance deals/trillion PPP$ GDP
5.2.5 Patent families filed in 3+ offices/billion PPP$ GDP

5.3 Knowledge absorption

5.3.1 Royalty and license fees payments, per cent total trade
5.3.2 High-tech imports less re-imports, per cent
5.3.3 Communications, computer and information services imports, per cent total trade
5.3.4 FDI net inflows, per cent GDP
5.3.5 Research talent, per cent in business enterprises

6 Knowledge and technology outputs

6.1 Knowledge creation

6.1.1 Domestic residents patent applications/billion PPP$ GDP
6.1.2 PCT residents patent applications/billion PPP$ GDP
6.1.3 Domestic residents utility model applications/billion PPP$ GDP
6.1.4 Scientific and technical articles/billion PPP$ GDP
6.1.5 Citable documents H index*

6.2 Knowledge impact

6.2.1 Growth rate of PPP$ GDP/worker, per cent
6.2.2 New businesses/thousand population 15-64
6.2.3 Computer software spending, per cent GDP
6.2.4 ISO 9001 quality certificates/billion PPP$ GDP
6.2.5 High- and medium-high-tech manufactures, per cent

6.3 Knowledge diffusion

6.3.1 Royalty and license fees receipts, per cent total trade
6.3.2 High-tech exports less re-exports, per cent
6.3.3 Communications, computer and information services exports, per cent total trade
6.3.4 FDI net outflows, per cent GDP

7 Creative outputs

7.1 Intangible assets

7.1.1 Domestic residents trademark applications/billion PPP$ GDP
7.1.2 Madrid trademark applications/billion PPP$ GDP
7.1.3 ICTs and business model creation†
7.1.4 ICTs and organizational model creation†

7.2 Creative goods and services

7.2.1 Cultural and creative services exports, per cent total trade

7.2.2 National feature films/million population 15-69

7.2.3 Global entertainment and media output/thousand population 15-69*

7.2.4 Printing and publishing manufactures, per cent

7.2.5 Creative goods exports, per cent

7.3 Online creativity

7.3.1 Generic TLDs/thousand population 15-69

7.3.2 Country-code TLDs/thousand population 15-69

7.3.3 Wikipedia monthly edits/million population 15-69

7.3.4 Video uploads on YouTube/population 15-69

Source: European Institute for Business Administration, 2016.

* Composite index indicator.

† Opinion survey indicator.

Bibliography

Benni, Enrico, and others (2016). Digital Middle East: Transforming the region into a leading digital economy. *McKinsey&Company*. Available from https://www.mckinsey.com/global-themes/middle-east-and-africa/digital-middle-east-transforming-the-region-into-a-leading-digital-economy.

Communications and Information Technology Commission of Saudi Arabia (2015a). *ICT Report: ICT Investments in the Kingdom of Saudi Arabia*. Riyadh. Available from http://www.citc.gov.sa/en/reportsandstudies/Reports/Documents/ICTInvestments_EN.pdf.

_____ (2015b). *ICT Report: ICT Workforce in the Kingdom of Saudi Arabia*. Riyadh. Available from http://www.citc.gov.sa/en/reportsandstudies/Reports/Documents/ICTWorkforce_en.pdf.

Cornell University, European Institute for Business Administration and World Intellectual Property Organization (2016). *The Global Innovation Index 2016: Winning with Global Innovation*. Ithaca, Fontainebleau and Geneva. Available from https://www.globalinnovationindex.org/gii-2016-report.

Elmasry, Tarek, and others (2016). Digital Middle East: Transforming the Region into a Leading Digital Economy. New York: McKinsey Global Institute.

European Commission (2010). *A Digital Agenda for Europe*. Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. Brussels. Available from http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52010DC0245R(01)&from=EN.

_____ (2015). *The Predict Report: An analysis of ICT R&D in the EU and beyond*. Available from http://is.jrc.ec.europa.eu/pages/ISG/PREDICT/documents/PREDICT2015.pdf.

_____ (2016). *Europe's Digital Progress Report 2016*. Brussels. Available from http://ec.europa.eu/newsroom/dae/document.cfm?action=display&doc_id=17338.

_____ (2017). ICT specialist in employment. *Eurostat Statistics Explained.* Available from http://ec.europa.eu/eurostat/statistics-explained/index.php/ICT_specialists_in_employment#ICT_specialists_by_gender.

Henke, Nicolaus, and others (2016). *The Age of Analytics: Competing in a Data-driven World*. New York: McKinsey Global Institute. Available from https://www.mckinsey.com/business-functions/mckinsey-analytics/our-insights/the-age-of-analytics-competing-in-a-data-driven-world.

International Data Corporation (2013). Where in the World is Storage: Byte density across the globe. Available from http://www.idc.com/downloads/where_is_storage_infographic_243338.pdf. Accessed 30 July 2017.

International Labour Organization (n.d.). The Global Initiative on Decent Jobs for Youth: Together, making a difference for young people everywhere. Available from

http://www.ilo.org/global/topics/youth-employment/databases-platforms/global-initiative-decent-jobs/WCMS_487961/lang--en/index.htm.

International Telecommunication Union (2011). *Handbook for the Collection of Administrative Data on Telecommunications/ICT*. Geneva. Available from https://www.itu.int/en/ITU-D/Statistics/Pages/publications/handbook.aspx.

_____ (2014a). ICT facts and figures. Geneva. Available from http://www.itu.int/en/ITU-D/Statistics/Documents/facts/ICTFactsFigures2014-e.pdf.

_____ (2014b). *Manual for Measuring ICT Access and Use by Households and Individuals*. Geneva. http://www.itu.int/dms_pub/itu-d/opb/ind/D-IND-ITCMEAS-2014-PDF-E.pdf.

_____ (2015a). ICT facts and figures 2015. Geneva. Available from https://www.itu.int/en/ITU-D/Statistics/Documents/facts/ICTFactsFigures2015.pdf.

_____ (2015b). *Key performance indicators related to the use of information and communication technology in smart sustainable cities*. ITU-T Focus Group on Smart Sustainable Cities. Geneva. (March) Available from https://www.itu.int/en/ITU-T/focusgroups/.../web-fg-ssc-0269-r4-KPIs_impact.docx.

_____ (2016a). ICT facts and figures. Geneva. Available from http://www.itu.int/en/ITU-D/Statistics/Documents/facts/ICTFactsFigures2016.pdf.

_____ (2016b). How can we close the digital gender gap? *ITU News Magazine* (April). Available from http://www.itu.int/en/itunews/Documents/2016-04/2016_ITUNews04-en.pdf.

_____ (2017). ICT facts and figures. Geneva. Available from http://www.itu.int/en/ITU-D/Statistics/Documents/facts/ICTFactsFigures2017.pdf.

Khan, Mehmoud Ul Hassan (2014). UAE ICT Strategy 2021. *The Seoulpost*. Available from http://www.eseoulpost.com/news/articleView.html?idxno=2303.

Luxton, Emma (2016). Where are the women in tech? 3 charts that reveal the gender gap, 28 April. Available from https://www.weforum.org/agenda/2016/04/where-are-the-women-in-computing/.

Manyika, James, and others (2015). *Digital America: A tale of the haves and have-mores*. New York: McKinsey Global Institute. Available from https://www.mckinsey.com/industries/high-tech/our-insights/digital-america-a-tale-of-the-haves-and-have-mores.

Mas, Matilde, and Juan Fernández de Guevara Radoselovics (2015). *The 2015 Predict Report. An Analysis of ICT R&D in the EU and Beyond*. JRT (Joint Research Centre) Science and Policy Report, Giuditta De Prato and Ibrahim K. Rohman, eds. Brussels: European Commission. Available from http://is.jrc.ec.europa.eu/pages/ISG/PREDICT/documents/PREDICT2015.pdf.

Miller, Trisha (2016). The Internet of things and what it means for female culture. *Women2.0,* 29 September. Available from https://women2.com/2016/09/29/the-internet-of-things-and-what-it-means-for-female-culture/.

Organization for Economic Cooperation and Development (2005). *Oslo Manual: Guidelines for Collecting and Interpreting Innovation Data.* Paris. Available from http://www.oecd-ilibrary.org/science-and-technology/oslo-manual_9789264013100-en.

_____ (2008). *Handbook on Constructing Composite Indicators: Methodology and User Guide.* Paris. Available from http://www.oecd.org/std/42495745.pdf.

_____ (2011). *OECD Guide to Measuring the Information Society 2011*. Paris. Available from http://dx.doi.org/10.1787/9789264113541-en.

_____ (2013). Recommendation of the Council concerning guidelines governing the protection of privacy and transborder flows of personal data. Digital Economy Policy. Amended on 11 July. Available from http://webnet.oecd.org/oecdacts/Instruments/ShowInstrumentView.aspx?InstrumentID=114&InstrumentPID=312&Lang=en&Book=False.

_____ (2014a). Recent FDI trends in the MENA region. Draft background note prepared for the LAS-OECD Regional Conference and MENA-OECD Regional Investment Working Group, Cairo, Egypt, 9-11 December. Available from https://www.oecd.org/mena/competitiveness/Draft per cent20Note_FDI per cent20trends per cent20in per cent20MENA_Dec. per cent202014.pdf.

_____ (2014b). *Measuring the Digital Economy: A New Perspective*. Paris. Available from http://dx.doi.org/10.1787/9789264221796-en.

_____ (2015a). *OECD Digital Economy Outlook 2015.* Paris. Available from http://dx.doi.org/10.1787/9789264232440-en.

_____ (2015b). Digital security risk management for economic and social prosperity: OECD recommendation and companion document. Paris. Available from http://dx.doi.org/10.1787/9789264245471-en.

_____ (2015c). *Data Driven Innovation: Big Data for Growth and Well-Being.* Paris. Available from http://dx.doi.org/10.1787/9789264229358-en.

_____ (2016a). The Internet of things: seizing the benefits and addressing the challenges. Background report for the 2016 ministerial meeting on the digital economy. OECD Digital Economy Paper, No. 252. Paris. Available from http://www.oecd-ilibrary.org/science-and-technology/the-internet-of-things_5jlwvzz8td0n-en.

_____ (2016b). Stimulating digital innovation for growth and inclusiveness: the role of policies for the successful diffusion of ICT. Background report for the 2016 Ministerial Meeting on the Digital Economy. OECD Digital Economy Paper, No. 256. Available from http://www.oecd-ilibrary.org/docserver/download/5jlwqvhg3l31-en.pdf.

_____ (2016c). Protecting consumers in peer platforms markets: exploring the issues. Background report for the 2016 Ministerial Meeting on the Digital Economy. OECD Digital Economy Paper, No. 253. Paris. Available from http://www.oecd-ilibrary.org/science-and-technology/protecting-consumers-in-peer-platform-markets_5jlwvz39m1zw-en.

_____ (2016d). New forms of work in the digital economy. Technical report for the 2016 Ministerial Meeting on the Digital Economy. OECD Digital Economy Paper, No. 260. Available

from http://www.oecd-ilibrary.org/science-and-technology/new-forms-of-work-in-the-digital-economy_5jlwnklt820x-en.

_____ (2016e). *Skills Matter: Further Results from the Survey of Adult Skills*. OECD Skills Studies. Paris. Available from http://dx.doi.org/10.1787/9789264258051-en.

_____ (2016f). Skills for a digital world. Background report for the 2016 Ministerial Meeting on the Digital Economy. OECD Digital Economy Paper, No. 250. Available from http://www.oecd-ilibrary.org/science-and-technology/skills-for-a-digital-world_5jlwz83z3wnw-en.

_____ (2016g). *PISA 2015 Results (Volume I): Excellence and Equity in Education.* Paris. Available from http://dx.doi.org/10.1787/9789264266490-en.

_____ (2017a). Going digital: making the transformation work for growth and well-being. Meeting of the OECD Council at Ministerial Level, Paris, 7-8 June. Paris. Available from https://www.oecd.org/mcm/documents/C-MIN-2017-4%20EN.pdf.

_____ (2017b). Key issues for digital transformation in the G20. Report prepared for a joint G20 German Presidency/OECD Conference, Berlin, 12 January. Paris. Available from https://www.de.digital/DIGITAL/Redaktion/EN/Publikation/key-issues-for-digital-transformation-g20.pdf?__blob=publicationFile&v=4.

_____ (2017c). *OECD Digital Economy Outlook*. Paris. Available from http://www.oecd-ilibrary.org/docserver/download/9317011e.pdf?expires=1508223530&id=id&accname=ocid195767&checksum=2DEF86D2FEAB3108E4CF77E76C24324C.

Rafi, Sonia (2013). Three-quarters of Middle East based SMEs have no online presence. Available from http://www.customerservice.ae/three-quarters-of-middle-east-based-smes-have-no-online-presence. Accessed September 2016.

Trapscott, Don (2015). The Digital Economy: Rethinking Promise and Peril in the Age of Networked Intelligence. New York: McGraw-Hill. ISBN 978-0-07-183555-8.

United Nations (2008). *International Standard Industrial Classification of All Economic Activities*, Revision 4. New York. Available from http://unstats.un.org/unsd/publication/seriesM/seriesm_4rev4e.pdf.

_____ (2016). *United Nations E-Government Survey 2016: E-Government in Support for Sustainable Development*. Sales no. E.16.II.H.2. Available from http://workspace.unpan.org/sites/Internet/Documents/UNPAN96407.pdf.

United Nations Conference on Trade and Development (2009). *Manual for the Production of Statistics on the Information Economy, 2009 Revised Edition*. New York, Geneva. Available from http://unctad.org/en/PublicationsLibrary/sdteecb20072rev1_en.pdf.

_____ (2012). *Information Economy Report 2012: The Software Industry and Developing Countries*. New York, Geneva. Available from http://unctad.org/en/PublicationsLibrary/ier2012_en.pdf.

_____ (2017). UNCTADstat. Available from http://unctadstat.unctad.org/. Accessed on 20 July 2017.

United Nations Economic Commission for Africa (2014). Manual for measuring e-government. Addis Ababa. Available from http://repository.uneca.org/handle/10855/22774.

United Nations Economic and Social Commission for Western Asia (2013a). *Impact of ICT on Arab Youth: Employment, Education and Social Change*. Available from http://www.escwa.un.org/information/publications/edit/upload/E_ESCWA_ICTD_13_TP-3_E.pdf.

_____ (2013b). *Impact of Selected E-Services on Socioeconomic Development in the Arab Region*. Beirut. Available from https://www.unescwa.org/sites/www.unescwa.org/files/publications/files/e_escwa_ictd_13_2_e.pdf.

_____ (2014a). *Arab Integration: A 21st Century Development Imperative*. Beirut. Available from https://www.unescwa.org/sites/www.unescwa.org/files/publications/files/e_escwa_oes_13_3_e.pdf.

_____ (2014b). *Arab Middle Class: Measurement and Role in Driving Change*. Beirut. Available from https://www.unescwa.org/sites/www.unescwa.org/files/publications/files/e_escwa_edgd_14_2_e.pdf.

_____ (2017a). *Innovation Policy for Inclusive Sustainable Development in the Arab Region.* Beirut. Available from https://www.unescwa.org/publications/innovation-policy-inclusive-sustainable-development-arab-region.

_____ (2017b). Smart Digital Transformation in Government. (E/ESCWA/TDD/2017/Technical Paper.4), 14 September. Available from https://www.unescwa.org/sites/www.unescwa.org/files/page_attachments/smart-digital-transformation-government-en.pdf.

United Nations Economic and Social Commission for Western Asia and the Government Summit (2015). *Smart Cities: Regional Perspective*. Government Summit Thought Leadership Series. Beirut; Dubai. Available from https://worldgovernmentsummit.org/api/publications/document/d1d75ec4-e97c-6578-b2f8-ff0000a7ddb6.

United Nations, Economic and Social Commission for Western Asia, University of St Andrews (2016). *Syria at War: Five Years On*. Beirut; St Andrews, United Kingdom. Available from https://www.unescwa.org/publications/syria-war-five-years.

United Nations Educational, Scientific and Cultural Organization (2015). *UNESCO Science Report: Towards 2030*. Paris. Available from https://en.unesco.org/unesco_science_report.

United Nations Educational, Scientific and Cultural Organization Institute for Statistics (2009). Guide to measuring information and communication technologies (ICT) in education. Technical Paper No. 2. Paris, Montreal. Available from http://unesdoc.unesco.org/images/0018/001865/186547e.pdf.

_____ (n.d.). Online database. Available from http://stats.uis.unesco.org. Accessed 20 July 2017. United Nations Global Pulse. New York. Available from http://www.unglobalpulse.org/.

World Bank (2015). *Doing Business*. Washington, D.C. Available from http://www.doingbusiness.org/~/media/WBG/DoingBusiness/Documents/Annual-Reports/English/DB15-Full-Report.pdf.

_____ (2016). *World Development Report 2016: Digital Dividends*. Washington, D.C. Available from http://www.worldbank.org/en/publication/wdr2016.

_____ (2017a). *Doing Business*. Washington, D.C. Available from http://www.doingbusiness.org/~/media/WBG/DoingBusiness/Documents/Annual-Reports/English/DB17-Full-Report.pdf.

_____ (2017b). The Little Data Book on Information Communication and Technology. Available from http://data.worldbank.org/products/data-books/little-data-book-on-info-communication-tech.

World Economic Forum, European Institute for Business Administration and Cornell University (2016). *The Global Information Technology Report 2016: Innovating in the Digital Economy*. Silja Baller, Soumitra Dutta and Bruno Lanvin, eds. Geneva. Available from http://www3.weforum.org/docs/GITR2016/WEF_GITR_Full_Report.pdf.

Zafar, Rahilla (2017). The future of female tech leadership is thriving – in the United Arab Emirates. *Quartz*, 3 July. Available from https://qz.com/1018217/the-future-of-female-tech-leadership-is-thriving-in-the-united-arab-emirates/.

Endnotes

1. Trapscott, 2015.
2. Ibid.
3. Ibid., foreword by Eric Schmidt, former Google chief executive.
4. As witnessed by the June 2016 OECD high-level ministerial meeting (the third since 1998) on the digital economy (http://www.oecd.org/internet/ministerial/meeting/). Though organized by OECD (a developed countries organization), non-OECD developing countries, among them Egypt, participated.
5. OECD, 2015a, p. 16.
6. Uber for taxis and Airbnb for hotels are examples.
7. OECD, 2016a.
8. Machine learning is the main technology underpinning artificial intelligence (AI), performing tasks only humans previously could, as illustrated by the March 2016 victory of AI programme AlphaGo over the best human Go player. See http://www.economist.com/news/science-and-technology/21694883-alphagos-masters-taught-it-game-electrifying-match-shows-what.
9. Miller, 2016.
10. OECD, 2017b.
11. United Nations, 2016.
12. United Nations, 2008.
13. OECD, 2017c.
14. OECD, 2015a, p. 89.
15. OECD, 2017c, p. 117.
16. Data does not add up, however, since not all ICT sector employees are necessarily ICT specialists.
17. OECD, 2017c, p.181
18. European Commission, 2017.
19. Luxton, 2016.
20. OECD, 2017c.
21. ITU, 2016a, p. 1.
22. Ibid., p. 5.
23. Ibid., p. 6.
24. This is assuming that physical connectivity is possible through, for instance, submarine cables, which are not always available, particularly on the African continent and in certain landlocked and isolated countries.
25. Henke et al., 2016.
26. International Data Corporation, 2013. One zettabyte is one trillion gigabytes (or 10^{21} bytes).
27. OECD, 2017c, p.171.
28. Ibid., p. 169.
29. World Bank, 2016, p. 156.

30. Ibid., p. 175.
31. OECD, 2015a, p. 140.
32. ITU, 2016b, p. 4.
33. United Nations, 2016.
34. OSI is one of three components of EGDI. The other two (of equal weight) are HCI and TII, built from education and telecom infrastructure and Internet-use indicators from UNESCO and ITU. OSI will be used in the sequel of this text instead of the less focused EGDI.
35. United Nations, 2016, pp. 80-81.
36. This applies both to EGDI and its companion E-Participation Index, which focuses on what governments offer to enable citizens to participate in government decision-making, provide feedback on government services or raise concerns.
37. Every three-year assessment period focuses on a particular field. The focus of the last assessment of 2015 was on science. About 540,000 students completed the 2015 assessment, representing about 29 million 15-year-olds in the 72 participating countries and economies.
38. OECD, 2016g.
39. Unfortunately, no Arab, and very few non-OECD, countries participate in this programme.
40. OECD, 2016e, p. 72.
41. Ibid., p. 79.
42. OECD, 2016f, p 7.
43. Ibid.
44. OECD, 2017b, p. 30. According to data reported for 2014, only Indonesia reached a higher percentage, namely almost 10 per cent.
45. In their most recent, 2016, editions, NRI and GII survey 13 Arab countries. In addition to the 12 countries surveyed by both indices, NRI surveyed Mauritania while GII surveyed Yemen. Neither index surveyed Iraq, Libya, the State of Palestine, the Sudan and the Syrian Arab Republic.
46. Pillar ranks of each Arab country are highlighted in bold when the pillar value illustrates a relative strong point compared with the country's overall rank in the index, and in italics when it illustrates a weak point.
47. These are the GCC countries except Kuwait, plus Tunisia and Morocco. In all, 190 countries were surveyed in the latest edition from 2017.
48. Qatar is just below Israel (8th rank globally with a score of 5.5), and the United Arab Emirates is above the Republic of Korea (25th with a score of 4.62) and France (28th with a score of 4.58).
49. According to UNCTAD data, the share of developing countries in FDI flows stood at 43.4 per cent in 2015, 38.6 per cent in 2008 and 39.4 per cent in 2009; therefore, one cannot blame the falling FDI inflows of Arab countries on global trends that do not favour developing countries.
50. OECD, 2014a, p. 7.
51. ESCWA, 2017a.
52. United Nations, 2016.
53. It is instructive to compare the values of Arab countries in the respective pillars of each index. Some non-GCC countries known for their human capital (Morocco and Egypt) obtain far more reasonable GII scores.
54. No other Arab countries participated.
55. Same as above.

56. OECD, 2016g.
57. The situation in Turkey is similar. Israel is below the OECD average in all three disciplines but has quite a good percentage of high achievers (a notch higher than the United States).
58. For a recent summary on this issue, see ESCWA, 2017b.
59. Rafi, 2013.
60. United Nations, 2016.
61. In total, there are 32 countries – among the 193 surveyed – in this category (United Nations, 2016, p 81). The E-government Survey identifies an OSI value as very high if it is above 0.75.
62. Among Arab countries missing from the United Nations E-Government Survey 2016, following are the OSI values of some Arab countries: Iraq (0.3551), Syrian Arab Republic (0.3261), the Sudan (0.2174), Yemen (0.1449) and Libya (0.1087). Except for Algeria and Mauritania, the OSI values of all those countries are lower than those listed in table 18.
63. ILO, n.d.
64. Zafar, 2017.
65. Ibid.
66. Filed under the Patent Cooperation Treaty (PCT); averages for years 2012-2013.
67. See detailed discussion in ESCWA, 2017b. Non-residents may seek patent protection under a given jurisdiction due to its importance as a market or, as is the case for some GCC countries, the company/individual filing the patent is registered/resident in another country.
68. The two survey indicators used by NRI on ICT impact on business and organizational models are part of the 13 indicators that comprise pillar 7 of GII on creative outputs.
69. Lebanon is ranked 15th globally under this subpillar and first globally under the printing and publishing manufactures output (per cent of manufactures total output). It should be noted though that this is based on 2007 data.
70. Many developed countries are within the 5,000-10,000 margin; some, such as the United Kingdom, are closer to 10,000 while Germany is closer to 5,000. Israel at 7,900 stands in eighth position globally. See Cornell University, INSEAD and WIPO, 2016, p. 389.
71. For more information, see http://www.reach2025.net/.
72. The Vision 2021 is available from https://www.vision2021.ae/en/our-vision/united-knowledge.
73. Khan, 2014.
74. The ICT 2030 Strategy is available from http://www.mcit.gov.eg/ICT_strategy.
75. The National Transformation Programme 2020 is available from http//vision2030.gov.sa/en/ntp.
76. The e-Government 2020 strategy is available from http://portal.www.gov.qa/wps/portal/about-hukoomi/integrated-e-government.
77. This is the case for Lebanon, for instance, with the often-quoted example of Banque du Liban Circular 331, which is available from www.bdl.gov.lb/circulars/download/477/en.

The digital economy describes the pervasive use of information and communications technologies in social and economic endeavours, leading to expanded opportunities, economic growth and improved public service delivery. The digital economy is crucial to creating 'smart societies' that empower all actors – public authorities, government, businesses and citizens, particularly youth – to take optimal and informed decisions and reduce inequalities.

The digital revolution has a far-reaching impact, similar to that of the industrial revolution in the nineteenth century, and the Arab region cannot afford to stand removed from it. It should embrace the benefits and address the risks. Arab countries, with their large human potential, educated youth, financial resources and central geographic position, should utilize the assets offered by the digital economy to transform their economies and societies.

17-00675