An Overview of ICTs and Sustainable Development

Academy of ICT Essentials
for Government Leaders

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/ APCICT

An Overview of ICTs and Sustainable Development

APCICT ASIAN AND PACIFIC TRAINING CENTRE FOR INFORMATION AND COMMUNICATION TECHNOLOGY FOR DEVELOPMENT

The Academy of ICT Essentials for Government Leaders

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ABOUT THE MODULE SERIES

In today's "Information Age", easy access to information is changing the way we live, work and play. The "digital economy", also known as the "knowledge economy", "networked economy" or "new economy", is characterized by a shift from the production of goods to the creation of ideas. This underscores the growing, if not already central, role being played by information and communication technologies (ICTs) in the economy in particular, and in society as a whole.

As a consequence, governments worldwide have increasingly focused on ICTs for development (ICTD). For these governments, ICTD is not only about developing the ICT industry or sector of the economy, but also encompasses the use of ICTs to stimulate economic growth, as well as social and political development.

However, among the difficulties that governments face in formulating ICT policy is unfamiliarity with a rapidly changing technology landscape and the competencies needed to harness ICTs for national development. Since one cannot regulate what one does not understand, many policymakers have shied away from ICT policymaking. But leaving ICT policy to technologists is also wrong because often, technologists are unaware of the social and policy implications of the technologies they are developing and using.

This module is part of the Academy of ICT Essentials for Government Leaders module series that has been developed by the Asian and Pacific Training Centre for Information and Communication Technology for Development (APCICT) for:

1. Policymakers at the national and local government levels who are responsible for ICT policymaking;
2. Government officials responsible for the development and implementation of ICT-based applications; and
3. Managers in the public sector seeking to employ ICT tools for project management.

The module series aims to develop familiarity with the substantive issues related to ICTD from both a policy and technology perspective. The intention is to provide a good understanding of what the current digital technology is capable of achieving, where technology is headed, and what this implies for policymaking. The topics covered by the modules have been identified through a training needs analysis and a survey of other training materials worldwide.

The modules are designed in such a way that they can be used for self-study by individuals or as a resource in a training course or programme. The modules are stand-alone as well as linked together, and effort has been made in each module to link to themes and discussions in the other modules in the series. The long-term objective is to make the modules a coherent course that can be certified.

Each module begins with a statement of module objectives and target learning outcomes against which readers can assess their own progress. The module content is divided into sections that include case studies and exercises to help deepen understanding of key concepts. The exercises may be done by individual readers or in groups during a training workshop. Figures and tables are provided to illustrate

specific aspects of the discussion. References and online resources are listed for readers to look up in order to gain additional perspectives.

Supporting the Academy of ICT Essentials for Government Leaders module series in print format is an online distance learning platform—the APCICT Virtual Academy (http://e-learning.unapcict.org) with virtual classrooms featuring the trainers' presentations in video format and PowerPoint presentations of the modules.

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AN OVERVIEW OF ICTS AND SUSTAINABLE DEVELOPMENT

This module, in its fourth edition, provides an updated overview of the intersections between information and communication technologies (ICTs) and the Sustainable Development Goals (SDGs), drawing attention to the various dimensions and sectors in which ICTs can provide valuable support through national governments' policies, plans and programmes.

The module invites readers to explore the various dimensions of the linkage through case studies of ICT applications in key sectors of development in Asia-Pacific countries. The module also highlights key issues and decision points, from policy to implementation, in the use of ICTs to meet development needs.

The aim is to foster a better understanding of how ICTs can be used for sustainable development and achieving the SDGs, and to equip policymakers and programme managers with a development-oriented framework for ICT-based and ICT-supported interventions in a range of sectors.

This module is an overview—it touches on ideas, concepts and practices, drawing from experience and research worldwide. Other modules of the Academy of ICT Essentials for Government Leaders discuss different aspects in detail, expanding many of the themes introduced here. Please visit http://www.unapcict.org/flagship-programmes/academy to access all the modules.

MODULE OBJECTIVES

This module aims to:

1. Introduce the concept of sustainable development and the SDGs;

2. Highlight the role of ICTs in achieving the SDGs;

3. Discuss the trends in the development of ICTs;

4. Provide an overview of the challenges related to the use of ICTs for sustainable development;

5. Draw attention to the digital divide;

6. Foster a better understanding of how ICTs can be used to achieve sustainable development;

7. Feature good practices and lessons learned from the case studies;

8. Explain how ICTs are integrated into national development policies and plans to achieve the SDGs;

9. Explore the main factors that determine the failure and success of using ICTs to achieve the SDGs; and

10. Pinpoint issues to consider when planning ICT interventions to achieve the SDGs.

LEARNING OUTCOMES

After working on this module, readers should be able to:

1. Provide a rationale for the use of ICTs to achieve the SDGs;

2. Cite and discuss examples of ICT applications to achieve each SDG;

3. Discuss challenges in the effective application of ICTs for sustainable development and measures to address them;

4. Highlight good practices and lessons learned from the application of ICTs for sustainable development in Asia and the Pacific; and

5. Identify key principles and issues to consider in the design and implementation of ICTs for sustainable development programmes and projects.

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ABBREVIATIONS AND ACRONYMS

a2i	Access to Information (Bangladesh)
ADB	Asian Development Bank
AI	Artificial Intelligence
APC	Association for Progressive Communications
APCICT	Asian and Pacific Training Centre for Information and Communication Technology for Development (United Nations)
APFSD	Asia-Pacific Forum on Sustainable Development
API	Application Programming Interface
ASEAN	Association of Southeast Asian Nations
CETS	China Education Technology Standards
CGAP	Consultative Group to Assist the Poor
CO_2	Carbon Dioxide
EPI	E-Participation Index
ESCAP	Economic and Social Commission for Asia and the Pacific (United Nations)
FAO	Food and Agriculture Organization (United Nations)
GDP	Gross Domestic Product
GEM	Gender Evaluation Methodology
GIS	Geographic Information System
GSMA	Global System for Mobile Communications Association
i4.0	Fourth Industrial Revolution
ICT	Information and Communication Technology
ICTD	Information and Communication Technology for Development
ILO	International Labour Organization (United Nations)
IoT	Internet of Things
IP	Internet Protocol
ITU	International Telecommunication Union (United Nations)
IVR	Interactive Voice Response
MDEC	Malaysia Digital Economy Corporation
MDES	Ministry of Digital Economy and Society (Thailand)
MDG	Millennium Development Goal
MERS	Middle East Respiratory Syndrome
MOOC	Massive Open Online Course
NGO	Non-Governmental Organization
OER	Open Educational Resource
OGCIO	Office of the Government Chief Information Officer (Hong Kong)
ONE	Open Network for Education (Mongolia)
OPAL	Open Algorithms
PPP	Public-Private Partnership
SARS	Severe Acute Respiratory Syndrome
SDG	Sustainable Development Goal
SME	Small- and Medium-Sized Enterprise
SMS	Short Message Service
UN	United Nations
UNCDF	United Nations Capital Development Fund
UNDP	United Nations Development Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNHCR	United Nations Refugee Agency

UNICEF	United Nations Children's Fund
USO	Universal Service Obligation
WHO	World Health Organization (United Nations)
WIFI	Women ICT Frontier Initiative
WSIS	World Summit on the Information Society

1. INTRODUCTION

The Asia-Pacific region is home to nearly 60 per cent of the world's population.[1] Compared to the rest of the world, this region has the greatest diversity, with the oldest and the youngest civilizations. It includes the most populous states on continental Asia, as well as the sparse and distant island countries of the Pacific. People of all races, ethnicities and religions live here, and amidst great wealth there is extreme poverty. In this region the world's fastest growing economies coexist with the least developed countries and countries in transition.

The development challenges that the Asia-Pacific region faces are massive. As this module is being updated, the world is in the midst of the **coronavirus (COVID-19) pandemic**, which is having significant social, economic and environmental impacts on all countries in the region.

In this crisis, information and communication technology (ICT) has become essential infrastructure, a lifeline, especially as nationwide lockdowns are imposed to contain the spread of COVID-19. Without regular access to a suitable device and enough data at sufficient speeds, people are unable to communicate with family members and health workers, and participate in online learning and remote work.

The pandemic underscores the importance of a robust, resilient and inclusive ICT infrastructure, and reinforces why it is crucial that everyone has access to broadband Internet. More than half the world's population is now online. But access varies hugely according to the development level of countries, the wealth and education of individuals, and gender—fewer women than men use the Internet.

The pandemic has clearly exposed the inequalities in Internet access and affordability, or the **digital divide** across the region. Most of those offline live in low- and middle-income countries. Women, older persons, persons with disabilities, ethnic minorities, indigenous groups, migrants, refugees, internally displaced persons, and people living in rural and remote areas are disproportionately without Internet access.

Compounding the connectivity gap, people in poorer countries are also less likely to have access to resources needed to protect themselves, like a safe place to isolate, a strong healthcare system and the financial safety net to be able to forgo work if necessary.

While the pandemic is still developing and the actual economic impact has yet to be fully revealed, the deceleration in gross domestic product (GDP) growth could be

[1] ESCAP, "Population Dynamics". Available at http://www.unescap.org/our-work/social-development/population-dynamics.

significant.[2] In addition, the fallout would be uneven across countries depending on their current economic conditions and the exposure to COVID-19. Small and medium-sized enterprises (SMEs) that account for 80 to 90 per cent of Asia-Pacific businesses[3] and the informal sector are particularly vulnerable. In the region, around 400 million people still live below the international poverty line of USD 1.90 a day and more than 1 billion live on less than USD 3.20 a day.[4] These individuals are much less capable of protecting themselves against COVID-19.

In September 2015, member States of the United Nations adopted the **2030 Agenda for Sustainable Development** with 17 Sustainable Development Goals (SDGs) at its core.[5] It is a comprehensive global blueprint for social, economic and environmental development that is sustainable and inclusive.

The SDGs offer a roadmap to tackle this global crisis, ensuring that COVID-19 recovery leads to more equal, inclusive and sustainable economies and societies that are more resilient to pandemics, climate change and other global challenges. The COVID-19 pandemic has provided opportunities to rethink and promote more resilient and sustainable development practices.

The latest report from the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP) reveals that on its current trajectory, the region remains unlikely to meet any of the 17 SDGs by 2030.[6]

There is an urgent need to find innovative approaches and solutions to address the developmental challenges of the countries. In this era, cutting-edge applications of ICTs make possible such innovative approaches and out-of-the-box solutions.

This module examines the linkage between ICTs and sustainable development, and the practice of ICTs for development (ICTD). This practice focuses on the meaningful application of ICTs—particularly computer, web-based, mobile and other digital technologies[7]—to achieve the SDGs in Asia and the Pacific.

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[2] ESCAP, "The Impact and Policy Responses for COVID-19 in Asia and the Pacific", 26 March 2020. Available at https://www.unescap.org/resources/impact-and-policy-responses-covid-19-asia-and-pacific.

[3] ESCAP, "Financing Small and Medium-Sized Enterprises: A Priority for Asia-Pacific", 14 July 2015. Available at https://www.unescap.org/media-centre/feature-story/financing-small-and-medium-sized-enterprises-priority-asia-pacific.

[4] ESCAP, "The Impact and Policy Responses for COVID-19 in Asia and the Pacific", 26 March 2020. Available at https://www.unescap.org/resources/impact-and-policy-responses-covid-19-asia-and-pacific.

[5] United Nations General Assembly, Transforming our world: The 2030 Agenda for Sustainable Development, seventieth session, agenda items 15 and 116 (A/RES/70/1). Available at https://www.un.org/ga/search/view_doc.asp?symbol=A/RES/70/1&Lang=E.

[6] ESCAP, *Asia and the Pacific SDG Progress Report 2020* (Bangkok: United Nations, 2020). Available at https://www.unescap.org/publications/asia-and-pacific-sdg-progress-report-2020.

[7] Older technologies such as radio and television will be discussed only in so far as they are integrated with digital technologies.

It is important to note at the outset that there is no one way of using ICTs to address development goals—each country must determine its own ICTD goals, objectives, strategies and pathways to implementation. This module aims to develop a common understanding of the approaches and challenges of ICTD, and introduce ways that countries can formulate and implement their ICTD strategies effectively.

The module is divided into four sections. The first section that follows this introduction provides an overview of sustainable development and the SDGs.

The second section introduces current ICT trends.

The third section explores, through a discussion of selected case studies, ICT applications to achieve each SDG. While the SDGs are discussed separately, it is important to remember that applications for achieving one SDG have interlinkages with other SDGs and will have spin-off benefits or drawbacks for other SDGs.

The fourth section looks at ways ICTs are integrated into national development policies and plans to achieve the SDGs. It offers insights into the main factors that determine the failure and success of using ICTs to achieve the SDGs, and provides planning and implementation tips.

This module is intended to provide a broad overview and introduce key points for using ICTs for the development of more sustainable, inclusive and resilient economies and societies. There are other modules in the Academy of ICT Essentials for Government Leaders that address specific key issues in greater detail.

There are modules that focus on **managerial** aspects like ICT project management, funding, and monitoring and evaluation; **technical** topics on information security and privacy, and Internet governance; and **thematic** modules on realizing data-driven governance, social media, development and governance, ICTs for climate change and green growth, and ICTs for disaster risk management.[8]

[8] To access all Academy of ICT Essentials for Government Leaders modules available in different languages, visit http://www.unapcict.org/flagship-programmes/academy.

Questions to think about

- How were ICTs used during the response and recovery from the COVID-19 pandemic in your country? (see Case Study 13 for an overview of how the Republic of Korea used ICTs for COVID-19 response and recovery.)
- How did the digital divide impact the effectiveness of these ICT interventions? Were marginalized and vulnerable groups (e.g., women, rural inhabitants, persons with disabilities and migrants) able to benefit from these ICT interventions?
- How has COVID-19 response and recovery in your country impacted your country's economic, social and environmental outlook?
- What has improved as a result of COVID-19?

2. SUSTAINABLE DEVELOPMENT AND THE SDGS

This section aims to:

- Introduce the concept of sustainable development and the SDGs; and
- Highlight the role of ICTs in achieving the SDGs.

2.1 Sustainable Development

Sustainable development was defined in 1987 by the Brundtland Commission Report as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs".[9]

Sustainable development is a concept that has emerged in the context of a growing awareness that global economic growth has been contributing to environmental degradation. Also, despite this rapid growth, extreme poverty and social inequalities have persisted across countries, including serious gender inequality and a digital divide.

The so-called "trickle-down" effect of economic growth benefiting the poor was only partly true in cases where absolute poverty was diminished—for example, death from malnutrition was greatly reduced—but relative poverty and an inequality of wealth and income distribution in many cases widened.

In response, in the year 2000, the Millennium Development Goals (MDGs) of the United Nations were adopted, aiming to eradicate extreme forms of poverty and inequalities, and ensure environmental sustainability in developing countries.

Sustainable development centres around inter- and intra-generational equity anchored essentially on these three distinct but interconnected pillars—economy, society and environment. It is an approach to development that uses resources in a way that allows the resources to continue to exist for others.[10]

Sustainable development is only achievable through the integration of economic, social and environmental concerns in policymaking, planning and implementation. In these processes, we need to consider the relationships, complementarities and trade-

[9] Brundtland Commission, *Report of the World Commission on Environment and Development: Our Common Future* (Oxford University Press, 1987). Available at http://www.un-documents.net/our-common-future.pdf.

[10] Justice Mensah and Sandra Ricart Casadevall, "Sustainable development: Meaning, history, principles, pillars, and implications for human action - Literature review", *Journal of Cogent Social Sciences*, vol. 5, no. 1 (2019). Available at https://www.tandfonline.com/doi/full/10.1080/23311886.2019.1653531.

offs among these pillars, and commit to responsible human behaviour and actions at the international, national, community and individual levels.

This is why sustainable development requires adopting a multi-stakeholder approach and working in partnerships across different levels, as well as different sectors.

Linked with the concept of sustainable development are two additional concepts—inclusion and resilience.

Inclusive development is generally defined as development that includes and pays special attention to the needs of the poor and the excluded. They include women, older persons, persons with disabilities, ethnic minorities, indigenous groups, migrants, refugees, internally displaced persons, and people living in rural and remote areas. The implication here is that no real and sustained development can take place if large sections of the population are excluded from the benefits of development. Other related key concepts are integration, participation and "leave no one behind".

Sustainable development also implies **resilience** to shocks, whether human-made or natural. A definition of resilience is, "the ability of groups or communities to cope with external stresses and disturbances as a result of social, political and environmental change."[11]

For example, when a community is dependent on agriculture as its main source of livelihood, it is apparent that any change in climate or environment could impact upon their livelihood. The community's resilience depends on its ability to cope with and adapt to changing climatic conditions or episodes related to excessive rain or drought. The better it is equipped to cope, as well as recover or bounce back after a disaster or other adversities, the more resilience it has.

Resilience includes looking at a society's ability to "bounce back better", which is the ability to use the recovery process to improve physical, economic, social and environmental conditions to create a more resilient society.

2.2 Sustainable Development Goals

In 2015, the United Nations member States adopted the SDGs that consist of 17 goals as shown in Box 1. The 17 SDGs carry on the work started by the MDGs from 2000 to 2015 to end poverty in its various dimensions. While the MDGs only applied to

[11] W. Neil Adger, "Social and ecological resilience: are they related?" *Progress in Human Geography*, vol. 24 (September 2000), pp.347-364. Available at https://groups.nceas.ucsb.edu/sustainability-science/2010%20weekly-sessions/session-102013-11.01.2010-emergent-properties-of-coupled-human-environment-systems/supplemental-readings-from-cambridge-students/Adger_2000_Social_ecological_resilience.pdf.

developing countries, the SDGs apply universally to all United Nations member States, resulting in the design of national strategies that incorporate the three pillars of sustainable development—economic growth, social equality and environmental protection (Figure 1).

Box 1: The 17 SDGs

1. End poverty in all its forms everywhere
2. End hunger, achieve food security and improved nutrition, and promote sustainable agriculture
3. Ensure healthy lives and promote well-being for all at all ages
4. Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all
5. Achieve gender equality and empower all women and girls
6. Ensure availability and sustainable management of water and sanitation for all
7. Ensure access to affordable, reliable, sustainable and modern energy for all
8. Promote sustained, inclusive and sustainable economic growth, full and productive employment, and decent work for all
9. Build resilient infrastructure, promote inclusive and sustainable industrialization, and foster innovation
10. Reduce inequality within and among countries
11. Make cities and human settlements inclusive, safe, resilient and sustainable
12. Ensure sustainable consumption and production patterns
13. Take urgent action to combat climate change and its impacts (taking note of agreements made by the United Nations Framework Convention on Climate Change forum)
14. Conserve and sustainably use the oceans, seas and marine resources for sustainable development
15. Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification and halt and reverse land degradation, and halt biodiversity loss
16. Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels
17. Strengthen the means of implementation and revitalize the global partnership for sustainable development

Source: United Nations, "Sustainable Development Goals". Available at https://sustainabledevelopment.un.org/sdgs.

These 17 SDGS are complementary, which means achieving one goal leads to achieving another. It is suggested that countries review the numerous targets to identify the ones most likely to be catalytic, as well as those that have multi-pronged impacts, while also aiming to implement the entire agenda. This choice would be informed by country-specific priorities and resource availability.[12]

Figure 1: The organization of the SDGs along three pillars of sustainable development—economy, society and environment

Source: Stockholm Resilience Centre. Available at http://www.stockholmresilience.org/images/18.36c25848153d54bdba33ec9b/1465905797608/sdgs-food-azote.jpg.

The SDGs also have trade-offs and tensions which come with difficult choices that may result in winners and losers, at least in the short term. For example, biodiversity could be threatened if forests are cut down for purposes of increasing agricultural production for food security, while food security could be in danger if food crops are switched to biofuel production for energy security.[13] The delicate balance between achieving high levels of economic growth that contributes to poverty reduction and the preservation of the environment is not easy.

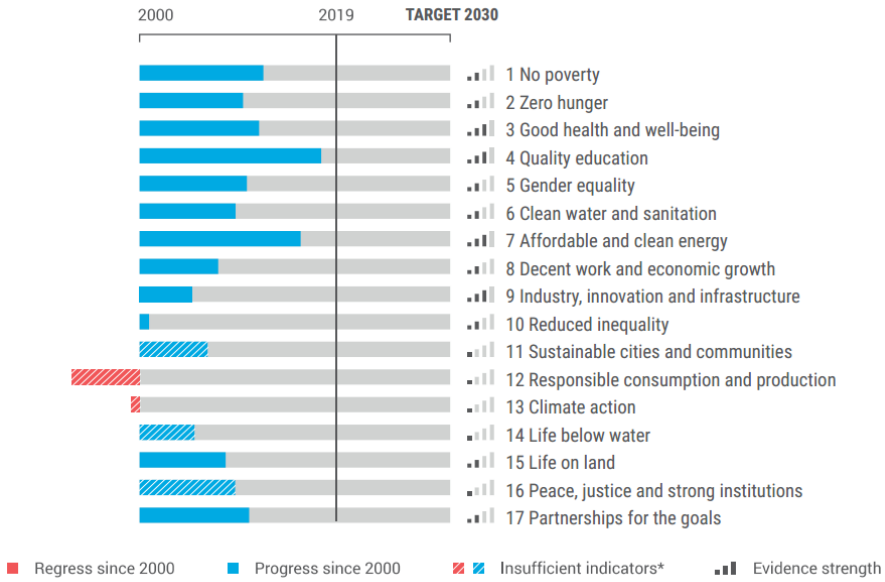
[12] Justice Mensah and Sandra Ricart Casadevall, "Sustainable development: Meaning, history, principles, pillars, and implications for human action - Literature review", *Journal of Cogent Social Sciences*, vol. 5, no. 1 (2019). Available at https://www.tandfonline.com/doi/full/10.1080/23311886.2019.1653531.
[13] Ibid.

2.3 SDG Progress in Asia and the Pacific

The "Asia and the Pacific SDG Progress Report 2020" published by ESCAP highlights that the Asia-Pacific region cannot be expected to achieve the SDGs by 2030 without accelerated actions.[14]

In particular, the region needs accelerated actions in responsible consumption and production (SDG 12) and climate action (SDG 13) where the region has regressed (Figure 2). The region's lack of progress on environmental sustainability is striking.

Figure 2: Asia-Pacific's progress towards achieving the SDGs in 2019



Source: ESCAP, *Economic and Social Survey of Asia and the Pacific 2020: Towards Sustainable Economies* (Bangkok, 2020). Available at https://www.unescap.org/publications/economic-and-social-survey-asia-and-pacific-2020.

There are some bases for optimism that goals which focus on basic needs of the population for health and well-being, education, water and sanitation, and safe and just societies (SDGs 3, 4, 6 and 16, respectively) can be achieved. More than half of the measurable targets for which the Asia-Pacific region is on track fall under these four goals.

Yet even within them, the region lacks progress on critical targets, including health coverage and access to health facilities and personnel, learning outcomes, access to safely managed drinking water and adequate sanitation and hygiene, and human trafficking.

[14] ESCAP, *Economic and Social Survey of Asia and the Pacific 2020: Towards Sustainable Economies* (Bangkok, 2020). Available at https://www.unescap.org/publications/economic-and-social-survey-asia-and-pacific-2020.

Data availability on the SDG indicators has substantially increased over the past few years in Asia and the Pacific (from 25 per cent in 2017 to 42 per cent in 2019). But data is still lacking on over half of the SDG indicators.

Something to do

- Go to the website: https://sustainabledevelopment.un.org/sdgs.
- Explore all the SDGs, and their targets and indicators. Then discuss the following:
    - What are the key development goals that your country has identified as part of its national development policy and plan?
    - To what extent do they match the SDGs? Which SDGs are not addressed in your country's national development policy and plan?
    - Can you identify the complementarities and trade-offs between the SDGs that your country is implementing?
    - Is your country's progress in achieving the SDGs publicly available? (See for example, Bangladesh's SDG Tracker at http://www.sdg.gov.bd and India's SDG Index and Dashboard at https://sdgindiaindex.niti.gov.in)

2.4 ICTs and Their Roles in Achieving the SDGs

Within the 17 SDGs, there are 169 targets to be reached and 232 indicators. Seven are ICT-related indicators, appearing as six targets within four of the goals—SDGs 4, 5, 9 and 17 (Table 1).

While none of the SDGs are specifically about ICTs, the 2030 Agenda for Sustainable Development recognizes that "the spread of information and communication technology and global interconnectedness has great potential to accelerate human progress, to bridge the digital divide and to develop knowledge societies".[15]

Achieving the SDGs requires multi-stakeholder participation and collaborations, which can be effectively facilitated using different ICTs.

Achieving the SDGs also requires the generation and application of creative ideas and innovative design and techniques. According to a report by the World Economic Forum, innovation is increasingly based on ICTs.[16]

[15] United Nations General Assembly, Transforming our world: The 2030 Agenda for Sustainable Development, seventieth session, agenda items 15 and 116 (A/RES/70/1). Available at https://www.un.org/ga/search/view_doc.asp?symbol=A/RES/70/1&Lang=E.
[16] World Economic Forum, *The Global Information Technology Report 2016* (Geneva, 2016).

These ICTs can enhance the efficiency and effectiveness of the activities undertaken to achieve the SDGs. It can also enhance our capability to measure progress towards the SDGs.

Table 1: SDG targets and indicators related to ICT

Goal	Target	Indicator
4	**4.4:** Substantially increase the number of youth and adults who have relevant skills, including technical and vocational skills, for employment, decent jobs and entrepreneurship	**4.4.1:** Proportion of youth and adults with ICT skills, by type of skill
	4.A: Build and upgrade education facilities that are child, disability and gender sensitive and provide safe, non-violent, inclusive and effective learning environments for all	**4.A.1b:** Proportion of schools with access to the Internet for pedagogical purposes **4.A.1c:** Proportion of schools with access to computers for pedagogical purposes
5	**5.B:** Enhance the use of enabling technology, in particular ICT, to promote the empowerment of women	**5.B.1:** Proportion of individuals who own a mobile telephone, by sex
9	**9.C:** Significantly increase access to ICT and strive to provide universal and affordable access to the Internet in least developed countries by 2020	**9.C.1:** Proportion of population covered by a mobile network, by technology
17	**17.6:** Enhance North-South, South-South and triangular regional and international cooperation on and access to science, technology and innovation and enhance knowledge sharing on mutually agreed terms, including through improved coordination among existing mechanisms, in particular at the United Nations level, and through a global technology facilitation mechanism	**17.6.2:** Fixed Internet broadband subscriptions per 100 inhabitants, by speed
	17.8: Fully operationalize the technology bank and science, technology and innovation capacity-building mechanism for least developed countries by 2017 and enhance the use of enabling technology, in particular ICT	**17.8.1:** Proportion of individuals using the Internet

Sources: ITU, "2030 Agenda for Sustainable Development". Available at https://www.itu.int/en/ITU-D/Statistics/Pages/intlcoop/sdgs/default.aspx; and United Nations, "Sustainable Development Goals Knowledge Platform". Available at https://sustainabledevelopment.un.org/sdgs.

2.4.1 The Role of ICTs in Measuring SDG Progress

ICTs play an indispensable role in the quantitative and qualitative measurement of progress in achieving the SDGs—from data gathering to analysis, visualization and communication, as well as in enabling citizen-led data.[17]

Automated data collection systems using Internet of Things (IoT) sensors and devices, and satellites improve the quality, timeliness and precision of data. Surveys can be conducted online.

Integrated data management tools create efficiencies and help with analysis, using algorithms to identify patterns in the data. Analytics and visualization tools simplify complex data into accessible, actionable information to support planning, coordination and decision-making.

Earlier technologies such as print, radio and television expanded the reach and speed of information delivery, but communication was essentially one way, from one to many users. Newer digital technologies, on the other hand, have allowed the providers and users of information to communicate and interact with each other. More importantly, these technologies have enabled users to become providers of information, particularly through various social media services such as Facebook and YouTube.

Big data for measuring SDG progress is being explored (see Section 3.1.5 for information on big data). The United Nations Statistical Commission created the Global Working Group on Big Data for Official Statistics to investigate the benefits and challenges of big data for monitoring and reporting on the SDGs. Task teams are looking into mobile phone data, satellite imagery and geospatial data, scanner data, and social media data. Task teams are also forging partnerships with public and private organizations to access big data sources for official statistics, and working to address issues related to methodology, data quality, legislation, privacy, management and finance.[18]

The Open Algorithms (OPAL) initiative is exploring the use of private sector big data in a safe, ethical, scalable and sustainable manner. It is building capacity gaps to

[17] For more information on citizen-led data, please refer to: APCICT, *Academy of ICT Essentials for Government Leaders Module on Realizing Data-Driven Governance* (United Nations, 2019). Available at https://www.unapcict.org/sites/default/files/inline-files/Academy%20of%20ICT%20Essentials%20for%20Government%20Leaders%20-%20Realizing%20Data-Driven%20Governance.pdf.

[18] United Nations Global Working Group on Big Data for Official Statistics. Available at https://unstats.un.org/bigdata/.

leverage private sector big data, and piloting the development of systems and standards to mitigate privacy risks.[19]

SDG trackers and dashboards have been created to monitor progress globally,[20] regionally by ESCAP[21] and in some countries.[22] Some countries have added a new section to existing statistical websites or data platforms to report data on the SDGs alongside other national data and statistics. In several cases, countries are repurposing platforms used to report on the MDGs. Other countries are developing entirely new platforms to provide data on the SDGs.[23]

The Asia-Pacific SDG Partnership,[24] a collaboration between the Asian Development Bank (ADB), ESCAP and United Nations Development Programme (UNDP), has developed a platform allowing countries to provide and display data on the SDGs, and compare progress.

The importance of open data

Data is too often spread out, not comparable, not indexed or categorized in a common framework. For data to facilitate change, the data has to be accessible, understandable and clearly visualized.

Open data that is machine readable, processable and can be accessed programmatically (i.e., through open application programming interfaces or APIs) is needed. This way, the data can be analysed and used for machine learning to create new insights.

A data strategy and structure is also needed that makes it possible to update, compare and share these findings easily across sectors and nations.

[19] OPAL. Available at https://www.opalproject.org/; and Global Partnership for Sustainable Development Data, "OPAL Case Study: Unlocking Private Sector Data", 2018. Available at http://www.data4sdgs.org/resources/opal-case-study-unlocking-private-sector-data.
[20] Bertelsmann Stiftung and Sustainable Development Solutions Network, "Sustainable Development Report Dashboards 2019". Available at https://dashboards.sdgindex.org.
[21] ESCAP, "SDG Gateway Asia Pacific". Available at https://dataexplorer.unescap.org/.
[22] Government of Bangladesh, "SDG Tracker". Available at http://www.sdg.gov.bd; and National Institution for Transforming India, Government of India, "SDG India Index and Dashboard". Available at https://sdgindiaindex.niti.gov.in.
[23] ESCAP, "SDG Help Desk: Follow-up and Review – SDG National Reporting Initiative". Available at https://sdghelpdesk.unescap.org/knowledge-hub/thematic-area/Follow-up-and-Review.
[24] Asia-Pacific SDG Partnership. Available at https://sdgasiapacific.net/.

2.4.2 SDGs and WSIS

At the World Summit on the Information Society (WSIS),[25] which took place in two phases (Geneva in 2003 and Tunis in 2005), world leaders adopted a common vision towards achieving a people-centred, inclusive and development-oriented Information Society. The fundamental aim of the WSIS process is to foster the use of ICTs to improve people's lives and bridge the digital divide through the implementation of 11 Action Lines as follows:

C1. The role of public governance authorities and all stakeholders in the promotion of ICTs for development

C2. Information and communication infrastructure

C3. Access to information and knowledge

C4. Capacity building

C5. Building confidence and security in the use of ICTs

C6. Enabling environment

C7. ICT applications

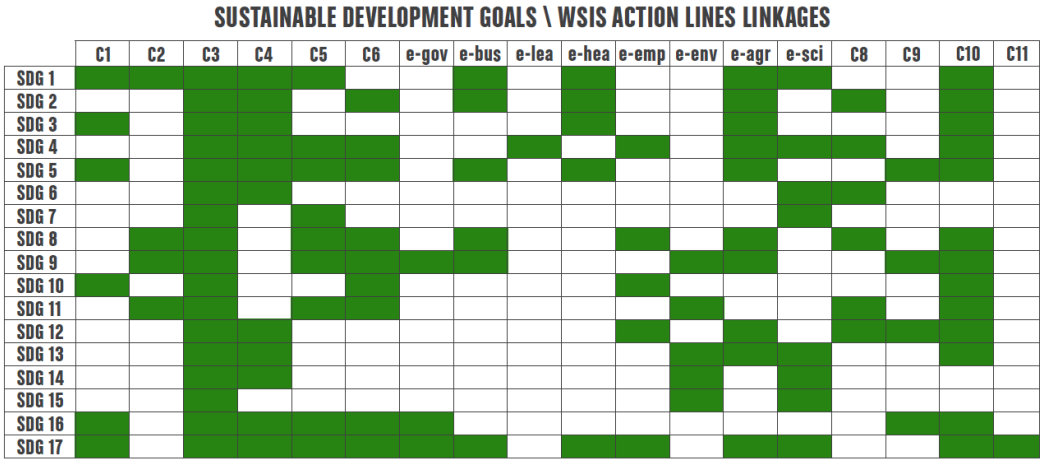
C8. Cultural diversity and identity, linguistic diversity and local content

C9. Media

C10. Ethical dimensions of the Information Society

C11. International and regional cooperation

Figure 3: WSIS-SDGs matrix



Source: ITU, "WSIS-SDG Matrix: Linking WSIS Action Lines with Sustainable Development Goals". Available at https://www.itu.int/net4/wsis/sdg/.

Notes: e-gov = e-government; e-bus = e-business; e-lea = e-learning; e-hea = e-health; e-emp = e-employment; e-env = e-environment; e-agr = e-agriculture; e-sci = e-science. Refer to source for documents detailing the linkages.

[25] ITU, "World Summit on the Information Society". Available at https://www.itu.int/net/wsis/.

The United Nations General Assembly Resolution A/70/125, adopted on 16 December 2016, provides guidance on the implementation of the WSIS outcomes until 2025,[26] and calls for close alignment of the WSIS and SDG processes.

In response, the WSIS-SDGs Matrix has been developed by the United Nations Action Line Facilitators that clearly shows the linkage between each Action Line and the 17 SDGs (Figure 3).[27] The key aim of WSIS is to harness the potential of ICTs to promote and realize the SDGs.

2.5 Key Points

- Sustainable development was defined in 1987 by the Brundtland Commission Report as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs".
- The 17 SDGs, the successors to the MDGs, consist of 169 separate targets and 232 indicators.
- The SDGs and the concepts of inclusiveness and resilience have been accepted by the global community of nations as the development agenda until 2030.
- The "Asia and the Pacific SDG Progress Report 2020" highlights that the Asia-Pacific region cannot be expected to achieve the SDGs by 2030 without accelerated actions.
- Although ICTs are explicitly mentioned in only four of the goals (in six targets and seven indicators), they are transformative tools that can potentially improve development programme impacts, empower communities and accelerate the achievement of the SDGs, as shown in Section 4.
- The effective implementation of the WSIS Action Lines can also help accelerate the achievement of the SDGs.
- ICTs provide new, more automated means to monitor and evaluate progress towards the SDGs, improving data collection, analysis, visualization and dissemination capabilities. Online platforms and open data standards can facilitate sharing and foster transparency and accountability.
- The benefits and challenges of big data for monitoring and reporting on the SDGs are being explored. Partnerships to access big data sources are being forged and issues related to methodology, data quality, legislation, privacy, management and finance are being worked out.

[26] ITU, *WSIS+10 Outcome Documents* (Geneva, United Nations, 2014). Available at https://www.itu.int/net/wsis/implementation/2014/forum/inc/doc/outcome/362828V2E.pdf.
[27] ITU, "WSIS-SDG Matrix: Linking WSIS Action Lines with Sustainable Development Goals". Available at https://www.itu.int/net4/wsis/sdg/.

3. ICT TRENDS

This section aims to:

- Discuss the trends in the development of ICTs;
- Provide an overview of the challenges related to the use of ICTs for sustainable development; and
- Draw attention to the digital divide.

3.1 Trends in the Development of ICT

The term ICT became familiar during the 1970s, although its origin goes back before that. By common usage, ICTs now refer to mean all devices, networking components, applications and systems that combined allow people and organizations to interact in the digital world.[28]

The progression from an analogue age to a digital age has happened at a remarkable speed, far faster than the transitions from an agricultural society to an industrial manufacturing society and then to a service consumer society. Driving it have been revolutionary advances in ICTs, notably in:

- Solid-state electronics;
- Miniaturization of computing power and its incorporation in smart devices;
- Battery technologies;
- Broadband fibre and wireless technologies;
- Communication using Internet protocols (IPs), the Web and web-based platforms; and
- Software programming of advanced algorithmic code.

Each change in technology has created changes in business models (e.g., the emergence of web-based platform businesses such as social media and e-commerce) and regulations.

Governments have introduced regulations that facilitate the use of digital applications, such as the legal recognition of digital signatures. Regulations have been put in place to address the privacy and security of these digital applications through data protection and cybersecurity laws, respectively. Governments have had to review existing laws, such as those related to copyright, child pornography and fraud to ensure their applicability in the online world. Governments also need to think through whether and

[28] Dias Sakenov, "History of ICT", *Sutori*. Available at https://www.sutori.com/story/history-of-ict-information-and-communications-technology--N7J51bQqSU7vLWcVfdn5M9qa.

how to tax digital transactions as they rapidly replace offline purchases and sales, and threaten future taxation revenues.

Table 2 outlines some of the key ICT developments that are still taking place. No timelines are attached because they have been developed at different rates of growth but seeing them develop in three phases up to today gives a sense of the changes happening. Each of these developments is examined in turn below.

Table 2: Phases in the development of various ICTs

Phase	Digital / IP	Wireless	Bandwidth	Business / Social Applications	Connected	Algorithms
1	Internet	Mobile	Narrow	Email	Devices	Cybernetics
2	Web	Cellular	Broad	Website	Internet of Things and Big Data	Machine Learning
3	Cloud	Smart	Super-Fast Fibre and 5G	Platform	Biometric Sensors	Artificial Intelligence

3.1.1 Digital / IP

Internet ⇨ Web ⇨ Cloud

Once devices turn digital, they can communicate universally as they are all speaking the same IP language. Today, computers, phones, game consoles, and “smart” watches, televisions, refrigerators and light bulbs can communicate and exchange data with each other.

When the World Wide Web was invented in 1989, followed by the first Web browsers, it allowed users to post messages, images, music, videos, etc. Today, social media users do that all the time using their smart devices. The operators’ APIs enable different apps to work on the smart devices.

Recently, there is a shift to storing data from the computer and company-owned server to an outsourced data centre of managed servers known as the cloud. Cloud service providers are offering a range of services on demand, such as Infrastructure-as-a-Service, Software-as-a-Service and Applications-as-a-Service—generically known as XaaS—which does away with the need of individuals and companies having to buy their own infrastructure, software or applications, and upgrade and protect them. Most

of these services are offered by large multinational companies, but this does not mean that local companies cannot provide them.

To accommodate the rapid rise in demand for IP addresses for sending traffic over the Internet, countries have been upgrading from IPv4 that operates with 32 bit addresses, to IPv6 that operates with 128 bit addresses. That is a difference of 2^{32} = 4,294,967,296 possible IP addresses to 2^{128} = 3.4×10^{38} addresses, which is too large to type out. But the actual release of IP addresses, which is supervised in the Asia-Pacific region by the Asia-Pacific Network Information Centre—one of the five regional Internet address registries worldwide—is limited to a much smaller number as required.[29]

3.1.2 Wireless

Mobile ➡ Cellular ➡ Smart

Radio communications use spectrum frequencies that are often nationally regulated following the recommendations of the International Telecommunication Union (ITU) World Radiocommunications Congress.

The first step is to allocate certain frequency ranges to different wireless services. For example, 5G mobile has frequencies allocated for its use both below and above 6GHz.

Next, blocks of frequencies are assigned to various operators, usually with a licence attached, but unlicensed frequencies can also be used to promote adoption, for example, in unserved and underserved areas of a country.

The first commercial cellular wireless mobile phones were launched in the early 1970s, but the biggest breakthrough was Apple's smartphone in 2007, although IBM did have a forerunner 15 years earlier, which shows that some inventions are ahead of their time and it takes several parts of the system, most notably infrastructure, to be in place before they are widely adopted.

The smartphone is a mini-computer with a telephone function, although voice calls today are being replaced by social media and instant messaging apps that provide real-time video calls. Examples include Facebook Messenger, Line, Telegram, Viber, WeChat and WhatsApp.

No ICT has been more influential globally and for low-income people in developing countries than the emergence of low-cost mobile phones, especially smartphones, although the lower the cost, the less capacity they have to download or access apps.

[29] RedNectar, "Just how many IPv6 addresses are there? Really?" 24 May 2012. Available at https://rednectar.net/2012/05/24/just-how-many-ipv6-addresses-are-there-really/.

In India, for example, one study found that the selling price of an Android smartphone fell from above USD 150 to below USD 20 from 2009 to 2018.[30] Admittedly, USD 20 remains out of reach for many living in extreme poverty on less that USD 1.90 a day. Also, India is a large market, meaning that price falls may not be so quick in other low-income countries, but the trend is very clearly towards an increase in mobile phone ownership, with the entry-level price of an Internet-enabled device falling from 2.6 to 2.3 per cent of GDP per capita between 2014 and 2017.[31]

At the end of 2019, 2.8 billion people in Asia-Pacific subscribed to mobile services, accounting for 66 per cent of the population. With nearly 500 million new subscribers added since 2014, the region is one of the fastest growing in the world and home to over half of total global mobile subscribers.[32] The growth in the ownership of mobile phones is important because it gives manufacturers and app developers the market scale they need to invest and innovate, and this in turn drives service providers to develop their own apps.

Another wireless device that is having a major impact on the provision of aerial services, such as surveillance, land mapping, product deliveries, spraying fields, etc., is the drone.

Higher in the skies are a new generation of low-Earth orbiting satellites and medium-Earth orbiting satellites used for wider-area surveillance and communication, and high-frequency satellites operating as geostationary Earth orbiting satellites at 35,786m altitude. These satellites are vital for the provision of radio-navigational geo-positioning systems that many terrestrial systems depend on, from military, mobile phone apps to many commercial applications. For strategic reasons, China (Beidu), Europe (Galileo), Russian Federation (GLONOSS) and North America (GPS) have each developed their own system.

There is a cost to all of this, namely 3,000 abandoned satellites and a further 34,000 objects larger than 10cm within the Earth's atmosphere. With the debris of human activity extending into space, the European Space Agency is launching a ClearSpace initiative in an effort to clean up.[33]

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[30] The News Minute, "The average selling price of smartphones in India down 16% in 10 years", 27 March 2019. Available at https://www.thenewsminute.com/article/average-selling-price-smartphones-india-down-16-10-years-icea-kpmg-report-99025.

[31] GSMA, *Connected Society: State of Mobile Internet Connectivity 2018* (2018). Available at https://www.gsma.com/mobilefordevelopment/wp-content/uploads/2018/09/State-of-Mobile-Internet-Connectivity-2018.pdf.

[32] GSMA, *The Mobile Economy: Asia Pacific 2020* (2020). Available at https://www.gsma.com/mobileeconomy/wp-content/uploads/2020/06/GSMA_MobileEconomy_2020_AsiaPacific.pdf.

[33] ClearSpace Today. Available at https://clearspace.today/.

Similarly, there is a cost to the ubiquity of mobile phones, namely the toxic chemicals they contain in their batteries and electronic components when they are disposed of as waste. Monitoring ocean health and land systems often relies on remote sensors, which may also result in e-waste in marine areas and on land, respectively.

3.1.3 Bandwidth

Narrow ➡ Broad ➡ Super-Fast Fibre and 5G

Bandwidth determines the capacity of a network and a device to download or upload content. Higher bandwidths are associated with higher speeds (bit rates or data rates) but the correspondence is not one-to-one and often speeds and downloads are limited by the capacity of the device.

For many applications, from voice to simple data transmissions, narrowband is sufficient. What is considered narrowband has been a moving target—from 64kbps to 1.544Mbps.

Meanwhile, broadband is being redefined almost annually as research development produces speeds over 100Gbps, even over mobile phones in laboratories. The ITU defines broadband as a connection speed of 256kbps or higher, but many governments today are targeting to provide broadband at higher speed. The global average broadband Internet speed is 11Mbps.[34]

For video transmissions and media-rich content, high-speed broadband is required. For instant downloads of movies, sports events and gaming, speeds and bandwidths of 5G will offer the best and most expensive services. Globally, video streaming accounts for the majority of Internet traffic, and with advancements in augmented reality and virtual reality, these trends indicate that more bandwidth availability in the near future will be a necessity.

Bandwidths and speeds over fibre-optic cables are more reliable, but they are fixed in location. Transmissions by satellite are also effective, but are vulnerable to weather conditions, latency (signal delays) and attenuation (signal interference). As a result, satellites are often reserved for telecommunications and Internet back up should cables get cut, or to serve remote mountainous, desert or ocean regions.

[34] Akhyari Hananto, "Rank of Countries with Fastest (and Slowest) Internet in The World 2019", *Good News From Southeast Asia*, 12 July 2019. Available at https://seasia.co/2019/07/12/rank-of-countries-with-fastest-and-slowest-internet-in-the-world-2019.

3.1.4 Business / Social Applications

Email ➡ Website ➡ Platform

Business applications

Email and applications such as spreadsheets have become an essential part of many business communication and management from the 1990s onwards, followed by websites of organizations, although maintaining these often proved a problem, especially for government departments who lacked full-time ICT staff. This remains a problem to this day, and often the postings are no more than scanned files in PDF that are difficult to read, difficult to search and impossible to be made interactive.

Many advanced companies, especially those in retail markets, have moved to platforms. A platform allows many different companies to post their advertisements and sell their products and services in one common place for visitors. Examples are Amazon, Facebook, Google and WeChat who benefit from access to the data recording visitors and their preferences to target ads at potential customers.

Facebook and Google even build their own broadband fibre and aerospace networks to improve their coverage, while Amazon uses drones for deliveries. Usually, the services of the platform companies are zero-cost to consumers, and the revenues come from ads and sales. This poses problems for governments who see the huge global market value of platform companies and yet apparently no local profits to tax.

Social media

Studies have shown that social media is a key driver for people to go online. It is one of the top activities on the Internet, particularly in low-income countries, and is often people's first experience with the Internet.[35]

Facebook, LinkedIn and Twitter are some well-known global social media platforms. Asian examples of social media include: WeChat and Weibo from China; LINE from Japan; and Kakao Talk from the Republic of Korea. These platforms have surged in popularity, in parallel with the growth of mobile technology and tend to be optimized for mobile use.

Social media sites have mainly been used for communication, but they are also creating new business models and incorporating multiple services (e.g., shopping, e-payment and banking, and arranging transportation).

[35] Internet Society, "Issue Paper, Asia-Pacific Bureau: Social Media", 22 November 2017. Available at https://www.internetsociety.org/resources/doc/2017/issue-paper-asia-pacific-bureau-social-media/.

For governments, these platforms provide an opportunity to better engage with citizens. Businesses, entrepreneurs and others are using them for marketing and branding, selling their products and services, and customer service and feedback. For consumers, social media has empowered them to share experience to a global audience, particularly related to products and services. Civil society organizations use social media for campaigning, advocating for change and empowering marginalized voices.

The opportunities for individuals to become content creators have underpinned the rise of social media. These platforms have become important spaces for freedom of expression and the voicing of issues that are not covered in mainstream media.

One of the Academy of ICT Essentials for Government Leaders' modules focuses on "Social Media, Development and Governance".[36]

Social applications

Platforms are not just for commercial companies. They can be used by governments and non-governmental organizations (NGOs) to provide economic and social opportunities to local communities and marginalized groups. See Case Study 1 on a Government of Bangladesh project that has developed an e-commerce platform for refugees.

The accessibility of platforms by mobile devices has improved outreach to some of the poorest communities. However, this only works when the communities are themselves connected to networks and involved as digital citizens, which is often a challenge, especially for women, older persons and those who are illiterate.

[36] See http://www.unapcict.org/flagship-programmes/academy.

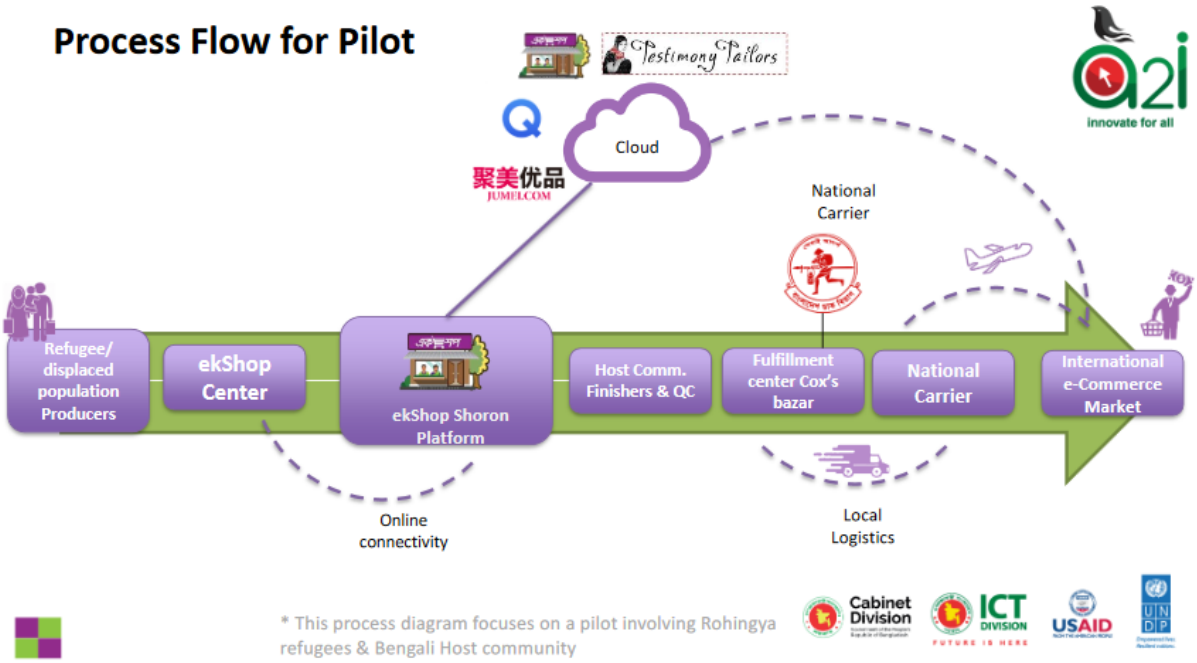
Case Study 1: ekShop Shoron – Bangladesh's e-commerce platform for refugees

The ekShop is an innovative and award-winning e-commerce platform developed by the Government of Bangladesh's Access to Information (a2i) Programme in 2018. The ekShop platform connects with 33 national and international e-commerce platforms like Amazon and Alibaba through API, providing rural sellers with access to urban and international customers.

Using this e-commerce model, the a2i Programme adapted it to help build the livelihoods of Rohingya refugees in Cox Bazaar through ekShop Shoron in 2019. Training was provided to Rohingya women to develop a fashion line to be marketed internationally. Consignments have been successfully exported to Thailand and the United Kingdom.

Since the Rohingya refugees are restricted from handling cash in Bangladesh, the a2i Programme partnered with World Food Programme on an e-voucher system that allows the refugees to purchase food and daily supplies from the sales they have made.

Figure 4: Process flow of ekShop Shoron



Sources: ekShop. Available at http://www.ekshop.gov.bd/public/landing_assets/Ek-Shop.pdf; ITU, "ekShop", WSIS Prizes 2020. Available at https://www.itu.int/net4/wsis/stocktaking/Prizes/2020/Nominated?jts=7VRB31&id=10&page=8#start; and UNHCR, "UNDP Bangladesh: e-Commerce for a Sustainable Livelihood for Displaced People", presentation made at the 3RP Livelihood Sector Meeting, Ankara, Turkey, 15 January 2020. Available at https://data2.unhcr.org/fr/documents/download/75036.

3.1.5 Connected Devices

Internet of Things and Big Data  **Biometric Sensors**

Originally, only computers and certain devices were connected to the Internet, but today, a whole host of machines in industry and in households are connected.

This may be machines in a factory to enable more efficient production and better management control—often called the Fourth Industrial Revolution or i4.0 (see Section 4.3.3).[37]

There are also home devices such as mobile phones using hotspots, remotely-controlled lighting systems, or gas and electricity meters that can be read remotely by utility companies.

The interoperability of these connected devices or IoT through agreed-upon technical standards is crucial in enabling seamless communication and sharing of data.

The growth of IoT has resulted in a huge increase in available data or big data that is used by commercial companies for market research and ads targeting, or by governments for analysis for smart city management.

Big data is mostly generated from social media sites, sensors, devices, video/audio files, networks, log files and the Web, and much of it is generated in real time and on a very large scale. The handling of such vast amounts of data efficiently and meaningfully requires analytics.

Big data analytics is the process of examining large datasets to uncover hidden patterns, unknown correlations, market trends, customer preferences and other useful information. Findings can lead to more effective planning and marketing, new revenue opportunities, better customer service, improved operational efficiency and competitive advantages over rival organizations.

For cities, the continuous accumulation of traffic data can be analysed to improve traffic flows and suggest routes to reduce road congestion. This is particularly relevant in Asia and the Pacific as many cities in the region face increasing traffic volume that is resulting in traffic congestion, more road accidents and urban pollution.

Big data from mobile phones, tablets and other smart devices can also be used for health monitoring and disaster early warning systems, as well as in disaster response

[37] The first industrial revolution began with industries powered by steam and water; in the second, electricity made mass production possible; the third one was the digital revolution; and this fourth revolution builds on the third but is characterized by a fusion of intelligent technologies that are blurring the lines between the physical, digital and biological spheres.

to rapidly identify those most in need of assistance. For example, mobile phone network data has been used to track population movements during times of natural disasters, so response and allocation of social assistance can be better targeted. A recent example is the use of mobile location data to track people's movements during the COVID-19 pandemic.

Refer to the Academy of ICT Essentials for Government Leaders module on "Realizing Data-Driven Governance"[38] on how to enhance the use and analysis of data, including big data, to support governance and government decision-making.

3.1.6 Algorithms

Cybernetics ➡ Machine Learning ➡ Artificial Intelligence

Algorithms are software drivers of programmed machines. They determine the sequence of steps in problem solving. From the 1930s, algorithms were recognized as essential to cryptology. In the 1940s, they were driving automation of analogue industrial machines using punched tape. By the 1960s, they were managing computer-aided design and computer-aided manufacturing.

Today, they have reached the stage of machine learning, whereby machines programmed by humans can improve upon the programming by themselves through a sequence of steps using more and more data examples.

Artificial intelligence (AI) is a step beyond whereby machines programmed by humans can develop and upgrade their own programming as independently of humans as humans permit—or as a set of ethical principles permit. The AI systems use various advanced forms of statistical and mathematical models to process, learn from, and analyse the massive amount of data to gain insights, make decisions and predictions, or solve complex problems.

The components discussed above, such as big data, cloud computing, IoT and broadband (including 5G networks), are fuelling the development of AI.

IoT enables the collection and exchange of data such as biometric data, behavioural information and unstructured information through network-connected sensors and devices that operate mostly without human interventions.

Broadband and 5G technologies enable data transmissions to data storage locations in the cloud. Cloud technologies provide the computing power to run AI systems. The

[38] See http://www.unapcict.org/flagship-programmes/academy.

collected data, known as big data, is then used by AI systems to build up their intelligent capabilities.

Each of these components is important on its own, but when aggregated and consolidated, the components can produce synergistic and transformative impacts, culminating into AI applications that bring new value.[39]

AI is already enabling innovations across all sectors. Some examples include:

- Increasing agricultural productivity through predictive analytics and on-the-spot diagnosis of crop diseases;
- Analysing healthcare data to facilitate scientific breakthroughs;
- Reducing waste by predicting and identifying optimal production levels;
- Improving early warnings of natural disasters; and
- Enhancing citizen and customer services with the use of chatbots.

Case Study 2: AI governance and ethics initiatives in Singapore

To address ethical and governance challenges arising from the use of AI, Singapore's Personal Data Protection Commission introduced three initiatives:

1. **Model AI Governance Framework** – The framework serves as a baseline set of considerations and measures for organizations operating in any sector. The framework's guiding principles are as follows: (1) decisions made by or with the help of AI should be explainable, transparent and fair; and (2) AI systems should be human-centric in that safety and well-being of humans should be at the centre of the design and use of AI. The framework translates these ethical and guiding principles into implementable practices.
2. **Advisory Council on Ethical Use of AI and Data** – Comprised of large tech providers, users, the academia and government, the advisory council provides advice to government on legal, ethical, policy and governance issues arising from the use of data-driven technologies in the private sector.
3. **Research Programme on Governance of AI and Data Use** – The programme is being led by the Singapore Management University School of Law to conduct industry-relevant research on AI.

These initiatives work together to understand various aspects and types of challenges arising from the use of AI and explore options to address them.

Source: Adapted from ITU, *WSIS Stocktaking Success Stories 2019* (Geneva, 2019). Available at https://www.itu.int/net4/wsis/forum/2019/Files/Outcomes/DRAFT-WSISStocktakingSuccessStories2019-en.pdf.

[39] ESCAP, *Artificial Intelligence and Broadband Divide: State of ICT Connectivity in Asia and the Pacific 2017* (Bangkok, 2017). Available at https://www.unescap.org/resources/artificial-intelligence-and-broadband-divide-state-ict-connectivity-asia-and-pacific-2017.

3.1.7 Other ICT Trends

There are some trends that have emerged through a combination of technologies described above but applied in a new way. They include 3D printing, peer-to-peer networks and super apps, and blockchain.

3D printing

The 3D printing process builds a three-dimensional object from a computer-aided design model. It allows production of physical objects (such as vehicle spare parts, prosthetics, hearing aids, dental implants, pharmaceuticals and food) from a design using various materials. 3D printing can reduce the cost of producing engineering and medical innovations, making them more affordable and widely available. 3D-printed materials are also customizable, so prosthetics, for example, can be produced to suit patient-specific anatomical requirements.

Metal 3D printing can be used to develop prototypes of various components of machineries or cars, which has led to quicker time to market and lower cost. This provides new opportunities to address critical shortages in low resource settings, such as spare parts for smallholder farm vehicles.

The COVID-19 pandemic has brought attention to the use of 3D printers for meeting the demands for face masks, face shields, test kits and ventilators.[40]

The technology carries some benefits over traditional manufacturing techniques—prototyping is quicker, customizing is easier, and machines can be set up almost anywhere, meaning you can produce a lot closer to where the products need to go.

However, the drawbacks are that they are generally slow, expensive and work well for only a few materials.[41] There are also regulatory barriers for producing medical equipment.[42]

Peer-to-peer networks and super apps

The client-server model was popular in the 1990s when many companies linked their desktop computers to office servers that hosted their software and stored their data.

[40] World Economic Forum, "3D Printing COVID-19 Rapid Response Initiative". Available at https://www.weforum.org/covid-action-platform/projects/3d-printing-covid-19-rapid-response-initiative.
[41] Mike Murphy, "3D printing finally found its market, and all it took was a pandemic", *Protocol*, 5 May 2020. Available at https://www.protocol.com/3d-printing-found-market-in-coronavirus-pandemic.
[42] Akane Okutsu, "Layer by layer, 3D printers boost Japan coronavirus mask supply", *Nikkei Asian Review*, 26 April 2020. Available at https://asia.nikkei.com/Spotlight/Coronavirus/Layer-by-layer-3D-printers-boost-Japan-coronavirus-mask-supply.

In more recent years, the peer-to-peer model has come to the fore, for example, taxi hailing apps that link a customer on a mobile phone directly to the driver. These are now widespread in most low-income countries, opening opportunities for job creation such as on-demand food delivery services.

Applications using an underlying peer-to-peer architecture are giving rise to a new generation of "super apps". These involve companies like Singapore-based Grab and Indonesia-based Go-Jek that began as ride sharing and taxi-hailing apps, then diversified into on-demand motorcycles and bicycles, food deliveries, and then into offering financial services. The range of financial services includes payment services, low-interest loans to users, and even wealth management services using AI-assisted estimates of creditworthiness of customers to allow for almost instant approvals of credit without the submission of collateral, as would be demanded by traditional banks.

Partnering these super-app companies are financial companies such as China-based Ant Financial and WeChat, and Japan's Softbank, as well as several banks. These super apps are shifting the landscape of services, impacting upon traditional businesses from transport, retailing to banks. In turn, banks are increasingly looking for ways to go online as virtual banks to compete, and monetary authorities are being asked to introduce virtual banking licenses.

Blockchain

At a more complex level, peer-to-peer networking has given rise to blockchains, or distributed digital ledgers, the technology underpinning cryptocurrencies such as Bitcoin. But other use cases include making financial disbursement more transparent and efficient, improving traceability across a supply chain, facilitating peer-to-peer clean energy trading among off-grid communities, and more.[43]

A blockchain consists of digitally recorded transactions that are entered as blocks into an existing chain of historical transactions after everyone with access to the blockchain has had a chance online to verify the transaction as genuine. Once "blocked", the transaction and its historical record are immutable, thus providing a transparent audit trail, which can serve as an effective corruption fighter. It can be useful in keeping records of property and financial transactions, for example.

The software can add a "smart contract" to a transaction that records a legally binding agreement, for example, to buy or sell at a predetermined price. In Cambodia, a pilot initiative uses blockchain technology to authenticate that the supply of rice for export to Europe and North America is genuinely local rice, according to Rules of Origin. As each strain of rice has its own DNA authentication, this is possible and once the data

[43] There are many sources of information about blockchain on the Internet and YouTube. The video from IBM available at https://youtu.be/QphJEO9ZX6s is a good start.

has been entered into the blockchain, it cannot be removed or altered in any way. It becomes immutable, and anyone with access to the digital blockchain can check it online at any time. Further, a contract price with the buyer can be agreed before the rice is grown and that is entered into the blockchain as a smart contract that is also immutable (see Case Study 9).

Blockchains can generate tokens that are derivatives of the underlying transactions, which can be traded like any other kind of derivative. This is a technology in its infancy, but it is being applied to a growing number of markets, from financial, manufacturing to retail. It therefore has important longer-term implications for the resilience and sustainability of markets, as in the example of rice.

For blockchain to work, there are a number of prerequisites that need to be met, including accurate and reliable data, a public key infrastructure as blockchain relies on cryptographic tools, and the availability of skills to create blockchain applications.

Blockchains require sophisticated programming but they are not rocket science. Developing economies with the right skill sets can develop their own blockchain application. The complication lies principally in blockchains not being able to handle many different product lines simultaneously and the current practice is separate blockchains for each supply chain by keeping things simple.

Questions to think about

Being innovative does not only mean creating something new. Innovation can mean changing your business model or making adaptations to deliver better products or services.

In Case Study 1 on ekShop Shoron, for example, an existing e-commerce platform has been adapted to help build livelihood opportunities for refugees.

- What innovations can be adapted in your country to drive social impact?
- What challenges do you anticipate when introducing your innovative product or service to your target group?

3.2 ICT-Related Challenges

Section 3.1 highlights the opportunities in using ICTs, particularly frontier technologies, for sustainable development. There is a set of challenges in the use of ICTs that needs to be addressed if ICTs are to be effectively used to achieve the SDGs. This section summarizes these challenges.

ICTs may be causing a decline in trust, especially with the rise in fake news, hate speech, cyberbullying and fraud on social media sites. Together with large-scale data

breaches, uncertainties about how personal data is being used, cybercrime and surveillance, the lack of trust may hinder ICT adoption. Policymakers are faced with an important challenge today of fully harnessing the opportunities of the digital revolution, while ensuring the safety and security of their citizens.

Particularly, the online vulnerability faced by women often leads to threats, harassments and violence offline. Therefore, it is important to provide women access to digital security tools.[44]

When new regulations to address these issues are introduced, they are often done through protectionist frameworks and without consulting civil society and women's organizations. In many countries, legal regulations also serve to censor the Internet, affecting the freedom of expression of women and marginalized groups.

An ICT-based society can become a surveillance society, with pervasive spying and loss of privacy. This spying may be by government, large ICT corporations or other anti-social elements.

Attitudes to state surveillance are often cultural—in some countries it is considered an unacceptable personal intrusion, while in others it is accepted as an inevitable aspect of maintaining law and order and social stability. Ultimately, it comes down to what are considered the legitimate boundaries of the state. In any case, transparency of purpose is part of the answer.

With IoT and big data analytics, data privacy has become a serious concern. Data can be collected by sensors and devices across networks without users' knowledge or consent. Using analytics and AI, the data can lead to categorization and re-identification of individuals, discrimination, exclusion, unjust treatment, and unequal opportunities.

Another area of serious concern is cybersecurity. As more people and devices are connected, the risk and impact of data breaches are much higher. Many of the IoT devices lack security features, and compromised devices can, for example, allow the hacker to listen to conversations from smart TV's built-in microphone, or control smart home appliances and systems, causing them to behave in unwanted and potentially dangerous ways. For industrial or governmental IoT systems, the risks are even higher.

At the same time, AI is being used to cause harm and conduct criminal activity. AI is being used in cyberattacks, and the creation of fabricated videos (or deepfakes) that

[44] Swedish International Development Cooperation Agency, "Brief: Gender and ICT", March 2015. Available at https://www.sida.se/contentassets/3a820dbd152f4fca98bacde8a8101e15/gender-and-ict.pdf.

uses a machine learning technique called “generative adversarial network” can threaten privacy, political unrest and national security, and lead to mistrust in major institutions and the media.

AI, blockchain, 3D printing and other frontier technologies present ethical, legal and accountability challenges. For instance, bias in the datasets or AI application can perpetuate existing inequalities and create unfair exclusions of underrepresented groups. Questions around liability for the consequences of decisions that AI systems make, and how those harmed can seek redress need to be considered. In blockchains, ways to recover damage when there is no central authority in charge need to be considered. Similarly, if a 3D-printed product causes damage, who should be responsible—the owner of the printer, the manufacturer of the printer or the person who printed the product?

An ICT-dependent economy is more vulnerable to network failures than a pre-ICT economy. Massive performance failures of the Internet or the power grid, or cable disruptions, can bring the economy to a grinding halt.

ICTs, especially AI and IoT, may displace workers and cause unemployment. Jobs in low-income countries are generally more susceptible to automation than in high-income countries. However, with appropriate skills enhancement and vocational education policies, technologies may enhance individual well-being and create a more knowledge-based workforce.

Finally, there is concern for the inequitable growth of ICTs, leading to a widening digital divide, despite apparent growth in absolute numbers (see Section 3.3). This can in turn exacerbate economic and social inequalities as ICTs are mainly accessible to people with resources and skills.

In short, while the SDGs represent a complex problem-solving exercise, the use of ICTs also has a set of challenges that needs to be addressed. These challenges may hinder ICT adoption and undermine efforts towards meeting SDG targets. We need to collaboratively ensure that the benefits of ICTs outweigh the risks and take steps to minimize risks.

3.3 The Widening Digital Divide

Many of the ICT developments described above, including AI, big data analytics, blockchain, cloud computing, IoT, smart devices and systems, super apps and platforms, 3D printing, and 5G, are often referred to as **frontier technologies**. These frontier technologies have the potential to accelerate the achievement of the SDGs. But they require resilient and affordable broadband connectivity to connect people and devices.

Asia and the Pacific is one of the most digitally divided regions in the world, with half of the region's population unable to access the Internet regularly.[45] Fixed-broadband subscriptions per 100 inhabitants in the Asia-Pacific region is still far lower than Europe and North America, and remain below the world's average of 14.5 in 2018.

The region has performed better in mobile-broadband penetration at an average of 42 per cent, but this figure is still below those of Latin America, Europe and North America.[46]

Although Asia-Pacific is home to the world's top connectivity performers like Australia, Hong Kong (China), Japan, the Republic of Korea, New Zealand and Singapore, 17 ESCAP member States still have less than 2 fixed-broadband subscriptions per 100 inhabitants with no or negative fixed-broadband subscription growth for the majority of these States.[47]

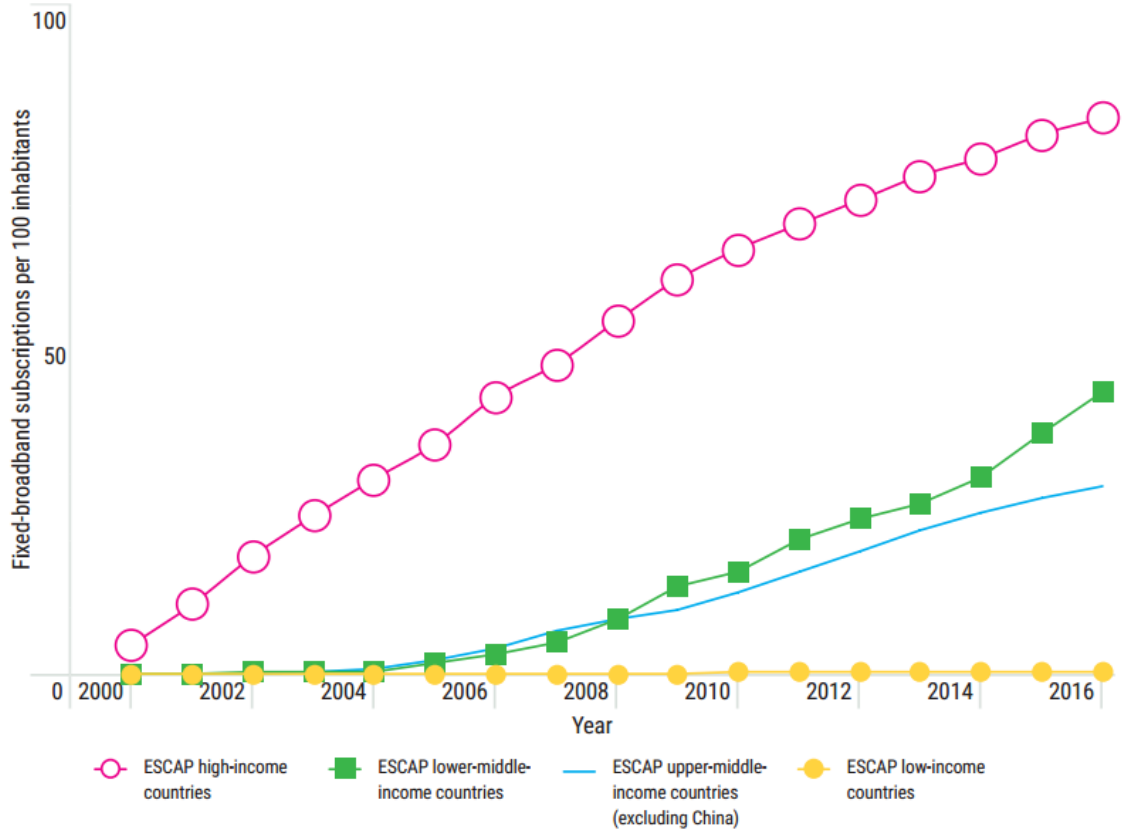
An analysis by ESCAP of fixed-broadband subscriptions between 2000 and 2016 shows a widening digital divide, especially between high- and low-income countries (Figure 5).

The digital divide persists within countries and societal groups, including between urban and rural areas, high-income and low-income groups, men and women, the young and old, and the educated and less educated.

For instance, the benefits of the Internet and technology are accessible to men at a much higher rate than women, leaving women behind in Internet access and mobile phone ownership. Globally in 2019, the proportion of women using the Internet was 48 per cent, compared to 58 per cent of men.[48] The gender gap in mobile Internet usage, while down to three per cent in East Asia and Pacific, remained at 51 per cent in South Asia in 2019.[49]

[45] ESCAP, "Connecting the Last Miles: Accelerating Inclusive Broadband in Asia and the Pacific", Asia-Pacific Information Superhighway (AP-IS) Working Paper Series, April 2020. Available at https://www.unescap.org/resources/connecting-last-miles-accelerating-inclusive-broadband-asia-and-pacific.
[46] GSMA, *The Mobile Economy 2020* (2020). Available at https://www.gsma.com/mobileeconomy/wp-content/uploads/2020/03/GSMA_MobileEconomy2020_Global.pdf.
[47] ESCAP, "AP-IS Policy Brief: Artificial Intelligence and Broadband Divide in Asia and the Pacific", April 2020. Available at https://www.unescap.org/resources/ap-policy-brief-artificial-intelligence-and-broadband-divide-asia-and-pacific.
[48] ITU News, "Why Girls in ICT Day is more important than ever", 23 April 2020, Available at https://news.itu.int/why-girls-in-ict-day-is-more-important-than-ever/.
[49] GSMA, *Connected Women: The Mobile Gender Gap Report 2020* (2020). Available at https://www.gsma.com/mobilefordevelopment/wp-content/uploads/2020/02/GSMA-The-Mobile-Gender-Gap-Report-2020.pdf.

Figure 5: Total fixed-broadband subscriptions by income group in 2000-2016



Source: ESCAP, "AP-IS Policy Brief: Artificial Intelligence and Broadband Divide in Asia and the Pacific", April 2020. Available at https://www.unescap.org/resources/ap-policy-brief-artificial-intelligence-and-broadband-divide-asia-and-pacific.

For persons with disabilities, they have much less access to the Internet.[50] Also, in Asia and the Pacific, websites are largely inaccessible for persons with diverse disabilities, in particular those with visual impairment and intellectual disabilities. ESCAP research indicates that only 40 per cent of government public websites are in accessible formats, while the websites of some countries are completely inaccessible for persons with visual impairment.[51] Further, while the new normal brought about by the COVID-19 pandemic has created a new working and educational culture whereby people utilize online conference tools, many online platforms are still not accessible for persons with disabilities, including those who need accurate real-time captioning.

[50] United Nations, “UN Flagship Report on Disability and Sustainable Development Goals”. Available at https://www.un.org/development/desa/disabilities/publication-disability-sdgs.html#:~:text=UN%20Flagship%20Report%20on%20Disability%20and%20Sustainable%20Development%20Goals,-%E2%80%9CThe%20UN%20Flagship&text=Against%20the%20backdrop%20of%20all,persons%20with%20disabilities%20by%202030.

[51] ESCAP, *Disability at a Glance 2019: Investing in Accessibility in Asia and the Pacific – Strategic Approaches to Achieving Disability-inclusive Sustainable Development* (Bangkok, 2019). Available at https://www.unescap.org/sites/default/files/publications/SDD-DAG-2019.pdf.

Taking into account that frontier technologies require access to robust and resilient broadband networks, it is feared that the broadband divide may create socioeconomic divides.[52]

It is going to be critical for Asia-Pacific countries to anticipate technology trends and address the digital divides. Countries will need to encourage investments in extending the broadband infrastructure to increase availability and accessibility, particularly in unserved and underserved areas that are not commercially viable—where most marginalized communities live.

Furthermore, the Alliance for Affordable Internet calls for “meaningful” Internet access that includes regular Internet use (daily use), access to an appropriate device (a smartphone), enough data (an unlimited broadband connection), and a fast connection (4G mobile connectivity).[53]

At the same time, countries must address the affordability of broadband, as well as enable the production of locally driven and gender-specific online content and applications in local languages to encourage the use of ICTs.

This is evident when we look at statistics from the Global System for Mobile Communications Association (GSMA) showing that there are 54 per cent of Asia-Pacific's population that has mobile broadband network coverage (3G and above) but are not using mobile Internet services.[54]

Although smartphone prices have dropped across the globe, they are still high—as much as people’s monthly income in a number of countries. Data packages are also costly, and the quality of the connection is often low, which does not incentivize people to buy the service. This, together with the lack of attractive applications with relevant content, is the reason why people are not using ICTs.[55]

Besides the lack of affordability of devices and data, and the lack of relevant content, another barrier to ICT uptake is the lack of capacity and skills to use ICTs and take advantage of what they offer (see Box 2).

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[52] ESCAP, "Connecting the Last Miles: Accelerating Inclusive Broadband in Asia and the Pacific", Asia-Pacific Information Superhighway (AP-IS) Working Paper Series, April 2020. Available at https://www.unescap.org/resources/connecting-last-miles-accelerating-inclusive-broadband-asia-and-pacific.

[53] Alliance for Affordable Internet, "Meaningful Connectivity - Unlocking the Full Power of Internet Access". Available at https://a4ai.org/meaningful-connectivity/.

[54] GSMA, *The Mobile Economy 2020* (2020). Available at https://www.gsma.com/mobileeconomy/wp-content/uploads/2020/03/GSMA_MobileEconomy2020_Global.pdf.

[55] Susan Teltscher, "Why digital skills training is so important if we are serious about closing the digital divide", *ITU News*, 18 June 2019. Available at https://news.itu.int/why-digital-skills-training-is-so-important-if-we-are-serious-about-closing-the-digital-divide/.

Apps now cover almost every aspect of smartphone usage and much of basic mobile phone usage. Using them offers access to services that directly benefit the poor, including:

- Communication with family, friends and “communities of interest”;
- Information, appointment and broadcasting services, such as weather reports, health appointments and disaster warnings;
- Transfer of funds and remittances into mobile wallets or to cash-out agents where no bank accounts are required; and
- Access to funds such as loans, insurance services and lines of credit.

Navigation around smart devices is one basic skill necessary to use them. However, it is not only the use of apps that improves livelihoods, but the opportunity and skills to create them.

A GSMA survey found that least developed countries only accounted for the creation of 0.2 per cent of all active mobile apps in 2017.[56] This in turn results in a significant lack of content in local languages in the least developed countries and among minorities in many other countries. Across the Asia-Pacific, the figure is higher at 27 per cent, but GSMA also notes a lack of local language content within the region, which leaves the poorest communties marginalized.[57]

While intuition and the courage to undertake trial-and-error, especially among digital natives, often lead to self-learning, for many of the extremely poor and marginalized communities, illiteracy in either reading and writing or in digital competency is a major hurdle. Of the unconnected, most lack basic ICT skills, while 40 per cent of adults in low-income countries are illiterate.[58]

[56] GSMA, *Connected Society: State of Mobile Internet Connectivity 2018* (2018). Available at https://www.gsma.com/mobilefordevelopment/wp-content/uploads/2018/09/State-of-Mobile-Internet-Connectivity-2018.pdf.
[57] Ibid.
[58] Ibid.

Box 2: The development of ICT skills and digital literacy

Digital skills are needed at all levels:

- **At the basic level**, to help people connect and benefit from ICT services and applications;
- **At the intermediate level**, to help students and job seekers get the necessary skills required by the digital economy; and
- **At the advanced level,** to increase the pool of ICT experts and meet the demands of the industry.

The ITU suggests the following framework for measuring the level of digital skills in an economy:

- **Basic skills** – Copying or moving a file or folder; using copy and paste tools to duplicate or move information within a document; sending emails with attached files; and transferring files between a computer and other devices.
- **Intermediate skills** – Using basic arithmetic formula in a spreadsheet; connecting and installing new devices; creating electronic presentations with presentation software; and finding, downloading, installing and configuring software.
- **Advanced skills** – Writing a computer program using a specialized programming language.

Developing ICT skills is one problem; keeping them is another. Due to the rapid pace of technological change, the availability of relevant ICT skills is in short supply, even in locations such as Silicon Valley and other centres of innovation.

For low-income countries this is an even greater challenge. Lack of qualified teaching staff holds back the supply of local graduate students, and the private sector usually outbids the public sector for their employment, or the best graduates emigrate. However, as China and India have shown, graduates returning from overseas with skills and industrial experience often create local startups.

If ICTs are to be adopted and adapted to local needs in order to promote ICT uptake, governments have to think hard about ways to:

- Increase the supply of qualified teachers and trainers;
- Encourage returnees and fresh graduates to innovate in local startups; and
- Make the best use of their knowledge and skills to develop the specific applications that can address local needs and achieve the SDGs.

Unless a country can sustain a pool of skilled ICT engineers, it will always be dependent upon importing software expertise to develop ICT applications for local use and meet local needs.

Besides building a pool of skilled ICT engineers, other major groups in need of ICT skills development include the following:

- **Policymakers and decision makers** – People with power to mobilize top-level support and commitment;

- **Planners and project designers** – Middle-level functionaries, who design, cost and implement initiatives. Such functionaries include academics, ICT specialists, technology designers, content experts and developers, among others; and

- **Trainers and educators** – Key individuals responsible for the training of personnel or education of students.

The training curriculum and methodology for each of these groups will be different, and will require a combination of training needs assessments, training curriculum development, instructional design, testing and evaluation.

If ICTs are to be effectively used to accelerate SDG achievement, these groups of people need to not only have a good understanding of ICTs, but also knowledge about the contexts and conditions in which these ICTs are to be deployed and used to achieve the SDGs.

On the demand side, there is an urgent need to raise literacy rates and spread digital literacy so that everyone can make use of the devices and apps developed.

Generally, a holistic and gender-sensitive approach to the development of ICT skills and digital literacy is needed, involving a concerted effort by all stakeholders, ranging from policymakers across different sectors to private companies, academic and educational institutions, as well as community-based organizations.

Sources: ITU, *Digital Skills Toolkit* (Geneva, 2018). Available at https://www.itu.int/en/ITU-D/Digital-Inclusion/Documents/ITU%20Digital%20Skills%20Toolkit.pdf; ITU, *Digital Skills Insight 2019* (Geneva, 2019). Available at https://academy.itu.int/sites/default/files/media2/file/Digital%20Skills%20Insights%202019%20ITU%20Academy.pdf; Susan Teltscher, "Why digital skills training is so important if we are serious about closing the digital divide", *ITU News*, 18 June 2019. Available at https://news.itu.int/why-digital-skills-training-is-so-important-if-we-are-serious-about-closing-the-digital-divide/; and APCICT, *ICT Human Capacity Building for Development*, ICTD Case Study 1 (Incheon, 2010). Available at http://www.unapcict.org/ecohub/ict-human-capacity-building-for-development-3.

3.4 Key Points

- The technological revolution has transformed ICTs not just from analogue to digital, but from stand-alone to connected, driven by advances in solid-state electronics (hardware) and programming (software).

- There have also been changes in the architecture of networks, from mainframes to client-server to peer-to-peer networks and cloud storage. Moreover, the number and speed of connections have increased exponentially, particularly among devices and sensors.

- The combination of AI, blockchain, big data analytics, cloud computing, IoT and broadband technologies is bringing about synergistic and transformative impacts, creating new business models, as well as regulations.

- These frontier technologies bring enormous opportunities but also significant challenges, especially related to privacy, security and trust. As more people and devices are connected, the risk and impact of data breaches are much higher with implications on people's safety and well-being. Frontier technologies also present ethical, legal and accountability challenges that can potentially perpetuate existing inequalities.

- The challenges may hinder ICT adoption and undermine efforts towards meeting SDG targets. We need to collaboratively ensure that the benefits of ICTs outweigh the risks, and take steps to minimize risks.

- The widening digital divide in the Asia-Pacific region means that countries without a robust and resilient broadband infrastructure risk being left behind, unable to reap the benefits of frontier technologies to achieve the SDGs.

- Besides a divide in the availability of and accessibility to broadband infrastructure, there are divides among different income groups, age, gender and ability, as well as between those with and without disabilities.

- Government regulations need to be focused on encouraging investments to develop the broadband infrastructure, particularly in unserved and underserved areas that are not commercially viable—where most marginalized communities live.

- Statistics show that 54 per cent of Asia-Pacific's population that has mobile broadband network coverage (3G and above) are not using mobile Internet services. This is because of a combination of the lack of affordability of devices and data, the lack of relevant content, and lack of skills to not only use ICTs but also create relevant applications. More women than men are not using ICTs.

- Governments must address the affordability of broadband, as well as enable the production of locally-driven and gender-specific online content and applications in local languages to encourage the use of ICTs.

- A holistic and gender-sensitive approach to the development of ICT skills and digital literacy is needed. This requires a concerted effort by all stakeholders, ranging from policymakers across different sectors to private companies, academic and educational institutions, as well as community-based organizations, committed to building capacities in the use of ICTs for sustainable development.

Something to do

Study your country's ICT policies and plans and identify any specific technologies that your country is promoting (including infrastructure, devices and applications).

Reflect on the following questions and choose three questions to engage in a group discussion on:

- To what extent are these technologies being used to achieve the SDGs?
- To what extent do the policies and plans promoting these technologies consider inclusive development and resilience building?
- What are the challenges of using these technologies and what policies need to be in place to address these challenges?
- Are these technologies likely to increase the digital divide?
- To what extent will vulnerable population groups such as women, older persons, and persons with disabilities be disproportionately impacted?
- What skills are being encouraged and built to develop and use these technologies?
- How many girls and women are engaged in ICT skills education or training or ICT-related occupations in your country compared to boys and men, and why?
- Are persons with disabilities engaged in the process of developing your country's ICT policy?

4. APPLICATION OF ICTS FOR SUSTAINABLE AND INCLUSIVE DEVELOPMENT: CASE STUDIES FROM ASIA AND THE PACIFIC

This section aims to:

- Foster a better understanding of how ICTs can be used to achieve sustainable development; and
- Feature good practices and lessons learned from the case studies.

ICTs, by their nature, are cross-cutting tools and their application may be multi-sectoral and multi-pronged. For instance, an ICT deployment for poverty reduction may primarily focus on providing income-generating opportunities. At the same time, it can strengthen women's participation in economic activity, thus addressing a parallel goal.

Therefore, when using ICTs for sustainable development, it is important to explore how these technologies can be used simultaneously in a synergistic manner to incorporate in a balanced way all three pillars of sustainable development (economic, social and environmental).

In the last two decades, there has been extensive experimentation in the field of ICTD, and much has been learned about the successes and failures. Some of the case studies presented in this section are well-known initiatives that commenced in the early 21st century. They stand out because they have been carefully planned, implemented, replicated and upscaled and are still working well today. Impact evaluations testifying to their successful implementation have been conducted in many of the case studies, and thus, it is possible to identify their success factors. Other case studies are more recent and explore the advances in ICTs.

Early in the experimentation of ICTD, it was sometimes assumed that creating an ICT application and making it available would lead to positive impact. This perspective, however, has given way to a realization that technology alone will not achieve development goals, but they are tools that could help change the behaviour of markets and people, and transform institutional structures towards more inclusive and sustainable development.

The case studies are organized by the five essential and interlinked elements for delivering the SDGs (Figure 6). While the case studies are structured within a set of goals, the myriad ways in which ICTs have been deployed to address one or more of

the SDGs will be highlighted. The case studies also look at the challenges faced by these ICTD initiatives and how to overcome them.

Although the section has been organized by SDGs, it should be noted that the use of ICTs for meeting the country's development goals provides opportunities to adopt a more integrated approach to development. Such an approach is necessary because in development, failure in one sector will have an adverse effect on another. For example, failure to provide education for all will impact upon the effectiveness of poverty alleviation efforts.

Figure 6: Five elements of the SDGs

Source: ESCAP.

4.1 People

4.1.1 SDG 1: End poverty in all its forms everywhere

Eradicating extreme poverty and its causes that arise from unequal access to resources, such as food, shelter, education and employment, is fundamental to the SDGs. These problems extend far beyond simple economics.

Eradicate does not mean there will be *absolutely* no poor people who are struggling to feed and house themselves and their families. It is set by the World Bank and others as meaning that *relatively* poor people will fall below three per cent of the population. The problem with this target is that there are no universally-accepted standards for defining and measuring poverty.

First, the terms “poverty” and “extreme poverty” are used slightly differently according to source. Extreme poverty is defined by the World Bank[59] as families living on less than USD 1.90 a day. The distinction is defined by one Malawi community-based organization as follows:[60]

> Theoretically, people living in poverty have access to shelter, food, clean water, and basic services provided by the government or private entities. On the other hand, people who live in extreme poverty are severely deprived of basic human needs and often do not have access to service aids.

Second, there is considerable debate over what are the most helpful ways to measure poverty, a debate that implicitly involves a definition of poverty. An absolute measure of poverty looks at the number of households that fall below a threshold income level. The World Bank uses an International Poverty Line of USD 1.90 a day—upped from USD 1.00 a day since the 1990s—as a purchasing power parity equivalent of local currencies.[61] A relative measure of poverty estimates the percentage of households that fall below the prevailing minimum standard of living in each country.

However, as measures of poverty, they confine themselves to the economic aspects and exclude the social and cultural aspects. Since 2018, the World Bank has widened its definition of poverty and included measurements related to consumption, education and access to basic infrastructure.[62] Future measures will also go beyond the household level in an effort to capture how poverty affects individuals.[63]

Third, poverty is multidimensional. People can be extremely poor because they are old, isolated, physically or mentally disabled, or discriminated against due to ethnicity, gender, beliefs and culture. Due to its multidimensional characteristic, it becomes difficult to untangle which elements of poverty have been addressed and which remain. Often, there is no one government agency, and no one United Nations

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[59] World Bank, “Poverty”. Available at https://www.worldbank.org/en/topic/poverty/overview.

[60] Ekari, "Poverty vs. Extreme Poverty", 5 February 2017. Available at http://www.ekarifoundation.org/en/poverty-vs-extreme-poverty/.

[61] Purchasing power parity measures what goods and services worth USD 1.90 in the USA would cost in other countries in local currency.

[62] World Bank, *Piecing Together the Poverty Puzzle* (Washington, DC, 2018). Available at https://openknowledge.worldbank.org/bitstream/handle/10986/30418/9781464813306.pdf.

[63] This shift towards a more multidimensional approach to poverty is the result of recommendations from: World Bank, *Monitoring Global Poverty: Report of the Commission on Global Poverty* (Washington DC, 2017). Available at https://openknowledge.worldbank.org/handle/10986/25141.

agency, that tackles the problems of poverty. As a result, coordinating across agencies to address multiple causes of poverty is a major challenge.

Case Study 3: Net Pracharat, Thailand

In line with the Thailand 4.0 policy to drive the country by innovation, knowledge, technology and creativity, the Ministry of Digital Economy and Society (MDES) and the National Broadcasting and Telecommunications Commission collaborated to implement the Net Pracharat initiative. This initiative aims to extend affordable broadband Internet to every village, including rural and remote villages that are not commercially viable for telecom operators by 2020.

This includes building the fibre-optic network, free WiFi hotspots and mobile access nodes, as well as public Internet centres equipped with computers. Subsidies are also being provided to 600,000 low-income households, allowing them free broadband access for three years.

Understanding that access and affordability is insufficient, Net Pracharat focuses on promoting the use of the Internet for rural development. MDES developed curricula on the basic use of the Internet and Internet applications for career building and income supplement.

Working with the Office of Non-Formal and Informal Education, a leading group of Net Pracharat trainers was created, which in turned trained more than 100,000 community leaders. In collaboration with the Ministry of Interior, the trainings were extended to reach over a million villagers.

At the same time, MDES recruited volunteers from the villages and formed a Net Pracharat Volunteer Network to promote the use of the Internet among their communities. Communities are encouraged to try online learning on platforms like ThaiMOOC (see Case Study 17), and a number of smart farming apps, as well as access telemedicine and e-government services (such as paying water and electricity bills online and e-filing tax).

MDES is collaborating with Thailand Post, Ministry of Commerce and the Electronic Transactions Development Agency to develop an e-commerce platform that offers an e-marketplace, e-payment and logistics service.

As of July 2019, more than 6.6 million users have registered to access Net Pracharat's public WiFi. There are around 200,000-300,000 new registrants every month.

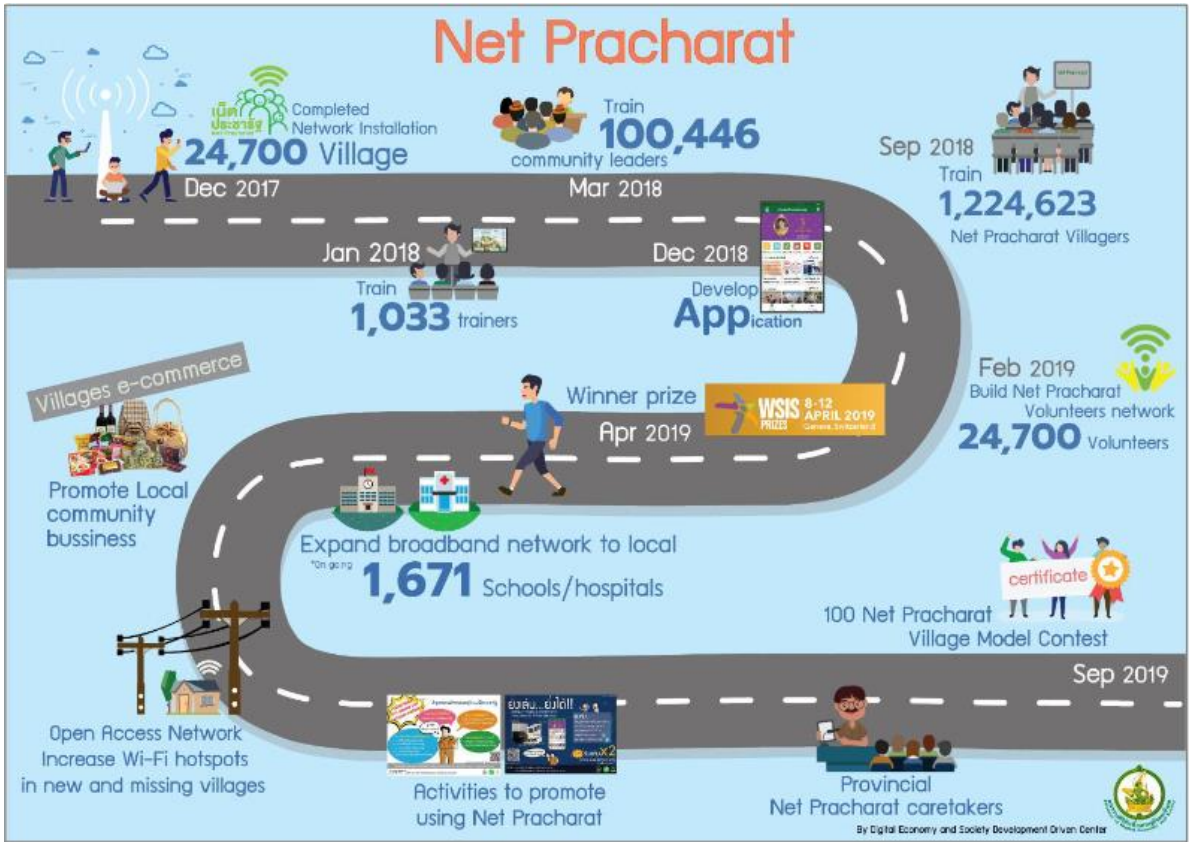
In Baan Nong Klong Village in Singburi province, communities have used the Net Pracharat network to launch a tourism campaign through social media. A number of tourists have visited the village, generating higher income for the community, and its

success has prompted some of the villagers to make use of the social media platform to sell local products.

To motivate villages to use Net Pracharat services, MDES plans to organize the Net Pracharat Model Village Contest as an opportunity to feature Net Pracharat use cases, exchange best practices and lessons learned among communities, and provide official recognitions of success stories.

The Universal Service Obligation (USO) Fund is used to support Net Pracharat. The USO Fund is a funding mechanism to incentivize the expansion of Internet services in remote and underserved locations. The fund is financed through mandatory contributions from telecommunications service providers.

Figure 7: Timeline of Net Pracharat activities



Sources: Net Pracharat. Available at https://npcr.netpracharat.com; Asia-Pacific Telecommunity, "APT Report on Best Practice of Connectivity: Village Broadband Internet Project (Net Pracharat) of Thailand", August 2019. Available at https://netpracharat.com/Documents/20190805_APT_Netpracharat_V12_Final.pdf; and ITU, *WSIS Stocktaking Success Stories 2019* (Geneva, 2019). Available at https://www.itu.int/net4/wsis/forum/2019/Files/Outcomes/DRAFTWSISStocktakingSuccessStories2019-en.pdf.

Globally, countries are using ICTs to address issues relating to poverty eradication, including its multidimensional nature. The initiatives often focus on rural development

to bridge the rural-urban divide, but there are also initiatives that address urban poverty.

Case Study 3 looks at a nationwide approach to rural development in Thailand that is being led by MDES. It adopts an all-of-government approach that involves cooperation with various government agencies and engages with the private sector and communities in using ICTs to promote income-generating activities.

Questions to think about

- In your country, is there an initiative similar to Net Pracharat?
- How are they similar or different?
- Does the initiative address accessibility, affordability and use of ICTs?
- Does the initiative focus on skills building?
- What are the ways in which the initiative is encouraging the use of ICTs?
- Is the initiative inclusive?
- Does the initiative address gender inequality? If so, how?
- What about addressing the specific needs of youth, older persons, persons with disabilities, ethnic minorities and other marginalized groups?
- Is the initiative succeeding or failing to reduce poverty?
- How is the initiative monitoring progress and measuring impact?

As demonstrated in Case Study 3, MDES not only developed the ICT infrastructure, but collaborated with various government agencies, the private sector and communities to promote the use of ICTs through training, subsidies and incentives. They are essential to bridging the digital divide (as discussed in Section 3.3), which in turn enable ICTs to be leveraged to reduce poverty.

One of the challenges of such large-scale initiatives is its sustainability once funding support ends. Many public Internet centres, sometimes called telecentres, community multimedia centres or village digital centres have failed or closed for a variety of reasons, including failing to meet the needs of the local communities.

The Government of Bangladesh has attempted to address this issue and ensure the sustainability of their local digital centres by enabling a cadre of entrepreneurs to run them (see Case Study 4).

Case Study 4: a2i Programme, Bangladesh

The a2i is a whole-of-government programme of the ICT Division, supported by the Cabinet Division and UNDP. The a2i aims to:

- Empower civil servants with the tools, expertise, knowledge and resources they need for experimenting and innovating citizen-centric solutions to public service challenges;
- Establish both physical and online one-stop access points that scale innovative services and make them available to citizens easily, reliably and in an affordable manner; and
- Encourage and support non-government actors, including small entrepreneurs, teachers and youth to partner with government actors.

One of its many achievements is the establishment of 5,865 Digital Centres—one within 3-4km of every citizen in Bangladesh—that deliver over 150 services to 6.5 million underserved citizens. Services that would require multiple trips to the district government office 35km away are now available at the nearby Digital Centre. On average, the time to receive services has come down by 65 per cent, cost by 73 per cent and the number of visits by 51 per cent. A study over a period of six years reveals that simplification and digitization have saved citizens of Bangladesh over half a billion dollars.

An innovative aspect of the Digital Centres is their public-private entrepreneurship model. The Digital Centres are physically hosted in local government offices and 1 per cent of their annual budget is directed towards these enterprises. Meanwhile, everyday expenses such as utility charges, Internet bills and computer maintenance costs are borne by the entrepreneurs who must generate revenues by providing certain public and private services.

The entrepreneurs leverage ICTs to provide citizens with access to public services (e.g., birth registration, land records, passport, telemedicine, overseas job application) and private services (e.g., mobile financial services, insurance, computer and vocational training). Increasingly, the Digital Centres are catalysing financial inclusion through agent banking, and connecting low-income communities to the wider digital economy through assisted rural e-commerce. These Digital Centres have been instrumental to the success of ekShop (see Case Study 1).

The a2i programme also underscores the importance of accessibility for persons with disabilities through the distribution of “Multimedia Talking Books” specially designed for visually-impaired students. Conventionally, while Braille textbooks have been distributed to students with visual impairment, the quantities in circulation have been limited. Further, students with visual impairment are not able to learn the pronunciation of words through Braille books. The distribution of the Multimedia Talking Books has expanded the learning capabilities of students.

Sources: a2i, "About". Available at https://a2i.gov.bd/about/; a2i, "One-Stop Shop: Digital Centers". Available at https://a2i.gov.bd/one-stop-shop-2/#1510318258673-86e9e595-5997; a2i, "Innovation Brief: Union Digital Centres", February 2019. Available at https://a2i.gov.bd/wp-content/uploads/2019/10/IB_UDC_Feb-2018-.pdf; and a2i, "Inclusive Development". Available at https://a2i.gov.bd/disability/.

Both the Net Pracharat and the a2i programme adopt a top-down model initiated by the national government. It is also important that governments enable bottom-up interventions from civil society and community-based organizations to complement government efforts in reducing rural poverty using ICTs.

Community-owned networks ensure that revenue spent on telecommunications is spent locally, creating more local economic circulation. They promote local skills development, and they can innovate faster and be more responsive to local needs.

Organizations like the Association for Progressive Communications (APC) and the Internet Society have a global campaign for Community Networks that supports this bottom-up model through public-private-civil society partnerships. One of the first Community Networks started in India through a partnership between the Internet Society and the Digital Empowerment Foundation (see Case Study 5).

Case Study 5: Wireless for Communities, India

Wireless for Communities is an initiative of the Internet Society and the Digital Empowerment Foundation that has been supported by various partners over the years. Launched in 2010, Wireless for Communities aims to connect rural and remote locations of India that are not commercially viable.

Wireless for Communities uses line-of-sight and low-cost WiFi equipment and the unlicensed spectrum bands—2.4 GHz and 5.8 GHz—to create community-owned and community-operated wireless networks in rural and remote villages. The local communities are trained to operate and maintain the network and promote its use.

In the past decade, the initiative has supported the establishment of about 350 Community Information Resource Centres in 95 districts, and deployed about 200 access points that have connected about 4,000 people.

Most of the Wireless for Communities networks are located in tribal and backward areas where people have not used a computer or smartphone before. Internet connectivity in these tribal and backward areas has resulted in the growth of ICT-enabled social enterprises, distance education and telemedicine services.

Sources: Wireless for Communities. Available at https://wforc.in/; and Nicola J. Bidwell and Michael Jensen, *Bottom-Up Connectivity Strategies: Community-led small-scale telecommunication infrastructure networks in the global South* (APC, 2019).

Some recommendations for enabling such bottom-up initiatives include the following:

- Provide open access to reliable and affordable high-speed backhaul networks;
- Allocate affordable spectrum—the radio frequencies that allow for wireless communication—to enable community networks to develop. This can be achieved either by specific licenses for these networks or by providing access to unlicensed spectrum;
- Reduce the high administrative burden on community networks through simple authorization systems; and
- Reduce fees and provide tax benefits for community networks.

In summary, we need to approach the multidimensional aspects of poverty through multi-stakeholder and cross-sectoral partnerships in order to accelerate the implementation of the SDGs. It will require a whole-of-government approach, as well as engagement with the private sector and civil society.

4.1.2 SDG 5: Achieve gender equality and empower all women and girls

Global data shows persistent gender disparities and discriminations in access to education, healthcare, employment and many other aspects of development, and women constitute a major proportion of the marginalized and vulnerable groups across all parts of the world.

For instance, female unemployment rates are higher than male unemployment rates in most Asia-Pacific countries, partly due to women's engagement in unpaid care and domestic work, which reduces their opportunities to access paid employment.[64]

Asia and the Pacific has made significant progress in achieving gender parity in primary education and in reducing maternal mortality. However, there are subregional disparities and significant challenges remain in reaching women and girls in rural and remote areas. For example, the number of women dying in childbirth in South and South-West Asia remains high, accounting for 22 per cent of global maternal deaths.[65]

The disparities are also evident in the difference between women and men’s access to and use of ICTs. Globally, women are eight per cent less likely to own a mobile phone, 20 per cent less likely to own a smartphone and 20 per cent less likely to use

[64] UN Women, "Gender Equality in Asia and the Pacific: 25 Years After the Beijing Declaration", 2019. Available at https://www2.unwomen.org/-/media/field%20office%20eseasia/docs/publications/2019/11/ap_ge-beijing25_infographics_a4-2sided-fa-s.pdf?la=en&vs=3455.

[65] ESCAP, "SDG Help Desk: Gender Equality for Sustainable Development". Available at https://sdghelpdesk.unescap.org/knowledge-hub/thematic-area/gender-equality-sustainable-development.

the Internet on a mobile—20 per cent translates to 300 million fewer women than men.[66]

There is recognition that the SDGs cannot be achieved unless gender disparities and discriminations are addressed, and women and girls are empowered and provided with equal opportunities.

However, many development policies and programmes remain gender blind, including ICT policies and programmes. This is further compounded by the lack of sex-disaggregated data and gender-specific indicators—a key barrier to evidence-based decision-making.

ICTs hold enormous potential for the empowerment of women and girls, by enabling access to online and mobile learning, as well as increased employment opportunities and engagement in e-commerce, bypassing the sociocultural barriers that would have hindered access. ICTs have also enabled women to organize advocacy campaigns for women's rights, and participate in online forums to voice their views and concerns.

For ICTs to fully benefit women, the gender digital divide must be bridged. This includes not only ensuring that women have access to a device and broadband Internet, but are also equipped with the skills to use ICTs to improve their livelihood and social status.

Most of the barriers women face in accessing ICTs are the same ones they face when accessing education or economic opportunity of any kind—illiteracy, lack of education and awareness, poverty, lack of time, low confidence and self-esteem, and sociocultural norms.

Specific barriers that women face in accessing and using ICTs include the lack of affordability of devices and Internet connectivity, lack of relevant content, lack of digital literacy and skills, and lack of security and trust in ICTs.

Nevertheless, there are examples of ICTs benefiting women when ICTs have been meaningfully and appropriately embedded and integrated into programmes and activities that focus on women's empowerment.

ESCAP is placing particular emphasis on enabling economic participation and enhancing women's share in safe, formal and fully-remunerated employment across

[66] GSMA, *Connected Women: The Mobile Gender Gap Report 2020* (2020). Available at https://www.gsma.com/mobilefordevelopment/wp-content/uploads/2020/02/GSMA-The-Mobile-Gender-Gap-Report-2020.pdf.

Asia and the Pacific (see Case Study 6). Promoting women's economic participation is a means to achieve empowerment.[67]

Research has shown that there are significant macroeconomic gains and positive development outcomes from increased women's participation in the economy. Gender equality leads to higher economic growth, enhances overall productivity, improves corporate profitability, boosts economic resilience and contributes to better development outcomes, including improved social conditions for both women and children,[68] since women on average reinvest 80 per cent of every dollar they earn back into the family.[69]

In response, APCICT launched the **Women ICT Frontier Initiative (WIFI)** flagship programme in 2016 that aims to create empowered women through ICT-enabled entrepreneurship. Its training programme adopts a two-pronged approach to:[70]

- Strengthen the capacity of women entrepreneurs to utilize ICTs in support of their businesses; and
- Strengthen the capacity of government leaders and policymakers to create an enabling environment for ICT-empowered women entrepreneurs.

The WIFI programme has been rolled out in eight countries, namely Armenia, Bangladesh, Cambodia, India, Kyrgyzstan, Lao PDR, the Philippines and Sri Lanka with its training modules available in seven languages. In Bangladesh, a series of training is being conducted using the WIFI modules to equip 30,000 women by 2021 with the necessary knowledge and skills to become ICT-empowered women entrepreneurs. In Cambodia, the National Committee for One Village One Product is training around 2,000 women entrepreneurs using the WIFI modules.[71]

[67] ESCAP, "Gender Equality and Women's Empowerment". Available at https://www.unescap.org/our-work/social-development/gender-equality/about.
[68] APEC, *APEC Economic Policy Report 2019* (Singapore, 2019). Available at https://www.apec.org/Publications/2019/11/2019-APEC-Economic-Policy-Report.
[69] International Chamber of Commerce, "Here are 3 reasons why ICT matters for gender equality", 17 July 2017. Available at https://iccwbo.org/media-wall/news-speeches/3-reasons-ict-matters-gender-equality/.
[70] APCICT, "Flagship Programmes: WIFI". Available at https://www.unapcict.org/flagship-programmes/wifi.
[71] APCICT, "APCICT launches the Cambodia and Nepal Editions of the Women ICT Frontier Initiative (WIFI) Policymaker Module". Available at https://www.unapcict.org/news/apcict-launches-cambodia-and-nepal-editions-women-ict-frontier-initiative-wifi-policymaker-module.

Case Study 6: ESCAP programme on catalysing women's entrepreneurship

ESCAP is implementing a five-year regional programme (2018-2023) on "Catalysing Women's Entrepreneurship – Creating a Gender-Responsive Entrepreneurial Ecosystem". The programme aims to advance women's economic empowerment and contribute to poverty reduction in the Asia-Pacific region in a holistic manner.

In Viet Nam, one of the countries that the programme is working with, SMEs are vital to economic growth, accounting for more than 98 per cent of all business, 40 per cent of GDP and 50 per cent of total employment. Yet, women are estimated to own only 21 per cent of formal enterprises and face various barriers to entrepreneurship.

The barriers include, among others, limited access to finance and ICT infrastructure, lack of financial and business knowledge, and discriminatory social norms. Overcoming these challenges is essential to unlocking the potential of many women to manifest their full economic aspirations and capacities for building better livelihoods, prosperous communities and thriving societies.

The Catalysing Women's Entrepreneurship programme intends to create an enabling policy and business environment that enhances women entrepreneurs' access to capital through innovative financing mechanisms as well as increase their use of ICTs and digital solutions. It is being implemented in six countries—Bangladesh, Cambodia, Fiji, Nepal, Samoa and Viet Nam.

As part of this programme, APCICT's WIFI Programme is being used to train both women entrepreneurs and policymakers. Women entrepreneurs are trained to utilize ICTs in support of their businesses, and government leaders and policymakers are trained to create an enabling environment for ICT-empowered women entrepreneurs.

In addition, the programme has a FinTech Innovation Fund, a women's livelihood bond and an impact investment fund, to pilot innovative digital solutions that improve access and use of financial services for women-owned, managed and/or led micro, small or medium enterprises. Successful applicants are provided with technical assistance, mentorship and early stage co-funding (USD 25,000 - USD 50,000) to pilot and upscale their solutions.

In the first round of the FinTech Innovation Fund, some of the innovative digital solutions selected include:

- Aeloi digital tokens to track in real time, investment usage and customer spending;
- BanhJi platform that combines payment, accounting and credit assessment services;
- HFC bank-linked mobile wallet;

- iFarmer crowdfunding platform that connects women farmers with sponsors;
- Romoni platform that connects skilled women freelancers with training, customers, other businesses and financial services;
- Kotra Riel app for women micro-enterprises;
- SkyEye payment gateway connecting mobile money providers with banks to facilitate e-commerce transactions; and
- Sparrow Pay digital marketplace and payment platform.

Sources: ESCAP, "Catalyzing Women's Entrepreneurship: Creating a Gender-Responsive Entrepreneurial Ecosystem". Available at https://www.unescap.org/our-work/social-development/gender-equality/catalyzing-women-s-entrepreneurship; ESCAP, "Press Release: United Nations Launches Project to Boost Women's Entrepreneurship in Viet Nam", 17 February 2020. Available at https://www.unescap.org/news/united-nations-launches-project-boost-women-s-entrepreneurship-viet-nam; and ESCAP, "Women MSME Fintech Innovation Fund". Available at https://www.unescap.org/sites/default/files/Women-MSME-FinTech%20Innovation-Fund.pdf.

In Pakistan, many female doctors had to stop practicing for social or cultural reasons. An e-health startup connects with these qualified home-based female doctors to provide affordable healthcare across the nation using ICTs, addressing multiple SDGs at the same time (see Case Study 7).

Case Study 7 shows that ICTs can create new employment opportunities for women, and when given the opportunity, women have been able to not only use ICTs to empower themselves economically and socially, but also contribute to sustainable development and the SDGs.

Besides using ICTs for economic empowerment, women have used the ICT tools and skills gained to create their own social spaces for articulation and aggregation of their collective interests, especially through social media platforms. Women have also used these platforms for support, peer learning and mentoring, resulting in the collective empowerment of women.

ICTs can also contribute to the political empowerment of women. ICTs can facilitate women's participation in government and political affairs by providing a communication platform to exchange opinions, articulate and aggregate interests, and engage political leaders in women's issues.

Women's advocacy groups can effectively use ICTs to network and connect with each other, and mobilize public opinion. For example, Shirkat Gah,[72] one of Pakistan's most respected women's rights groups, has used the Internet to support its networking, information and communication needs and in the process, strategically link local women's concerns with the global women's movement.

[72] Shirkat Gah Women's Resource Centre. Available at http://shirkatgah.org.

Case Study 7: Sehat Kahani, Pakistan – Bridging the healthcare gap by bringing female doctors back into the healthcare workforce

Founded by two female Pakistani doctors, Dr. Iffat Zafar and Dr. Sara Saeed, Sehat Kahani is empowering female doctors and digitizing healthcare in Pakistan. An e-health startup, the company aims to democratize access to quality and affordable healthcare using cost-effective ICT-enabled solutions through a network of qualified home-based female doctors who had to stop practising or leave their careers midway due to social and cultural norms.

Patients can visit one of 26 Sehat Kahani e-Health Hubs located in rural and remote areas where frontline workers connect them to one of 1,500 qualified home-based female doctors and skilled specialists using video consultation and an electronic medical records system. These frontline workers are trained on medical knowledge, leadership and soft skills.

For those with a smartphone, they can directly connect with the home-based female doctors through the Sehat Kahani mobile or web-based app.

Patients that seek consultation at the Sehat Kahani e-Health Hubs are charged between USD 0.50 and 3.00. For those using the app, the charges are USD 2-5, depending on the pay-as-you-go or subscription model. Sehat Kahani also provides value-added services like the delivery of lab results and medicines to homes.

During the COVID-19 pandemic, Sehat Kahani has made its mobile app free of cost for three months, in collaboration with the Government of Pakistan. In one month more than 18,000 patients have been consulted on the app.

Sources: Sehat Kahani. Available at https://sehatkahani.com/; Microsoft, "Bridging the healthcare gap by bringing female doctors back into the healthcare workforce". Available at https://www.microsoft.com/africa/4afrika/sehatkehani.aspx; Nida Shehzad, "How a digital platform is paving the way for health-tech in Pakistan", *The Guardian*, 17 June 2019. Available at https://www.theguardian.com/business-call-to-action-partnerzone/2019/jun/17/how-a-digital-platform-is-paving-the-way-for-health-tech-in-pakistan; and Virtual Global Digital Development Forum, “Tech Demos: Sehat Kahani – Female doctors fight against Covid19 using telemedicine”, 6 May 2020.

Online violence against women and children

Yet, social media is a double-edged sword. On social media platforms, women and girls can learn about their rights and find their voice, but these platforms are also frequently used to monitor, harass, threaten, intimidate, impersonate and stalk victims.

Technology-facilitated gender-based violence must be addressed. The United Nations estimates that nearly three out of four women globally have experienced some form of online violence.[73]

“Technology-facilitated gender-based violence” is defined as an action using the Internet and/or mobile technology that harms someone because of their sexual or gender identity. They include behaviours such as stalking, bullying, sexual harassment, defamation, hate speech, exploitation and gender trolling.[74]

ICTs can heighten and prolong conventional forms of gender-based violence due to the anonymity of online presence, inadequate regulation and repercussion, and the unprecedented speed and reach of the Internet. Research suggests that women are both disproportionately targeted and suffer serious consequences, including emotional distress, loss of status, decreased productivity and suicide.[75]

For girls and boys, they are online more than ever. While the Internet brings opportunities for children’s education, self-expression and social development, it also exposes them to harmful content, online violence, abuse and exploitation, as well as data misuse.

A United Nations Children’s Fund (UNICEF) study on children's experience on social media in Cambodia, Indonesia, Malaysia and Thailand revealed that both girls and boys reported being sent and asked for sexually-explicit pictures. Two out of five children reported having bad experiences using social media that they would not want to tell anyone about.[76]

Another study by the United Nations Educational, Scientific and Cultural Organization (UNESCO) in Bangladesh, Fiji, the Republic of Korea and Viet Nam, found that children's reactions to pornography and other disturbing content were most frequently to close the file, delete it or scroll away, and block the person or website. On average, only about 20 per cent chose to tell a parent or report to the police with variations by country.[77]

For example, Korean children were more likely to report cyberbullying incidents to the police probably because they received training in school to use the national hotline or

[73] UN Women, "Urgent action needed to combat online violence against women and girls, says new UN report", 24 September 2015. Available at https://www.unwomen.org/en/news/stories/2015/9/cyber-violence-report-press-release.
[74] International Center for Research on Women, *Defining and Measuring Technology-Facilitated Gender-Based Violence* (2018). Available at https://n2r4h9b5.stackpathcdn.com/wp-content/uploads/2019/03/ICRW_TFGBVMarketing_Brief_v4_WebReady.pdf.
[75] Ibid.
[76] UNICEF, *Our Lives Online: Use of social media by children and adolescents in East Asia* (Bangkok, 2020) Available at https://www.unicef.org/indonesia/media/3106/file/Our-Lives-Online.pdf.
[77] UNESCO, *Digital Kids Asia-Pacific: Insights into Children's Digital Citizenship* (Bangkok, 2019). Available at https://unesdoc.unesco.org/ark:/48223/pf0000367985.

mobile app for school violence that are directly connected to police agencies since 2012.[78]

Box 3: Tech-enabled innovations complement but do not replace efforts to prevent and respond to violence against women

There has been a growth of technological innovations aimed at addressing violence against women.

For example, MyPlan (https://www.myplanapp.org) is designed to help survivors of intimate partner violence navigate a safe way forward. Studies have found that such safety aids apps help survivors feel more supported and confident when navigating decisions related to safety. MyPlan is being adapted for low and middle-income contexts including for Kyrgyzstan.

Research in Kyrgyzstan shows that women face significant barriers to disclosing violence because of social and cultural norms that support or encourage the abuse. This same research reports that social service providers and healthcare professionals see the strong need for safety planning and view myPlan as a promising approach to providing women-centred safety planning and standardizing their screening and response to gender-based violence.

However, researchers and practitioners working on the myPlan app emphasize:

- Technology is not a replacement for conventional approaches – It should reinforce existing mechanisms and complement efforts to ensure appropriately-trained professionals can support survivors;
- Tech-related solutions should be developed with end users as equal partners, to ensure solutions are culturally-appropriate, relevant and safe, and to achieve buy-in;
- Technology solutions require continuous investment and maintenance, which is often overlooked;
- The gender digital divide cannot be ignored – Gaps between women and men in digital literacy, affordability of devices, and access to hardware can reduce survivors' ability to use services; and
- Building the support ecosystem for survivors is critical – Campaigns to prevent violence against women are also needed and critical.

Sources: Adapted from Alicia Hammond, Mirai Maruo and Diana J. Arango, "The good, the bad and the intersection of gender-based violence and technology", *World Bank Blogs*, 4 December 2019. Available at https://blogs.worldbank.org/voices/good-bad-and-intersection-gender-based-violence-and-technology; and Saltanat Childress, "Adapting myPlan for Kyrgyzstan", CESS 2018. Available at https://nomadit.co.uk/conference/cess2018/paper/43439.

[78] Ibid.

It is important for countries to have legislations with a clear and consistent definition of "child" and "child pornography", and include offenses facilitated by all ICT-enabled platforms, in line with international legal standards. They include the Optional Protocol to the Convention on the Rights of the Child on the Sale of Children, Child Prostitution and Child Pornography, the WePROTECT Model National Response, and the ITU Guidelines on Child Online Protection. Inconsistent national laws are a barrier to extraditing and prosecuting transborder crimes.

It is also important to ensure that strategies and programmes to tackle online risks are aligned within broader national and regional violence against women and children frameworks. Comprehensive measures to equip adults and children with the knowledge, tools and skills to address online risks are necessary.

This is a nascent field and there are few interventions that specifically address technology-facilitated gender-based violence, most of which are small-scale and untested (see Box 3). Currently, the solutions that do exist tend to focus on supporting victims/survivors to report and document their experiences, and on connecting them to community and institutional support services. Other programmes are designed to support local initiatives and grass-roots movements to raise awareness of the issue.[79]

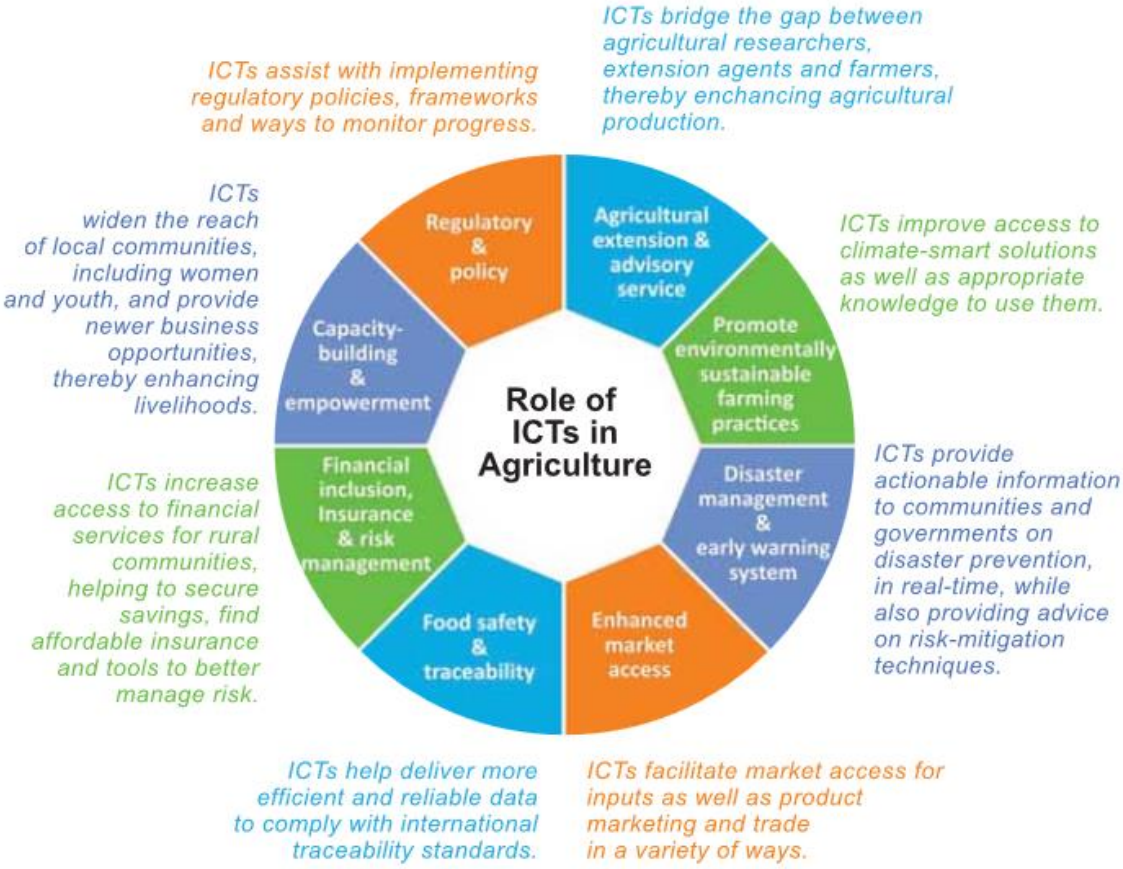
Technology-facilitated gender-based violence that disproportionately impacts women and girls must be addressed in a holistic manner. This involves a combination of legislative reforms, capacity building of law enforcement agencies and the judiciary, and coordinated online safety programmes in schools and for the public.

4.1.3 SDG 2: End hunger, achieve food security and improved nutrition, and promote sustainable agriculture

Hunger is on the rise globally and undernutrition continues to affect millions of children. Public investment in agriculture globally is declining, small-scale food producers and family farmers require much greater support, and increased investment in infrastructure and technology for sustainable agriculture is urgently needed.[80] At the same time, approximately one-third of all food globally produced for human consumption as measured by weight is either lost or wasted.[81]

[79] International Center for Research on Women, *Technology-Facilitated Gender-Based Violence: What Is It and How Do We Measure It?* (2018). Available at https://n2r4h9b5.stackpathcdn.com/wp-content/uploads/2018/07/ICRW_TFGBVMarketing_Brief_v8-Web.pdf.
[80] United Nations SDG Knowledge Platform, "SDG 2: End hunger, achieve food security and improved nutrition and promote sustainable agriculture - Progress & Info (2019)". Available at https://sustainabledevelopment.un.org/sdg2.
[81] FAO and others, *The State of Food Security and Nutrition in the World 2017* (Rome, 2017). Available at http://www.fao.org/3/a-i7695e.pdf.

Figure 8: The role of ICTs in agriculture



Source: FAO and ITU, *E-Agriculture Strategy: Piloted in Asia-Pacific Countries* (Bangkok, 2016). Available at http://www.fao.org/3/a-i5564e.pdf.

The World Bank makes the point that "two-thirds of the global extremely poor earn their livelihood in farming and productivity growth in agriculture has the largest impact of any sector on poverty reduction".[82] The effective use of ICTs can help farmers improve their farming practices and increase their revenues. This, in turn, reduces rural poverty. ICTs can be used to meet nations' agricultural and food security goals in multiple ways (Figure 8).

ICTs can be used in agriculture to help in food production, in monitoring of food quality and in logistics to distribute food from its place of production to locations of consumption. The types of ICTs used in agriculture generally fall into three categories:

1. Soil-based (or water-based) ICTs such as sensors and gauges that measure the chemistry of the earth or the water to identify parasites and diseases, determine the best-suited crops, and when and where to irrigate, drain or fertilize;

[82] World Bank, *Harvesting Prosperity: Technology and Productivity Growth in Agriculture* (Washington, DC, 2019). Available at https://openknowledge.worldbank.org/bitstream/handle/10986/32350/9781464813931.pdf.

2. Airborne ICTs such as drones and satellites providing GPS mapping, surveillance and weather information and, in the case of drones, methods of crop spraying; and
3. Communications such as walkie-talkie radios, narrowband radio, wireless mobile smart devices and the use of free television white spaces (the unused frequencies between television broadcast spectrum bands), all of which can be used for information services. Some can be used for visual data and machine-control communications, such as remote-controlled irrigation units, ploughs and harvesters.

Case Study 8: Precision farming pilot in Uzbekistan

Scientists at the University of Tashkent, with support from UNDP, have been localizing small-scale weather station technology and pheromone traps (which lure in insects using sexually-attractive pheromones) for information alerts serving Uzbekistan's many small farmers.

Data from sensors in the fields and in the traps is sent to a cloud database for analysis, and results from this analysis can be accessed by farmers and agronomists online or used offline. Farmers without Internet connectivity can be sent short message service (SMS) alerts and information about contagious diseases spread by insects and ways to tackle them, in addition to weather updates. With this service, farmers and agronomists no longer have to walk the fields to collect and count inspect species.

The project is designed to encourage farmers to replace chemical pesticides with non-chemical (biological) protection measures, despite their traditional preference for chemical solutions. With the availability of timely data and information through ICTs, farmers may be convinced to shift to more sustainable farming practices.

By 2019, UNDP has installed four weather stations in the Tashkent region, but due to their high cost, not every farmer can afford to purchase the equipment.

The shift towards precision or smart farming in Uzbekistan is still in its very early stages. Demonstration projects like this one is useful to assess whether the use of the technology delivers results and whether the design of the project encourages buy-in from local farmers.

A close monitoring and evaluation of both aspects are essential to establish the costs and the benefits and the sustainability of the project. If the project proves successful and sustainable, UNDP plans to replicate the system in other regions of country.

Source: UNDP, "Technologies for precision farming will become more accessible in Uzbekistan", 3 April 2019. Available at http://www.uz.undp.org/content/uzbekistan/en/home/presscenter/articles/2019/04/03/technologies-for-precision-farming-will-become-more-accessible-i.html.

Soil-based and airborne digital technologies have been applied to **"precision farming"** or "site-specific crop management".[83] They can map out wide areas or narrow-in on specific fields to help farmers choose the best crops to grow (although market information about crop prices may provide contrary advice).

For instance, satellite surveillance can map land usage, soil and crop type. The data is then sent to a centralized database for analysis with the results being made available to farmers by SMS over mobile phones or online to smartphones and computers.

The next step is for farmers to use the information to adjust their choice of crops, know when and where to fertilize, irrigate or spray their crops with insecticides, or when to take steps to prevent the spread of diseases. See Case Study 8 for an example of precision farming in Uzbekistan.

Although farmers with even very small holdings can potentially benefit from ICTs, poor farmers in more remote areas without the expertise, digital skills or resources to invest in these technologies are mostly excluded.

They often rely heavily upon traditional methods and local knowledge, and although their survival is historical testimony to their resilience, the speed of change overtaking the markets they depend upon can no longer guarantee their future sustainability. There is therefore a need for policymaking to construct ways in which the benefits of ICTs can be shared with them.

The use of ICTs in agriculture is spreading among low-income countries of the region, not just the advanced high-income countries. Examples of smart farming, where smart farming is defined as a "farming management concept using modern technology to increase the quantity and quality of agricultural products",[84] come from Australia, China, Japan, the Republic of Korea, Malaysia, the Philippines, Thailand and others,[85] but these media reports are rarely definitive in terms of results.

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[83] For more information on precision agriculture, see: ICT4AG, "Precision-Agriculture for Smallholder Agriculture", 21 August 2018. Available at http://ict4ag.cta.int/2016/10/08/precision-agriculture-for-smallholder-agriculture/index.html.

[84] FAO definition.

[85] Yang Han, "Smart farming yields solutions", *China Daily*, 11 June 2018. Available at https://www.chinadailyhk.com/articles/211/0/130/1528705349965.html; Charlene Chin, "Why is Smart Farming Asia's big new trend?" *Gov Insider*, 31 August 2016. Available at https://govinsider.asia/smart-gov/why-is-smart-farming-suddenly-so-cool/; Michell Christopher, "Smart farming: How Thailand's advancing technology is transforming its agricultural industry", *OpenGov Asia*, 19 July 2018. Available at https://www.opengovasia.com/smart-farming-how-thailands-advancing-technology-is-transforming-its-agriculture-industry/; and Erich Parpart, "Future Farming", *Bangkok Post*, 16 December 2019. Available at https://www.bangkokpost.com/business/1816909/future-farming.

Case Study 9: Blockchain for rice production and export in Cambodia

Rice is Cambodia's staple crop and leading cereal export. The supply chain starts with rice farmers, mostly small holdings that send their rice to millers who then forward the de-husked and/or ground rice to processors to make rice products and to exporters.

The International Finance Corporation has helped fund a Sustainable Rice Platform that involves contract farming—the offering of guaranteed prices and purchases to rice farmers under contract, thereby adding some certainty to their investment in buying seeds and expending their labour.

Some overseas markets offer "trade-for-aid" arrangements, such as the European Union for Cambodian rice, by offering a guaranteed quota on imports. But the Rules of Origin require the rice to be genuinely grown only in Cambodia and not smuggled across borders from Cambodia's neighbours.

Rice has its own DNA giving Cambodian rice a unique signature and this can be authenticated and entered as data into a blockchain. Smart contracts for contract farming can then be attached to the blockchain for future sales.

One such project is "Blockchain for Livelihoods from Organic Cambodian Rice" or Blocrice, a pilot project supported by Oxfam Cambodia that started in 2018 with 50 organic rice farmers participating.

The use of blockchain has a steep learning curve and software is needed to allow small farmers to check the chain online using smart devices. If the project succeeds the aim is to scale it up countrywide.

Only some parts of the supply chain are automated, such as some of the larger factories for milling, while much of the rice farming itself still relies heavily upon back-breaking labour. Therefore, although this is not ICT-enabled end-to-end, it is an important step towards a smart rice supply chain.

Sources: Research undertaken for Cambodia's forthcoming *Rectangular Strategy Phase V;* International Finance Corporation, "IFC Partners with Mars Food and its Local Supplier to Promotes Sustainable Rice Production in Cambodia", 22 May 2018. Available at https://ifcextapps.ifc.org/ifcext/pressroom/ifcpressroom.nsf/0/2D7B5F59F123A43885258295001BFFC0?OpenDocument; and Mark Barley, "Oxfam uses blockchain to empower Cambodian rice farmers", *Ledger Insights*, 2018. Available at https://www.ledgerinsights.com/oxfam-blockchain-cambodian-rice-farmers/.

Looking at evidence-based studies, a 2018 study in Iran[86] examined the perception of experts and farmers on the use of smart or precision farming methods. The results suggested that while the experts were fully convinced of the productivity gains, the farmers themselves were not at first much motivated by precision agriculture as they had little knowledge of it, but they were motivated when they could see that it was useful.

It is therefore important for policymakers to understand the nature of the technology, how it works and how to introduce it in ways that match the needs of local farming communities. Policymakers can assist poor farmers in adopting smarter methods of farming through a combination of funding, education and skills training, and possibly through some variant of contract farming as an incentive for them to adopt smart techniques (see Case Study 9).

ICTs have generally reduced the cost, time and risk associated with farming. They have improved agricultural value-chain processes (e.g., purchasing and selling) through market information and financial services. They have changed market structure through the removal of intermediaries and the introduction of farmers to supply chain contracting. ICTs have also contributed to the expansion of agriculture extension services (see Case Study 10).

A study that looks at the impact of ICT-enabled initiatives on rural resilience in low-income countries found that although ICTs are building the resilience of rural households and communities, the contribution has been small and incremental.[87]

To enable greater positive impact on rural resilience, recommendations from the study include the prioritization of transformative changes at the community level rather than at the individual farmers' level.

One way is to shift from the use of relatively simple ICT systems (such as those based on mobile phones) to those based on more complex ICT systems (such as remote sensing data and geographic information system or GIS).

Second way is a greater need for complementary resources to bring about changes in the institutions and structures of the wider livelihood system. Examples include policies that encourage the expansion of power and telecommunications infrastructure, education, and availability of finance in rural areas. iFarmer is an example of how ICTs can be used to boost agriculture financing (Case Study 11).

[86] Somayeh Tohidyan Far and Kurosh Rezaei-Moghaddam, "Impacts of the precision agricultural technologies in Iran: An analysis experts' perception & their determinants", *Information Processing in Agriculture*, vol. 5, no. 1 (March 2018), pp. 173-184. Available at https://www.sciencedirect.com/science/article/pii/S2214317316301329.

[87] Willian Hanson and Richard Heeks, "Impact of ICTs-in-Agriculture on Rural Resilience in Developing Countries", Paper No. 84, Centre for Development Informatics, 2020. Available at http://hummedia.manchester.ac.uk/institutes/gdi/publications/workingpapers/di/di_wp84.pdf.

Case Study 10: E-Choupal, India

The e-Choupal initiative, developed by an Indian food conglomerate, aims to link the company directly with farmers in order to facilitate the supply of production inputs and the procurement of outputs, such as soybeans, wheat, rice, coffee and prawns.

Since 2000, the company has installed computers with Internet access in rural villages to deliver real-time information and customized knowledge that help producers to better align output with market and consumer demand. This has helped farmers raise their quality standards and find the best price for their produce. It also creates a direct marketing channel, which, by eliminating wasteful intermediation and handling, reduces transaction costs and makes logistics more efficient.

While the farmers benefit through enhanced farm productivity and higher farm gate prices, the company benefits from the lower net cost of procurement (despite offering better prices to the farmer) having eliminated costs in the supply chain that do not add value.

E-Choupal is being used by 4 million farmers in 35,000 villages across 10 states of India. E-Choupal has been expanding its agriculture extension services that link the well-being of farmers with the well-being of the community. They include the provision financial and insurance services, as well as health services.

Sources: ITC, "E-Choupal". Available at https://www.itcportal.com/businesses/agri-business/e-choupal.aspx; ITC, "ITC's e-Choupal Ecosystem - Making agriculture profitable & empowering 4 million farmers across 10 states". Available at https://www.itcportal.com/sustainability/echoupal-ecosystem.aspx; and FAO, *Transforming Food and Agriculture to Achieve the SDGs* (Rome, 2018). Available at http://www.fao.org/3/CA1647EN/ca1647en.pdf.

Case Study 11: iFarmer – Transforming agriculture finance in Bangladesh via technology

iFarmer enables the farmer to access funding by selling the farm assets as they grow on their farm to investors for cash to cover the initial capital required. The farmer continues to look after the farm assets harvest. At harvest, iFarmer enables the sale of the farm produce through its business-to-business supply chain model, which ensures a healthy return for the farmer and the farm investor. By leveraging technology and data, iFarmer are also enabling banks and insurance companies to finance key market actors across the value chain including input retailers, farmers and traders.

Source: Extracted from iFarmer, “About Us”. Available at https://ifarmer.asia/pages/about_us.

Such policies are important when more complex applications of ICTs are involved—ones that are more demanding in terms of costs (the devices and services), capacities (skills and knowledge), and material requirements (technical infrastructure).

Moreover, these policies need to be jointly planned through involvement of other institutions, such as educational institutions, private sector providers, NGOs, developmental agencies, and the rural communities and farmers. This is to ensure their effectiveness, sustainability and inclusiveness—so that inequalities are not exacerbated because the technologies are not accessible, affordable, easily usable, safe or relevant.

The Food and Agriculture Organization (FAO) is advocating for national e-agriculture strategies that take into account all stakeholders to be drawn up, and it is critical that any digital strategy should be gender sensitive and participatory.[88]

The existence of an e-agriculture strategy and its alignment with other government plans will prevent e-agriculture initiatives from being implemented in isolation, and increase the sustainability and scalability of the initiatives

[88] FAO, “E-Agriculture Strategy Guide”. Available at http://www.fao.org/in-action/e-agriculture-strategy-guide/en/.

Something to do

1. In December 2019, China, released the Development Plan for Digital Agriculture and Rural Area (2019-2025). Review it at http://www.fao.org/3/ca7693en/ca7693en.pdf

   In summary, targets set by the plan include the following[89]:
   - By 2025, the agriculture digital economy must account for 15 per cent of China's agriculture added-value, and the proportion of agricultural products sold online should hit 15 per cent;
   - China wants to see a new generation of agricultural robots. These will track fish, diagnose diseases, and help in grazing and feeding animals;
   - AI should protect crops, generate aerial imagery and monitor yields;
   - Agricultural machinery should leverage China's homegrown satellite mapping systems, Beidou;
   - Farmers should be leveraging bid data to boost their productivity; and
   - Blockchain applications for rural finance, food safety and supply chain transparency should see breakthroughs.

2. Study FAO and ITU's " E-Agriculture Strategy Guide: Piloted in Asia-Pacific Countries" at http://www.fao.org/in-action/e-agriculture-strategy-guide/en/

3. Discuss in small groups the steps you would take to develop an e-agriculture strategy for your country. How would you ensure that it is inclusive, and contributes to rural resilience and SDG achievement?

4.1.4 SDG 3: Ensure healthy lives and promote well-being for all at all ages

The World Health Organization (WHO) and the World Bank reckon that at least half the world's population lacks access to the most essential healthcare facilities.[90]

There are two main categories of stakeholders in the health sector who can benefit from ICT support:

1. People who need healthcare, especially those people whose access to healthcare services and/or health-related information is limited; and

[89] FAO, "FAO hails first contribution to promoting digital agriculture through knowledge-sharing", 17 February 2020. Available at http://www.fao.org/e-agriculture/news/fao-hails-first-contribution-promoting-digital-agriculture-through-knowledge-sharing.Lavender Au, "China looks to robots, big data to drive agriculture forward", *technode*, 22 January 2020. Available, at https://technode.com/2020/01/22/china-looks-to-robots-big-data-to-drive-agriculture-forward/

[90] WHO and World Bank, *Tracking Universal Health Coverage: 2017 Global Monitoring Report* (2017). Available at http://documents.worldbank.org/curated/en/640121513095868125/pdf/122029-WP-REVISED-PUBLIC.pdf.

2. People who are providing healthcare services, including medical professionals such as doctors, nurses and caregivers; researchers and health managers; and policymakers in the area of healthcare.

Digital health is the umbrella term that includes all aspects of ICT use in healthcare.[91]

Telemedicine and m-health applications increase access to healthcare services

Telemedicine is where medical advice or consultation is provided over long distances via Internet, radio, telephone or other ICTs. Recent years have witnessed the extension of medical services through mobile apps (m-health).

ICTs such as wireless communications and smart mobile devices have improved access to healthcare in rural and remote communities by facilitating exchanges with doctors in urban areas (see Case Study 7 on Sehat Kahani in Pakistan).

Telemedicine and m-health applications have also improved access to healthcare in the island countries of the Asia-Pacific region, such as the Pacific Islands and the many islands of the Indonesian and Philippines archipelagos. For example, ICTs have improved prenatal care by enabling midwives to use ultrasound with the aid of mobile technology to share vital data and observations with obstetricians and gynecologists in larger hospitals.[92]

Health management information systems improves health administration

Efforts to modernize hospital and health administration have led to the development of a large number of health administration software. Digital data collection and health management information systems have enabled more efficient recording, monitoring and reporting of patient data, and supported decision-making (see Case Study 12).

[91] WHO, *Global Strategy on Digital Health 2020-2024* (2019). Available at https://extranet.who.int/dataform/upload/surveys/183439/files/Draft%20Global%20Strategy%20on%20Digital%20Health.pdf.

[92] Caroline Clarke, “Bridging the urban-rural healthcare divide in ASEAN’s island nations”, *Philips News Centre*, 17 June 2019. Available at https://www.philips.com.sg/a-w/about/news/archive/future-health-index/articles/20190617-bridging-the-healthcare-divide-in-ASEANs-island-nations.html.

Case Study 12: Moscow Unified Medical Information and Analytical System, Russian Federation

The Moscow Unified Medical Information and Analytical System is an initiative of Moscow's Information Technology Department and Healthcare Department that started in 2012. It is built with active involvement of key players of the ICT market, medical professionals and patients. It involves building both the hardware and software for an integrated health system.

Investments have been made to build: 1,800 terminals to make self-appointments with doctors; 10,000km of cables in outpatient clinics for computer networks; 200,000 sockets for new equipment; and 25,000 computers to healthcare providers (clinics and day hospitals).

The software is based on global standards of medical ICT systems for electronic health records and management. It includes services such as online appointment making and referrals, online prescription, sick leave application, laboratory information system (from the order of diagnostic tests to obtaining test results), and health analytics to improve the organization and management of the patient care process at both the city level and the clinic / hospital level.

The system integrates all outpatient clinics and day hospitals of the city's government-sponsored healthcare system. The number of users exceeds 9 million patients and 10,000 health workers. About 200,000 patients use the service daily. The system has cut waiting time for doctor's appointment in half, not exceeding 15-20 minutes, in line with international best practice.

Sources: Mos.ru, "Alexei Khripun: There is no high-tech medical service that is not currently available in Moscow", 26 February 2018. Available at https://www.mos.ru/en/news/item/36358073/; LANIT, "Development & Implementation Moscow Unified Medical Information and Analytics System (UMIAS)". Available at https://www.lanit.ru/en/projects/16805/; and Guangzhou Award Urban Innovation Database, "Moscow Unified Medical Information Analytical System (UMIAS)", 2016. Available at http://www.urban-innovations.org/innov/detail/index/rfId/240.html.

ICTs improve healthcare education

ICTs have provided access to the latest findings from medical research and enabled continuing education for healthcare professionals, which have impacted upon the quality of healthcare provision.

In many low-income countries, a critical mass of healthcare professionals, including educators for teaching hospitals, is lacking. Access to important medical literature is limited for both medical students and health workers who must keep up-to-date with

the latest developments through continuing medical education and training. ICTs have a key role to play in meeting these needs.

For example, an initiative started by a doctor in India is providing medical content in multimedia format, both online and offline, to medical students, aspiring doctors and practising health professionals.[93]

Global networks, such as the WHO-supported web portal called "Health InterNetwork Access to Research Initiative" or HINARI, are providing access to medical journals and vast online libraries either for free or at a substantially reduced subscription fee.[94]

ICTs support health emergencies

Another critical application of ICTs in health is the deployment of ICTs to predict, monitor, prevent and support public health emergencies. The availability of such systems has enabled both international agencies and national governments to monitor and anticipate outbreaks of diseases across international borders.

For instance, the protection against and treatment of highly contagious diseases such as Severe Acute Respiratory Syndrome (SARS), Middle East Respiratory Syndrome (MERS) and the avian flu have been possible because of ICT-based health surveillance systems.

The COVID-19 pandemic has brought to the fore, on the one hand, many innovative ICT solutions and their effectiveness in supporting health crisis management. On the other hand, it has revealed the inadequacies of both the ICT and health systems in terms of the infrastructure requirements and capacity needed to implement some of these ICT solutions.

The COVID-19 pandemic has also brought attention to the importance of addressing privacy and security risks of these ICT solutions.

The different types of ICT innovations available for COVID-19 response and recovery can be categorized as follows:

- Track and monitor those infected, including contact tracing and mapping;
- Predict and model the pandemic for decision-making, including identification of high-risk zones and the appropriate allocation of resources;
- Disseminate accurate and timely information to the public using different technologies such as websites, mobile apps, social media, chatbots, interactive voice response systems (IVR) and SMS;

[93] MediSys EduTech Private Limited, "SmarTeach". Available at http://www.smarteach.com.
[94] WHO, "Hinari Access to Research for Health Programme". Available at http://www.who.int/hinari.

- Diagnose and treat patients, including self-diagnosis and self-quarantine tools;
- Manage the logistics and supply chain for disinfectants, masks and personal protective equipment; and
- Platforms for multi-stakeholder collaboration.

These innovative solutions were targeted at a variety of users including individuals, businesses, health workers and policymakers.

Case Study 13 shares the Republic of Korea's experience in using ICTs to tackle COVID-19 and why they were successful.

Case Study 13: How the Republic of Korea responded to COVID-19 using ICTs

The Government of the Republic of Korea made use of ICTs to: (1) disseminate accurate and timely information; (2) diagnose and treat patients; and (3) track and monitor those infected.

Disseminate accurate and timely information

In order to promote social distancing, the Government of the Republic of Korea made use of cellular broadcasting service through telecom operators to send messages to mobile phones. This service was previously used in disaster situations in the Republic of Korea.

The government offered solutions and free services for remote learning and working. This included provision of free data packages, and donation or rental of smart tablets to low-income families. In addition, cybersecurity guidelines were issued to reduce the security risk of working and learning remotely.

An official website on COVID-19 was established (http://ncov.mohw.go.kr/en) with information on the accumulated count by region and number of tests performed. Information on finding COVID-19 screening centres, early detection of patients, use of epidemiologic surveys and isolating the close contacts of a patient was also provided.

The release of open data related to COVID-19 (https://www.data.go.kr/main.do?lang=en), including in the form of open APIs for developers, led to many local enterprises developing relevant apps for the public to cope with the COVID-19 pandemic.

For example, real-time data of publicly-distributed face masks was provided to people through mobile apps and web services, reducing confusion and inconvenience while raising distribution efficiency.

Another example was the Coronavirus Map app that informed users of the movements of confirmed patients based on information released by the Korea Centre for Disease Control and Prevention. The Cobaek app alerted users when they were within 100m of a place that a confirmed patient visited.

There was also the Medihere app that allowed patients to select the hospital they would like to visit, and make an appointment to see a doctor. They could receive remote medical advice via video call using the Telemedicine Treatment Room menu provided by the app. Prescriptions could also be sent to the pharmacy designated by the patient.

Diagnose and treat patients

In diagnosing and treating patients, test kits for COVID-19 quickly became widely available and played a major role in eliminating uncertainties in the early stages of the viral spread.

AI and big data played a significant role in supporting researchers and healthcare professionals in the diagnosis and screening of patients, and in developing appropriate responses. The Korean government provided policy support to businesses, academia and research institutes to fast track these AI-based innovations for diagnosis and treatment.

Track and monitor those infected

The Korean government developed the self-quarantine safety app to effectively support the monitoring of those under self-quarantine. The app allowed users to monitor their conditions and conduct self-diagnosis, and ensure that the self-quarantine orders were kept by setting off an alarm when the user ventured out from the designated quarantine area.

The COVID-19 Epidemiological Investigation Support System was developed to quickly identify the transmission routes and places that the infected visited by analysing real-time data from GPS, mobile information and credit-card transaction history. This analysis allowed the detection of cluster infection and showed the sources of transmission.

Factors contributing to the Republic of Korea's success in responding to COVID-19

Success factors include a strong healthcare and ICT infrastructure, early isolation and quarantine, effective communication, rapid decision-making, and transparency in reporting and tracking.

The Republic of Korea also has a strong legal and regulatory foundation, including for data protection, privacy and cybersecurity for effective crisis management. For instance, subject to regulations of the Republic of Korea, the COVID-19 Epidemiological Investigation Support System operated in a strict manner to protect privacy and security.

The scope of collected data was kept to a minimum and set procedures were followed in acquiring data. Epidemiological investigators must seek approval from relevant authorities to access the data. To protect the data gathered, access to the system was granted only to a few officials, with level of access differentiated according to the requirements of their duties.

The system ran on a private network to shield it from hacking and adopted advanced security technologies like double firewalls as well as a thorough management of log-ins. The system operated on an interim basis, with plans to delete all personal data stored upon completion of the official response to COVID-19.

Sources: Government of the Republic of Korea, “How Korea responded to a pandemic using ICT: Flattening the curve on COVID-19", 15 April 2020. Available at http://www.moef.go.kr/com/cmm/fms/FileDown.do?atchFileId=ATCH_000000000013739&fileSn=2; and World Economic Forum, "4 rules to stop governments misusing COVID-19 tech after the crisis", 15 May 2020. Available at https://www.weforum.org/agenda/2020/05/covid-19-tech-data-usage-privacy/.

Despite there being many digital health projects, the majority remain pilots, few are evaluated and even fewer are designed or assessed for scalability.[95] Case Study 14 features a WHO-ITU initiative that focuses on scaling up m-health initiatives.

Over 63 per cent of countries have implemented national digital health policies and strategies.[96] They play an important role in addressing the fragmentation of the digital health ecosystem and the lack of engagement and cross-sector collaborations. They are also essential for facilitating standards for interoperability, regulations and policies to support digital health solutions.

In order to utilize ICTs in the health field, various discussions and preparations are needed, including not only technical aspects, but also solutions of conflict with existing medical laws or privacy laws in each country and aspects of regulation, as well as detailed guidelines on responsibilities. It needs to be studied continuously via the cooperation with ICT and health experts.

[95] Meera Shekar and Kate Otto, “ICTs for Health in Africa”, 2014. Available at http://documents.worldbank.org/curated/en/553151468009030957/pdf/882290WP0Box380a0ICT0Health0summary.pdf.
[96] ITU, "Digital Health Strategies". Available at https://www.itu.int/en/ITU-D/ICT-Applications/Pages/e-health-strategies.aspx.

Multi-stakeholder collaboration is needed to realize the value and address the risks associated with implementing digital health technologies. It is important to establish mechanisms for joint action on shared goals, respecting inclusiveness and human rights. For instance, globally, women make up 70 per cent of those employed in the health sector. It is important to consider what the increase in technology in healthcare means for women.[97]

Key areas for action include the digital divide; digital health literacy; data privacy and security; data ownership rights and access; and methods to support innovation that is effective, affordable, safe, scalable and sustainable.[98]

[97] ILO, "COVID-19: Are there enough health workers?" Available at https://ilostat.ilo.org/covid-19-are-there-enough-health-workers/.
[98] WHO, *Global Strategy on Digital Health 2020-2024* (2019). Available at https://extranet.who.int/dataform/upload/surveys/183439/files/Draft%20Global%20Strategy%20on%20Digital%20Health.pdf.

Case Study 14: WHO-ITU Be He@lthy, Be Mobile initiative

The WHO-ITU Be He@lthy, Be Mobile initiative was established in 2013 to support the scale-up of digital health services for non-communicable diseases using evidence-based content and best practices. It now works with 12 countries from a range of regions and income levels, tackling issues as diverse as raising awareness on cervical cancer and diabetes, to helping people quit tobacco use.

In Asia, it is working in India and the Philippines to address tobacco addiction and diabetes. India's mTobacco Cessation programme has reached 2.4 million subscribers and its mDiabetes programme has over 100,000 users.

The programmes focus on selecting and deploying a number of digital solutions for non-communicable diseases; developing sustainability models that will help the solutions reach and maintain large-scale use; and monitoring the impact of these tools.

In India, for example, the digital solutions are implemented as part of the Prime Minister's Digital India Initiative. Its mTobacco Cessation programme allows users to register via SMS, a missed call or on a website, following which they will receive regular SMS messages offering guidance on managing cravings and coping with withdrawals, etc. Users can reply to SMS messages if they need specific support at any moment, and as their tobacco-free time increases, users will gradually receive less messages until they are tobacco-free. These activities are monitored and displayed in real time on an online dashboard that can be accessed by the programme managers to assess the effectiveness of the messages in helping users quit smoking. Similarly for the mDiabetes programme, a diabetic patient can register via SMS, a missed call or on a website, following which the patient receives regular support and advice on diabetic care and management strategies.

An evaluation of India's mTobacco Cessation programme showed that the programme achieved a 19 per cent self-reported quit rate (defined as not having used tobacco in the past 30 days) as compared with an estimated baseline population quit rate of around 5 per cent. Evaluation of India's mDiabetes programme showed ratings on the usefulness of the various digital features and received suggestions for improvement. Results from these evaluations have been used for scaling up the programmes.

The initiative's uniqueness comes from its emphasis on scale. It is also unique for its development of a multi-sectoral approach to ensure that programmes are sustainable, by bringing together stakeholders from across the m-health ecosystem—ministries of health, ministries of ICT, academia, local NGOs and private sector.

Sources: WHO, "Addressing mobile health". Available at https://www.who.int/activities/Addressing-mobile-health; WHO and ITU, *Be He@lthy, Be Mobile Annual Report 2018* (Geneva, 2018). Available at https://apps.who.int/iris/bitstream/handle/10665/326497/9789241516259-eng.pdf?ua=1; and WHO and ITU, *Be He@lthy, Be Mobile Fact Pack* (2018). Available at https://www.itu.int/en/ITU-D/ICT-Applications/Documents/Reports-BeHealthy-BeMobile/BD_BeHealthyBeMobile-FactPack_2017.pdf.

Questions to think about

What strategies should be adopted in your country to facilitate the diffusion of beneficial ICT innovations at scale and ensure that they meet the health needs of the population, including the poor and marginalized?

Refer to the content and case studies in this section and the following sources for guidance:

- WHO, *Global Strategy on Digital Health 2020-2024* (2019). Available at https://extranet.who.int/dataform/upload/surveys/183439/files/Draft%20Global%20Strategy%20on%20Digital%20Health.pdf
- Pathways for Prosperity Commission, *Positive Disruption: Health and Education in a Digital Age* (Oxford, 2019). Available at https://pathwayscommission.bsg.ox.ac.uk/positive-disruption.
- Gerald Bloom and others, "ICTs and the challenge of health system transition in low and middle-income countries", *Global Health*, vol. 13 (2017). Available at https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5547477/.

4.1.5 SDG 4: Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all

At the end of 2019, millions of children and youth were still out of school and more than half of those in school were not meeting minimum proficiency standards in reading and numeracy.[99]

The use of ICTs for education is both extensive and diverse. They have been used to bridge learning divides, enhance the quality and relevance of learning and strengthen inclusion—to provide educational access to those who, for reasons of poverty, physical disability, geographic location, gender, conflict, occupational commitments or cultural restrictions, are unable to go to school.

It started with the use of conventional media—radio and television—in countries like China and India to increase access to education, which continues to be used today together with newer technologies.

[99] United Nations Economic and Social Council, Progress towards the Sustainable Development Goals: Report of the Secretary-General - Summary, 2020 Session, 25 July 2019 - 22 July 2020. Available at https://sustainabledevelopment.un.org/content/documents/26158Final_SG_SDG_Progress_Report_14052020.pdf.

ICT-based education interventions can be broken down into four categories:

1. Providing ICT hardware and software to schools, teachers and students;
2. Computer-assisted learning using specially-designed software and online courses to improve learning outcomes;
3. Teacher training and professional development programmes on effective ICT use; and
4. ICT tools for educational administration and governance.

The COVID-19 pandemic has resulted in school closure across the world. As a result, education has changed dramatically with the rise of online learning and the creation of innovative applications that have enhanced teaching and learning. There are, however, challenges related to unequal access to devices and connectivity, and the lack of appropriate skill set that prevent participation in online teaching and learning, which can potentially widen educational gaps.

Access to ICTs

A number of ICT-based education interventions have involved placing computers in schools, initially for teacher administration and later as a learning tool for students.

From the 1980s, national research and education networks and SchoolNet initiatives emerged, connecting higher education institutions and schools, respectively, by landlines or satellite.

This was followed by the building of wireless local area networks for campuses, and then the distribution of laptops, then notebooks and finally smartphones and tablets to staff and students, reducing their reliance upon institutional investment in hardware, but increasing the demand for Internet. India, Thailand and Turkey are distributing millions of tablets to children in schools.[100]

One of the first global initiatives to provide hardware was the One Laptop per Child initiative.[101] The idea of a robust hardware that could work off a hand-driven dynamo to make it independent of local electricity supply, and came installed with local language educational software, was a good one. However, the gradual spread of electricity supplies, mobile networks and smart devices would inevitably render such features less necessary.

[100] Diwakar Kishore and Dhwani Shah, "Using technology to facilitate educational attainment: Reviewing the past and looking to the future", Background Paper 23, Pathways for Prosperity Commission, May 2019. Available at https://pathwayscommission.bsg.ox.ac.uk/sites/default/files/2019-09/using_technology_to_facilitate_educational_attainment.pdf.
[101] One Laptop per Child, “Stories”. Available at http://one.laptop.org/stories.

Yet today, access to ICTs in schools continues to be a major problem in low-income countries. The challenges include the following:[102]

- Many rural and remote regions do not have the basic infrastructure to support the use of computers due to irregular supply of electricity, lack of access to the Internet, etc.;
- Integrating ICTs (hardware and software) with the regular curriculum is a complex task that requires capacity at various levels, which can be difficult for some countries;
- The cost of deploying and maintaining hardware and software is a huge barrier for many parts of the world;
- The lack of culturally-and-linguistically appropriate and curriculum-relevant digital educational resources; and
- Students and teachers have been reluctant to change their routine to integrate ICTs. Studies have reported problems such as physical discomfort (eyestrain and headaches) caused by the use of tablets in classrooms, students leaving their tablets at home, the tablets needing regular charging, and students being distracted by games on their devices.

Despite these challenges, countries such as China have effectively integrated ICTs into the learning environment. In addition to building the ICT infrastructure for education, the development of digital learning resources and teacher training are emphasized, with incentives given to the private sector to develop innovative ICT products and services for education (see Case Study 15).

[102] Diwakar Kishore and Dhwani Shah, "Using technology to facilitate educational attainment: Reviewing the past and looking to the future", Background Paper 23, Pathways for Prosperity Commission, May 2019. Available at https://pathwayscommission.bsg.ox.ac.uk/sites/default/files/2019-09/using_technology_to_facilitate_educational_attainment.pdf.

Case Study 15: China's ICTs in education policies and strategies

China's national policy has dictated the adoption of ICTs in public sector education, driving the use of more widespread, ICT-enhanced pedagogy and resources in Chinese classrooms. This has been achieved through the Five- and Ten-Year Education Plans.

Through these plans, the government has made significant progress in enabling core infrastructure and allocating funding for hardware and software. However, some rural communities remain underserved.

To provide every public school in China with Internet by 2020, the current 10-Year Education Plan intends to provide all urban schools with access to 100MB broadband and all rural schools with at least 10MB broadband.

This vision is implemented through the Three Universal Accesses and Two Platforms initiative.

1. Universal access to broadband for all schools
2. Universal access to quality resources for all classrooms
3. Universal access to online learning spaces for all students and teachers

1. An educational service platform and marketplace for digital resources
2. An education information management platform to capture data on all students and facilities

Besides improving the hardware for education, the national education plans also emphasize the development of digital learning resources and teacher training. China's ambitions to be a global leader in AI and other high-tech fields are driving and pressuring schools to introduce digital literacy and coding earlier, which in turn require teachers to upgrade their knowledge and integrate the subjects in the curriculum.

The China Education Technology Standards (CETS) was introduced in 2004 and completion of the CETS course is now a mandatory prerequisite to obtain the national teaching certificate. In-service training under the CETS initiative has helped teachers establish core technology-related competencies.

Government policies also incentivize innovation, research and knowledge sharing in the use of ICTs for education. In China, for-profit and non-profit entrepreneurs invest and are involved in educating the public about education technologies.

Advances in technology coupled with the evolving needs and capacities of digital-native students and their parents have influenced entrepreneurs to continually improve

the design of products. This improvement includes making use of AI and big data to improve instructional quality and deliver personalized learning experiences.

Overall, a clear vision and strategy for ICTs in education from the highest level of the education system has served as a collective roadmap.

Source: Omidyar Network, "Scaling Access and Impact: Realizing the Power of EdTech – China Country Report", March 2019. Available at https://www.omidyar.com/sites/default/files/EdTech%20Country%20Reports/Scaling%20Access%20and%20Impact_China%20Report_.pdf.

Educational software and content

The development of educational software for teaching and self-learning has initially been slow. In the 1990s, educational software delivered through CD-ROMs and later DVD-ROMs supported distance learning initiatives that provided educational opportunities for those unable to access the conventional education system.

As the Internet becomes more widely accessible, it is being increasingly replaced by online video materials available on social media and more dedicated educational platforms. They include open educational resources (OERs) and online courses offered by universities and commercial groups called massive open online courses (MOOCs).

OERs are any type of educational materials that are in the public domain or introduced with an open license. The nature of these open materials means that anyone can legally and freely copy, use, adapt and re-share them. OERs range from textbooks to curricula, syllabi, lecture notes, assignments, tests, projects, audios, videos and animations. [103] An example is the Massachusetts Institute of Technology OpenCourseWare that provides free and open access to all its course content.[104] Educational institutions in many Asian countries have released OERs.[105]

Case Study 16 showcases an organization in Mongolia that has used OERs to develop quality digital content in collaboration with universities, and worked with government to build the ICT competency of teachers.

[103] UNESCO, "What are Open Educational Resources (OERs)?" Available at http://www.unesco.org/new/en/communication-and-information/access-to-knowledge/open-educational-resources/what-are-open-educational-resources-oers/.
[104] Massachusetts Institute of Technology OpenCourseWare. Available at https://ocw.mit.edu.
[105] Ramesh C. Sharma, "OER in Asia: Examples", 23 June 2019. Available at https://www.slideshare.net/rc_sharma/selected-examples-of-oer-in-asia.

Case Study 16: ONE Academy, Mongolia

In Mongolia, the Open Network for Education (ONE) launched a project in 2014 called ONE Academy to adapt free educational resources from the popular open educational platform—Khan Academy—which provides exercises, instructional videos and a personalized learning dashboard for learners to study at their own pace.

ONE Academy collaborated with the National University of Mongolia and the Mongolian State University of Education to implement this project. Professional teachers from these universities translated over 1,000 video lessons from Khan Academy into Mongolian languages.

In addition, the ONE Academy team conducted training for teachers to help them bring the e-learning technology into their classrooms.

By 2016, ONE Academy's training on the concepts and practices for using OERs to support effective teaching and learning was incorporated into professional development courses conducted by the Institute of Teachers' Professional Development of the Ministry of Education, Culture and Science for primary and secondary school teachers.

Source: Extracted from ESCAP, "Inclusive Use of Broadband Connectivity for Quality Education: Insights from Asia and the Pacific", Asia-Pacific Information Superhighway Working Paper Series, September 2019. Available at https://www.unescap.org/resources/inclusive-use-broadband-connectivity-quality-education-insights-asia-and-pacific.

MOOCs are courses made available over the Internet to a very large number of people. Anyone who decides to learn online can log on to the given website and sign up for the course. Popular MOOC platforms include Coursera, edX, FutureLearn and Udacity. Some courses charge a small fee for academic credit or certification.

Although MOOCs offer many benefits—they are often free, and can be used anywhere and anytime for formal or informal learning—studies have shown low completion rates of MOOCs (around 5 per cent). There is also little concrete evidence to date of their effectiveness in increasing access to education, especially since they require broadband Internet access.

Language remains a significant barrier as most of the MOOCs are currently in English.[106] The official recognition of the certifications issued by these education

[106] Diwakar Kishore and Dhwani Shah, "Using technology to facilitate educational attainment: Reviewing the past and looking to the future", Background Paper 23, Pathways for Prosperity Commission, May 2019. Available at https://pathwayscommission.bsg.ox.ac.uk/sites/default/files/2019-09/using_technology_to_facilitate_educational_attainment.pdf.

providers for employment, and the ability to accumulate and transfer academic credits across educational systems are also challenges that need to be addressed.[107]

To tackle these issues, some countries have developed their own MOOC platform in local languages. See Case Study 17 for details about Thai MOOC

Case Study 17: Thai MOOC

Thai MOOC was established in 2017 through a partnership between the Thailand Cyber University of the Office of the Higher Education Commission, National Science and Technology Development Agency and Ministry of Digital Economy and Society, to promote lifelong learning. Thai MOOC cooperates with educational networks nationwide in inviting faculty members or experts from educational institutions to produce courses for Thai learners.

Emphasis on certification and credit transfer

As of 2019, nine universities are using the Thai MOOC platform and have developed around 300 courses that 94,000 users are enrolled in. The platform has a credit bank system that enables learning credit transfers between courses in a university. Details of credit transfer between universities are being worked out.

Importance of data to improve learning outcomes and develop standards

Thai MOOC is in the process of developing digital learning standards and guidelines for quality assurance of Thai MOOC courses. The learning records and other relevant data of users are being collected for research and improvement of Thai MOOC.

Provision of training for quality assurance

The initiative includes the provision of training for instructors, instructional designers and others involved in creating the learning resources. They must complete three self-paced learning modules to qualify to open a course and teach on the Thai MOOC platform.

Partnerships are vital

Thai MOOC is actively seeking partnerships with other entities to build its platform and increase the number of courses available, such as the Asian Association of Open

[107] APCICT, "Open and Distance Learning in Asia and the Pacific", ICTD Case Study 3, 2014. Available at https://www.unapcict.org/resources/ictd-infobank/apcict-case-study-series-open-and-distance-learning-odl.

Universities, and with government agencies such as the Digital Economy Promotion Agency on courses for SMEs and farmers.

A common vision for educational development is needed

The development of Thai MOOC is in line with a number of policies and plans such as:

- Twenty-Year National Strategic Plan (2018-2037)
- Long Term Higher Education Framework (2008-2022)
- Five-Year Digital Plan for Economic and Social Development (2017-2021) with a target of at least 2 million people accessing MOOCs by 2021
- Digital Plan for Education (2018-2021)

Sources: Thai MOOC. Available at https://thaimooc.org/; and Anuchai Theeraroungchaisri and Jintavee Khlaisang, "Thai MOOC Sustainability: Alternative Credentials for Digital Age Learners", Proceedings of EMOOCs 2019, 2019. Available at http://ceur-ws.org/Vol-2356/experience_short20.pdf.

Teacher training

One of the main hurdles in ICTs for education initiatives is the lack of teachers with appropriate digital skills.

As teachers are key to the effective use of ICTs in the classroom, teachers need to develop both the technical and pedagogical skills for ICT-supported teaching and learning.

Challenges related to teachers' workload, willingness to learn a new ICT tool, classroom size and the quality of ICT-based learning materials also need to be addressed.

The success of Singapore's ICTs in education effort was largely due to the extensive training of teachers on teaching in an ICT-enhanced environment—even before computers were placed in schools.

Bhutan entered into a partnership with the Singapore International Foundation to systematically introduce teachers to ICTs through several training programmes in their colleges of education. The effort was synchronized with the deployment of hardware in schools for the teachers to use in ICT-supported lessons. After the first round of teacher training, the second phase saw the integration of ICTs into the curriculum as a requirement in the Bachelor of Education programme.[108]

[108] Philip Wong, "Bhutan 'Support for Teacher Education' Project", in *ICT in Teacher Education: Case Studies from the Asia-Pacific Region*, Ellie Meleisea, ed. (Bangkok, UNESCO, 2007), pp. 3-9. Available at http://www.unescobkk.org/index.php?id=7035.

Studies evaluating the difference in ICT skills training for pre-service and early in-service teachers have found that pre-service teachers perform marginally better. This may be explained by the flexible attitude of pre-service teachers compared to the resistance to change that in-service teachers may demonstrate. While investing in ICT training for pre-service teachers could have more impact, it makes sense to have more ICT training investment for in-service teachers, as they constitute the larger portion of the teaching force in most countries.[109]

A restructuring of pre-service and in-service teacher training programmes is essential. UNESCO's "ICT Competency Framework for Teachers"[110] is a policy tool to guide effective pre- and in-service teacher training. The framework aims to empower teachers to become facilitators and lifelong learners to engage students in collaborative, innovative and problem-solving activities beyond simple ICT skills.

Educational administration and governance

At the school level, ICTs have been used for administration and payroll. ICTs have also been used to communicate with stakeholders, such as the use of SMS and instant messaging apps for teacher-parent communication to report on student progress, increase parents' engagement with children's learning, and reduce student absenteeism and drop out.

At the country level, education management information systems can provide quality data that facilitate evidence-based education system planning and policy dialogue.

Related to Case Study 15, in line with China's national education policy, the Chinese government is setting up a national education information management platform for aggregating and storing students' data on tests, enrolment, study and employment. Once completed (expected in early 2020s), the data available on the platform can be leveraged for improving teaching and learning.

However, the massive centralization of student- and school-level data may raise concerns about student privacy and ethical use of data.

Educational policy and planning

Overall, the potential of ICT use in education is clear in many regards, particularly when it is introduced in the context of system-wide reform in educational policies and

[109] Diwakar Kishore and Dhwani Shah, "Using technology to facilitate educational attainment: Reviewing the past and looking to the future", Background Paper 23, Pathways for Prosperity Commission, May 2019. Available at https://pathwayscommission.bsg.ox.ac.uk/sites/default/files/2019-09/using_technology_to_facilitate_educational_attainment.pdf.
[110] UNESCO, *ICT Competency Framework for Teachers, Version 3* (Paris, 2018). Available at https://unesdoc.unesco.org/ark:/48223/pf0000265721.

practices that increases access to ICTs alongside teacher training on how to use the technology, curriculum reforms, reducing class size and teaching at the right level (with the use of extra teachers and/or teaching aids).

The development of national ICT in education plans in a holistic and collaborative manner that aim to use ICTs to remove barriers to education and enhance the quality of education is encouraged.[111]

It is important to note that rigorous evidence on the impact of ICTs on learning outcomes remains patchy.[112] Policy decisions and intervention designs have often been informed more by belief and marketing than by evidence because there simply has not been much evidence to draw on.[113]

Questions to think about

Do you have evidence of what works (and what does not work) to accelerate, spread and scale ICT-based education interventions to deliver better learning outcomes for all children, including the most marginalized in rural and remote areas?

4.1.6 Key Points

Poverty

- Poverty is often defined by one-dimensional measures—usually based on income. But poverty is multidimensional. Poor people experience various deprivations in their daily lives, including poor health, lack of education, disempowerment, poor quality of work, the threat of violence, and living in areas that are environmentally hazardous, among others.

- We need to approach the multidimensional aspects of poverty through multi-stakeholder, cross-sectoral partnerships in order to accelerate the implementation

[111] ESCAP, "Inclusive Use of Broadband Connectivity for Quality Education: Insights from Asia and the Pacific", Asia-Pacific Information Superhighway Working Paper Series, September 2019. Available at https://www.unescap.org/resources/inclusive-use-broadband-connectivity-quality-education-insights-asia-and-pacific.

[112] Diwakar Kishore and Dhwani Shah, "Using technology to facilitate educational attainment: Reviewing the past and looking to the future", Background Paper 23, Pathways for Prosperity Commission, May 2019. Available at https://pathwayscommission.bsg.ox.ac.uk/sites/default/files/2019-09/using_technology_to_facilitate_educational_attainment.pdf.

[113] A Research and Innovation Hub on Technology for Education (https://edtechhub.org/) has been established in 2019 to synthesize existing evidence, conduct new research, support innovations to scale, and provide advisory support. Michael Trucano, “A new research hub on the use of technology in education in developing countries”, *World Bank Blogs*, 28 January 2019. Available at https://blogs.worldbank.org/edutech/new-research-hub-use-technology-education-developing-countries.

of the SDGs. It will require a whole-of-government approach as well as engagement with the private sector and civil society.

- Through whole-of-government approaches and partnerships, governments have used ICTs to address issues relating to poverty eradication, including its multidimensional nature. The initiatives often focus on rural development to bridge the rural-urban digital divide.

- Besides a top-down model initiated by national government, bottom-up interventions from civil society and community-based organizations have emerged to complement government efforts in reducing rural poverty using ICTs. It is important that governments enable such bottom-up initiatives.

Gender

- The SDGs cannot be achieved unless gender disparities and discriminations are addressed, and women and girls are empowered and provided with equal opportunities. However, many development policies and programmes remain gender blind, including ICT policies and programmes.

- ICTs hold enormous potential for the empowerment of women and girls, by enabling access to online and mobile learning, as well as increased employment opportunities and engagement in e-commerce. ICTs have also enabled women to organize advocacy campaigns for women's rights, and participate in online forums to voice their views and concerns.

- For ICTs to fully benefit women, the gender digital divide must be bridged. This includes not only ensuring that women have access to a device and broadband Internet, but are also equipped with the skills to use ICTs to improve their livelihood and social status.

- Yet, social media is a double-edged sword. Women and girls can learn about their rights and find their voice. But social media platforms are also frequently used to monitor, harass, threaten, intimidate, impersonate and stalk victims.

- Technology-facilitated gender-based violence that disproportionately impacts women and girls must be addressed in a holistic manner. This involves a combination of legislative reforms, capacity building of law enforcement agencies and the judiciary, and coordinated online safety programmes in schools and for the public.

Agriculture

- Two-thirds of the extremely poor earn their livelihood in farming, and productivity growth in agriculture has the largest impact of any sector on poverty reduction. ICTs can help farmers optimize their farming operations and increase revenues.

- Precision farming is making use of satellite technology, sensors, drones, cloud computing and mobile apps to ensure farming profitability, sustainability and protection of the environment.

- Besides boosting agricultural productivity, ICTs have facilitated farmers' linkages to markets, including removal of intermediaries, which have helped to reduce transaction costs and improve agricultural value-chain processes.

- Although farmers with even very small holdings can potentially benefit from these frontier technologies, poor farmers in more remote areas without the expertise, digital skills or resources to invest in these technologies are mostly excluded.

- Policymakers can assist poor farmers adopt smarter methods of farming through a combination of funding, education and skills training, and possibly through some variant of contract farming as an incentive for them to adopt smart techniques.

- In addition to promoting the use of ICTs, policymakers need to make available complementary resources to bring about changes in the institutions and structures of the wider livelihood system. Examples include policies that encourage the expansion of power and telecommunications infrastructure, education, and availability of finance in rural areas.

- Such policies are important when introducing more complex applications of ICTs that can potentially bring about greater impact to the farming communities and the agricultural sector.

- These policies need to be jointly planned through involvement of other institutions, such as educational institutions, private sector providers, NGOs, developmental agencies and the rural communities and farmers. This is to ensure their effectiveness, sustainability and inclusiveness.

- The existence of an e-agriculture strategy and its alignment with other government plans will prevent e-agriculture initiatives from being implemented in isolation, and increase the sustainability and scalability of the initiatives.

Health

- Digital health is the umbrella term that includes all aspects of ICT use in healthcare.

- Telemedicine and m-health applications increase access to healthcare services, particularly for rural and remote communities, and island countries.

- Digital data collection and health management information systems have enabled more efficient recording, monitoring and reporting of patient data, and supported decision-making.

- ICTs have provided access to the latest findings from medical research, and enabled continuing education for healthcare professionals.

- ICTs have supported public health emergencies by predicting, preventing, monitoring and tracking disease outbreaks.

- The COVID-19 pandemic has brought to the fore, on the one hand, many innovative ICT solutions and their effectiveness in supporting health crisis management. On the other hand, it has revealed the inadequacies of both the ICT and health systems in terms of the infrastructure requirements and capacity needed to implement some of these ICT solutions.

- The COVID-19 pandemic has also brought attention to the importance of addressing privacy and security risks of these ICT solutions.

- Despite there being many digital health projects, the majority remain pilots, few are evaluated and even fewer are designed or assessed for scalability.

- National digital health policies and strategies play an important role in addressing the fragmentation of the digital health ecosystem and the lack of engagement and cross-sector collaborations. They are also essential for facilitating standards for interoperability, regulations and policies to support digital health solutions.

Education

- The use of ICTs for education is both extensive and diverse.

- There are interventions that focus on providing ICT hardware and software to schools, teachers and students, but on their own, they have often not worked well.

- This is because many rural and remote regions do not have the basic infrastructure to support the use of ICTs due to irregular supply of electricity and lack of access to the Internet; the cost of deploying and maintaining the ICTs is a huge barrier; teachers are not trained on the use of ICTs in the classroom; and there is a lack of culturally-and-linguistically appropriate and curriculum-relevant digital educational resources.

- ICT use in education needs to be introduced in the context of system-wide reform in educational policies and practices that increases access to ICTs alongside teacher training on how to use the technology and curriculum reforms.

- OERs and MOOCs have contributed to self-learning and lifelong learning. Language remains a significant barrier as most of the OERs and MOOCs are currently in English, although there have been efforts to localize them.

- The official recognition of the certifications issued by these education providers for employment, and the ability to accumulate and transfer academic credits across educational systems are challenges that need to be addressed.

- Education management information systems can provide quality data that facilitate evidence-based education system planning and policy dialogue.

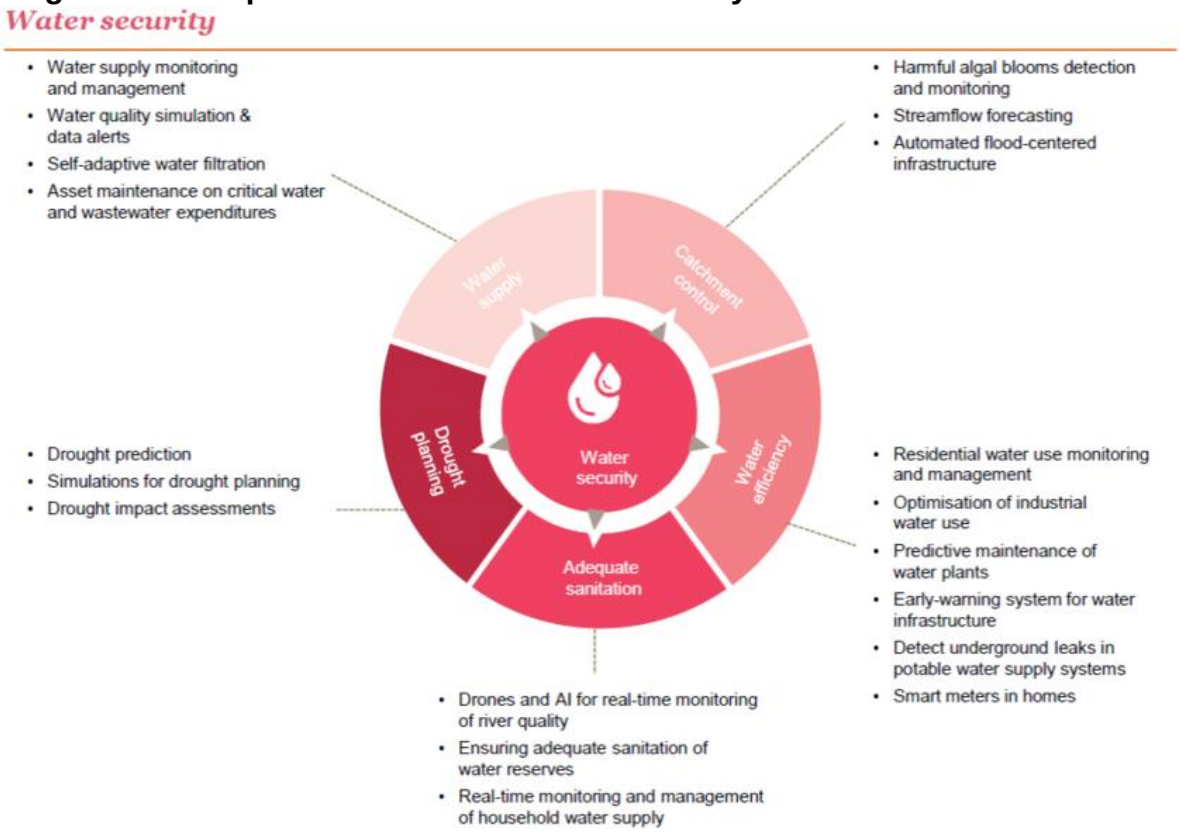
- The development of national ICT in education plans in a holistic and collaborative manner that aim to use ICTs to remove barriers to education and enhance the quality of education is encouraged.

4.2 Planet

In the Academy of ICT Essentials for Government Leaders, there are two modules entitled, "ICT, Climate Change and Green Growth" and "ICT for Disaster Risk Management" that are relevant to this section.[114]

4.2.1 SDG 6: Ensure availability and sustainable management of water and sanitation for all

Figure 9: Examples of ICT use for water security



Source: Will Sarni and Callie Stinson, "Innovation can transform the way we solve the world's water challenges", *World Economic Forum*, 24 August 2018. Available at https://www.weforum.org/agenda/2018/08/the-fourth-industrial-revolution-can-transform-how-we-solve-the-worlds-water-crises.

There are numerous ways in which ICTs are being used to address the scarcity, quality and distribution of water supplies in ways that support SDG 6 (Figure 9). They include the monitoring and evaluation of water systems using sensors to detect faults in pipes and pumps, sending alerts, locating groundwater reserves, measuring sanitation levels, and the installation of smart (connected) meters that not only allows for remote monitoring but also opens up opportunities to offer consumers incentives to reduce usage.

[114] See http://www.unapcict.org/flagship-programmes/academy.

A World Bank study identifies five major ways ICTs can help with water management and improving services as follows:[115]

1. **Reduces the duration and costs of monitoring and inventory activities** – ICTs can help make data transfer more efficient, reduce manual data errors and increase the frequency of monitoring. The data can then be mapped and analysed to support decision-making;

2. **Improves efficiency gains of water service providers throughout the supply chain** – ICTs can enable shortened response time, reduce travel distance and maintenance costs, optimize operations (production costs, energy efficiency, etc.) and improve quality of service (see Case Study 18);

3. **Improves collection rates of water service providers through ICT-based payment systems** – Some of the most common ICTs adopted by utilities are e-payment systems that offer payment facilitation and increased reliability in billing and payment recovery, reduced administrative and payment transaction costs, and improved revenue collection;

4. **Ensures better services to the poor** – Mobile phones are widespread and relatively low-cost communication option for rapid information transfer and service facilitation; and

5. **Strengthens citizen voice and accountability framework** – ICTs can be used to promote public participation and create a system of transparency and accountability.

[115] Fadel Ndaw, "5 potential benefits of integrating ICTs in your water and sanitation projects", *World Bank Blogs*, 30 July 2015. Available at https://blogs.worldbank.org/water/5-potential-benefits-integrating-icts-your-water-and-sanitation-projects.

Case Study 18: Melbourne, Australia cuts water treatment costs using AI

Melbourne Water, a utility company, is trialling a custom-developed platform that coordinates pump movement depending on the amount of treated water required on a given day, producing the most efficient use of energy.

The platform, called Python, has the benefit of being tailored to the demands of the company's systems, and was created in-house by one of Melbourne Water's data analysts. When in operational mode, the programme determines optimal pump calibrations and sends them directly to the pump system without human intervention. AI then determines the best settings and applies them in real time.

The Python programme utilizes historical data to determine the most energy efficient combinations of pumps and the associated speeds to run them at, in order to achieve the necessary flow rate.

The project has been tested at one of the treatment plants, where energy costs are expected to drop by 20 per cent.

The utility has made cybersecurity provisions to ensure hacking risks are minimized as the AI programme is not linked to the wider network. The local control system also has rules built in to its code to ensure the AI system can only optimize the pump operations within set parameters. This is an important fail-safe feature to ensure production can continue even when the AI system fails.

Source: Adapted from Harry Wells, "Melbourne cuts water treat costs using AI", *Cities Today*, 28 June 2018. Available at https://cities-today.com/melbourne-cuts-water-treatment-costs-using-ai/.

Like other sectors, water management and governance must adopt a holistic and cross-sectoral approach in working with multiple stakeholders to achieve the SDGs.

For example, agriculture accounts for around 70 per cent of global water withdrawals. Improving the efficiency of this sector will play a major role in the sustainability of the world's water resources. Knowing when to irrigate crops and how much water to use is crucial to maximizing yields. Wireless sensors are being used in the fields to monitor humidity levels and soil moisture, and can automatically turn on irrigation systems, based on the specific needs of the crops at a particular location and point in time.[116]

[116] Guy Ryder, "How ICTs can ensure the sustainable management of water and sanitation", *ITU News*, 22 March 2018. Available at https://news.itu.int/icts-ensure-sustainable-management-water-sanitation/.

4.2.2 SDG 12: Ensure sustainable consumption and production patterns

The Asia-Pacific region has regressed on sustainable consumption and production (see Figure 2) and urgently needs to reverse material consumption and footprint trends to meet the goal, notwithstanding progress on individual targets. Rising incomes and lifestyle changes and continued resource-intensive growth patterns are expected to further exacerbate resource depletion and ecosystem degradation. Concerted public and private action is needed to increase resource efficiency, fundamentally shift consumption patterns and production processes, improve waste management systems, and transition towards a more circular economy approach.[117]

ICTs have a part to play in sustainable consumption and production. On the production side, ICTs are already playing a role in increasing the efficiency of supply chains and reducing the carbon footprints associated with them.

Countries that have developed i4.0 strategies often aim to bring productivity to higher levels by reducing waste and improving the efficiency of production processes via more precise real-time planning using ICTs (see Section 4.3.3).

On the consumption side, there has been a focus on the use of ICTs to reduce food wastage, such as information systems to redistribute surpluses.[118] Additionally, social media has been used to raise awareness and change consumer behaviour towards buying eco-friendly products, which in turn puts pressure on companies to shift to more sustainable production practices.[119]

At each segment of the journey along a supply chain, ICTs have a part to play, but as is always the case, only if there are the right policies and oversights in place, such as providing incentives and supporting businesses that have positive environmental impacts.

Governments can foster a sharing economy to reduce waste

The sharing economy has grown rapidly in the Asia-Pacific region across different sectors including transport, housing, office rental and catering. For example, sharing cars and motorcycles is now common in Indonesia, Malaysia, the Philippines, Singapore and Thailand. Car sharing in the Netherlands has been found to reduce car

[117] ESCAP, "SDG 12 Goal Profile". Available at https://www.unescap.org/resources/sdg12-goal-profile.
[118] Molla E. Majid, “Role of ICT in promoting sustainable consumption and production patterns – A guideline in the context of Bangladesh”, *Journal of Environmental Stability*, vol. 6, no. 1 (2018). Available at https://scholarworks.rit.edu/cgi/viewcontent.cgi?article=1062&context=jes.
[119] Olivia Valentine, "Social Media's Influence on Green Consumerism", *We Are Social*, 6 November 2019. Available at https://wearesocial.com/blog/2019/11/social-medias-influence-on-green-consumerism.

ownership by 30 per cent, which in turn has reduced annual car-related carbon dioxide (CO_2) emissions by 13-18 per cent.[120]

In general, countries with large sharing economies tend to have reliable and speedy Internet connectivity, wide use of mobile phones and satisfactory availability of online banking or payment systems. Digital literacy and favourable regulations are also important.

E-Waste and the fostering of a circular economy

It is important to recognize that the ICT industry is contributing to unsustainable consumption and production through e-waste.

A United Nations University report shows that the Asia region accounts for the majority of electrical and electronic equipment sales, and generates the highest volume of e-waste, estimated at 16 million tonnes in 2014.

The volume of discarded electronics in East and South-East Asia jumped almost two-thirds between 2010 and 2015, driven by rising incomes and high demand for new gadgets and appliances. However, on a per capita basis, this amounts to 3.7kg per inhabitant, which is four times lower than per capita waste generated by Europe and North America.[121]

The report warns of improper and illegal e-waste dumping prevalent in most countries, irrespective of national e-waste legislation. The main reasons are:[122]

- Lack of awareness on how or where to dispose of e-waste;
- Lack of incentives – Users choose to ignore collection and/or recycling systems, especially if they need to pay for them;
- Lack of convenience to dispose e-waste through existing systems;
- Absence of suitable sites for hazardous waste disposal where residues from e-waste recycling can be sent; and
- Weak governance and lax enforcement of e-waste legislation.

[120] ESCAP, *Economic and Social Survey of Asia and the Pacific 2020: Towards Sustainable Economies* (Bangkok, 2020). Available at https://www.unescap.org/publications/economic-and-social-survey-asia-and-pacific-2020.
[121] United Nations University and ITU, *Global E-Waste Monitor* (Bonn, 2017). Available at https://globalewaste.org/.
[122] United Nations University, "E-Waste in East and South-East Asia Jumps 63% in Five Years", 15 January 2017. Available at https://unu.edu/media-relations/releases/e-waste-in-east-and-south-east-asia-jumps-63-percent-in-five-years.html.

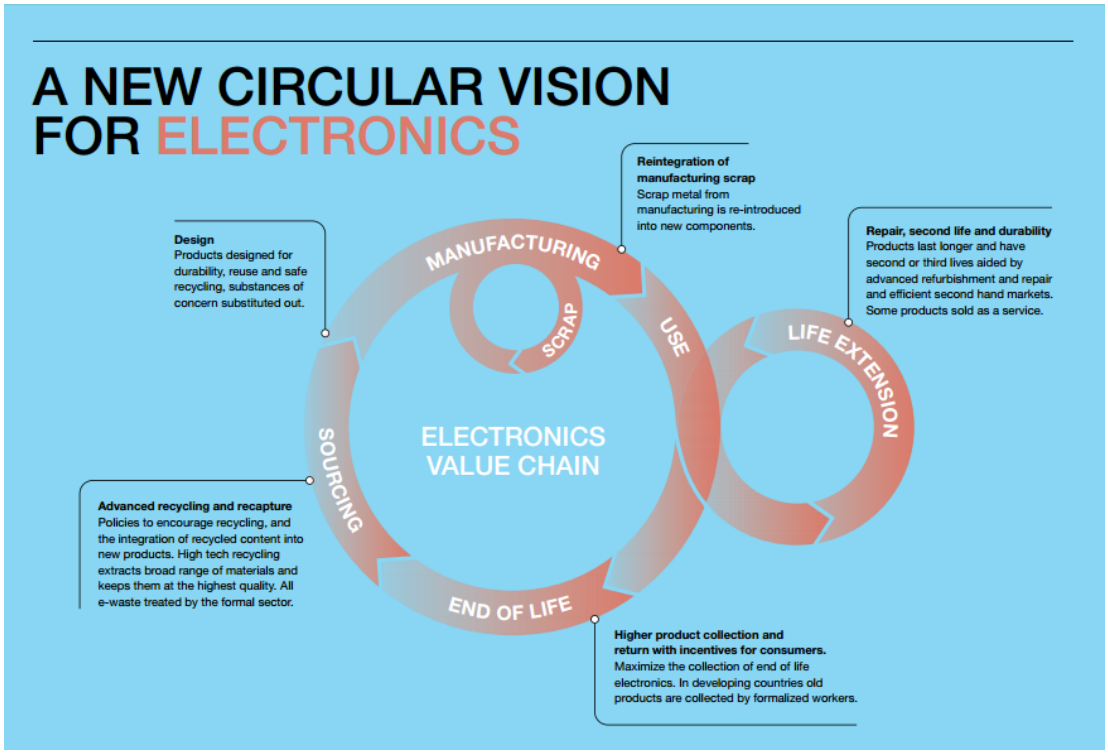
The illegal dumping and informal recycling of e-waste are not only hazardous for the recyclers, their communities and the environment, but they are also inefficient, as they are unable to extract the full value of the processed products.[123]

For low-income countries, rather than becoming dumping grounds for the toxic waste coming from more developed countries, there are opportunities to pioneer new methods of recycling and new materials that are either biodegradable, re-usable or simply long-lasting.

Governments can foster a circular economy that replenishes the resources used in consumption and production. A circular economy is aimed at the continual use of resources and the elimination of waste. This is in contrast to the traditional linear model of production of "take–make–dispose".[124]

The circular economy is gaining importance among the developing countries and in the Asia-Pacific region where i4.0 strategies focus on adopting more resource-efficient and non-linear approaches.[125]

Figure 10: A circular vision for electronics



Source: World Economic Forum, "A New Circular Vision for Electronics", January 2019. Available at https://www.itu.int/en/ITU-D/Climate-Change/Documents/2019/A-New-Circular-Vision-for-Electronics.pdf.

[123] Ibid.
[124] Ellen MacArthur Foundation, "The Circular Economy in Detail". Available at https://www.ellenmacarthurfoundation.org/explore/the-circular-economy-in-detail.
[125] ESCAP, "SDG Help Desk: Circular Economy". Available at http://sdghelpdesk.unescap.org/knowledge-hub/thematic-area/circular-economy.

Figure 10 shows a circular vision for electronics developed at the Platform for Accelerating the Circular Economy hosted by the World Economic Forum in 2019.

See Case Study 19 for an example of how a social enterprise is promoting a circular economy in Indonesia and the Philippines, and empowering the poor.

Case Study 19: Plastic Bank promotes a circular economy and empowers the poor

Plastic Bank is a social enterprise that started in Haiti in 2014 and has expanded to Indonesia and the Philippines.

Plastic Bank empowers the plastic recycling ecosystem by providing a consistent, above-market rate for plastic waste, incentivizing its collection and allowing collectors to earn a liveable income. Plastic collected at Plastic Bank branches is recycled and the raw material sold as “Social Plastic” to companies who want to create a more sustainable, eco-friendly and socially-responsible supply chain for their products.

Collectors can exchange plastic waste for money, blockchain-secured digital tokens, services or goods. For example, collectors can use the digital tokens to send their children to school through Plastic Bank education initiatives or apply for health insurance. Collectors can also use the digital tokens to purchase goods at the Plastic Bank branches.

Plastic Bank has developed a blockchain-based transaction platform with IBM to track the entire cycle of recycled plastic from collection, credit and compensation through delivery to companies for re-use. An app has been developed for collectors that also functions as a digital wallet, many of whom have never had a bank account before, thus introducing them to financial services and encouraging saving.

Sources: Plastic Bank, "SC Johnson". Available at https://plasticbank.com/sc-johnson/; MIT Solve, "Plastic Bank". Available at https://solve.mit.edu/challenges/RethinkPlastics-en/solutions/17263; Sheridan Prasso, “Treating Plastic as Currency Helps Keep It Out of the Ocean", *Bloomberg*, 29 October 2019. Available at https://www.bloomberg.com/news/articles/2019-10-28/plastic-bank-is-turning-plastic-into-currency; and David Katz, "Plastic Bank: Launching Social Plastic Revolution", *Journal of Field Actions*, Special Issue 19 (2019). Available at https://journals.openedition.org/factsreports/5478.

Lao PDR's Ministry of Energy and Mines with support from UNDP developed the “Circular Economy Strategies for Lao PDR”.[126] As part of the strategy for its existing industries to make better use of recycled or bio-based materials, the priorities include

[126] Ministry of Energy and Mines, Government of Lao PDR and UNDP, *Circular Economy Strategies for Lao PDR* (Vientiane, 2017). Available at https://www.undp.org/content/dam/undp/library/Climate%20and%20Disaster%20Resilience/undp-lecb-circular-economy-strategies-for-laos-pdr-20170911.pdf.

the recovery of end-of-life motorcycle and vehicle parts, the use of recycled and sorted fibres in the textile industries, and the safe and efficient recovery of metals from e-waste using bioleaching.

Bioleaching is a technology that can reduce the environmental impact of mining and e-waste processing. It is an extraction method that makes use of bacteria rather than hazardous chemicals, like arsenic or cyanide, for the extraction of metal from ores or e-waste.

The document recommends formalizing the e-waste sector and supporting its development, while improving labour conditions, extraction techniques and resource management.

Questions to think about

- How will you put a circular economy into practice in your country?
- What barriers do you anticipate in implementing a circular economy business model?
- Can ICTs play a role in supporting your circular economy business idea?

4.2.3 SDG 13: Take urgent action to combat climate change and its impacts

The Asia-Pacific region is home to 6 of the top 10 global carbon emitters, contributing to over half of the world's total greenhouse gases and is highly vulnerable to climate-induced disasters and extreme weather events. Addressing the impacts of climate change implies dealing with the increased variability, intensity and frequency of extreme events. Increased incidence and intensity of heatwaves, dust storms, floods and droughts call for enhanced modelling capabilities to better assess climate change and disaster risks. Asia is home to four-fifths of people who will face flooding if there is a 3°C rise in global temperatures.[127]

Climate change and associated disasters fundamentally threaten development in Asia-Pacific and disasters disproportionately burden the poor and the most vulnerable groups. Environmental depletion and climate-induced changes have a disproportionate impact on women and add increased pressures on women's time, income, health, nutrition and social support systems.[128]

[127] ESCAP, "SDG 13: Climate Action". Available at https://www.unescap.org/apfsd/6/document/sdgprofiles/Goal%2013_2019_04_10.pdf.
[128] United Nations Economic and Social Council, Review of the progress and remaining challenges in implementation of the Beijing Declaration and Platform for Action in Asia and the Pacific, Asia-Pacific Ministerial Conference on the Beijing+25 Review, 27-29 November 2019. Available at https://www.unescap.org/sites/default/files/Review_of_progress_%28ENG%29.pdf.

While there are positive steps in terms of climate finance flows and the development of nationally determined contributions, far more ambitious plans and accelerated action are needed on climate mitigation and adaptation.

A report, entitled "Exponential Climate Action Roadmap"[129] and co-authored by a number of organizations, examines the solutions for halving global CO_2 emissions by 2030. It concludes that extensive use of digital technologies will be required, as a third of the solutions identified are enabled by existing ICT solutions.

The ICT industry's contribution to climate action

The Broadband Commission for Sustainable Development reports that the ICT industry's own carbon footprint has stayed flat for several years at a level of 1.4 per cent of global emissions, despite significant growth in the sector to manufacture, distribute and power devices, and establish and maintain data centres and related infrastructural needs.[130]

However, Asia as a hub for the manufacture of smartphones is growing with manufacturers from India, Indonesia, the Philippines, Thailand and Viet Nam joining the established brands from China, Japan and the Republic of Korea. This means greater energy usage and associated greenhouse gas emissions, as many of these countries are heavily dependent on coal and other fossil fuels.[131]

An emerging solution to reduce carbon emissions in the telecommunications sector is the replacement of diesel fuel to power off-grid mobile cellular base stations with renewable energy sources.

Cellcard, a leading telecommunications company in Cambodia, uses solar hybrid technology for over half of its mobile sites, reducing CO_2 emissions by 100,000 metric tonnes over a 10-year period. In Sri Lanka, tree-based biomass and crop production by-products (such as rice straw and rice husk) are being used for power generation.[132]

Many large technology corporations are doing their part to tackle climate change. For example, Facebook designs, builds and operates some of the most sustainable data centres in the world. Its Open Compute Project servers can operate in a higher temperature environment with greater efficiency than traditional equipment. This

[129] Exponential Roadmap version 1.5.1. Available at https://exponentialroadmap.org/ (accessed on 18 May 2020).
[130] Broadband Commission for Sustainable Development, *The State of Broadband 2019* (2019). Available at https://www.itu.int/dms_pub/itu-s/opb/pol/S-POL-BROADBAND.20-2019-PDF-E.pdf.
[131] ESCAP, *Economic and Social Survey of Asia and the Pacific 2020: Towards Sustainable Economies* (Bangkok, 2020). Available at https://www.unescap.org/publications/economic-and-social-survey-asia-and-pacific-2020.
[132] Broadband Commission for Sustainable Development, *The State of Broadband 2019* (2019). Available at https://www.itu.int/dms_pub/itu-s/opb/pol/S-POL-BROADBAND.20-2019-PDF-E.pdf.

lowers the amount of energy needed to keep its servers cool and makes it possible for Facebook data centres to use outdoor air for cooling instead of energy-intensive air-conditioning units.[133]

Google reports that it has reduced energy use by 50 per cent since 2014 by establishing advance temperature management practices to cut facility energy use.[134] Apple has achieved 100 per cent renewable electricity for its operations worldwide.[135]

NTT Docomo, the predominant mobile operator in Japan, has developed weather forecast-linked green base stations equipped with solar panels and lithium-ion batteries that can reduce commercial electricity used during normal operations by 10 per cent, compared to conventional green base stations that do not have energy storage or weather forecast-linked capabilities. In addition, the conventional operation time of these base stations is doubled to approximately 63 hours during power outages following such events as natural disasters.[136]

E-Resilience

With climate change giving rise to more frequent extreme weather events and natural disasters, and as the COVID-19 pandemic shows, the ICT infrastructure is a lifeline, essential for effective and quick response and recovery.

As a result, ESCAP has developed an online "E-Resilience Toolkit for Asia and the Pacific".[137] E-resilience is defined as the ability of ICT systems to withstand and recover from external disturbances such as a natural disaster. In addition, e-resilience is concerned with utilizing ICTs for societal resilience.

Collaborations are important in building e-resilience, by planning ahead and engaging with multiple stakeholders, including marginalized communities, to ensure coordinated response when disaster strikes.

Regional collaborations between countries are also crucial. Sentinel Asia,[138] for example, brings together 95 organizations from 28 countries/regions and 16 international organizations to share and provide disaster-related information. It provides image data and analysed images acquired through satellites operated by

[133] Ibid.
[134] Data Economy, "The importance of green data centres", 21 October 2019. Available at https://data-economy.com/the-importance-of-green-data-centres/.
[135] Exponential Roadmap version 1.5.1. Available at https://exponentialroadmap.org/ (accessed on 18 May 2020).
[136] GSMA, *2019 Mobile Industry Impact Report: Sustainable Development Goals* (2019). Available at https://www.gsma.com/betterfuture/wp-content/uploads/2019/10/2019-09-24-a60d6541465e86561f37f0f77ebee0f7-1.pdf.
[137] ESCAP, "ICT&DRR Gateway: Asia-Pacific E-Resilience Toolkit". Available at http://drrgateway.net/e-resilience.
[138] Sentinel Asia, "About Sentinel Asia". Available at https://sentinel-asia.org/aboutsa/AboutSA.html.

participating space agencies. It also offers training to member countries on the utilization of satellite images for disaster risk management.

How can ICTs contribute to climate action?

Generally, the use of the Internet and ICT systems can:[139]

- Collect, manage, analyse and visualize data on greenhouse gas emissions and climate-related risks (Earth observation tools provide the most compelling evidence of the scope of climate change impact and fast developing negative trends);
- Create platforms to facilitate multi-sector and multi-stakeholder engagements for dialogue, collaboration, technical support and financing (e.g., crowdfunding) at local, national, regional and global levels;
- Promote awareness, knowledge exchange, technical cooperation, capacity building and incentives for action;
- Improve early warning systems and disaster risk management, including the provision of timely information for quick rescue and response;
- Improve energy efficiency in cities, buildings, transportation, and the production of goods and services through smart applications (thus, reducing energy consumption and material waste);
- Enable farmers, fishers and foresters to access information and choose among diverse methods of achieving sustainable production;
- Dematerialize or substitute high-carbon products and activities with low-carbon alternatives, e.g., remote working, online learning, e-payment and sharing economy; and
- Enhance transparency and traceability of transactions along supply chains to verify that products are produced sustainably (e.g., using blockchain).

Some key principles for deploying ICTs to combat climate change include:[140]

- Appointing a key stakeholder with multidisciplinary skills (either within government or endorsed by government) capable of delivering a holistic vision and leading collaborations at the country level;
- Promoting technology investment in open and scalable systems, using standards-based solutions;
- Complying with privacy and security best practices;

[139] Internet Society, Issue Paper, Asia-Pacific Bureau: Climate Change", 22 November 2017. Available at https://www.internetsociety.org/resources/doc/2017/issue-paper-asia-pacific-bureau-climate-change/.
[140] GSMA, "Maximising the Smart Cities Opportunity: Recommendations for Asia-Pacific Policymakers," 2017, https://www.gsma.com/iot/wp-content/uploads/2017/05/Smart-Cities-Report-web.pdf.

- Engaging in dialogue with multiple stakeholders, including end users, that goes beyond arguments of efficiency, and questions the values and rights behind the application of the technologies; and
- Making data available to promote and stimulate innovation.

These key principles are being applied in Hong Kong, China's smart city initiatives (see Case Study 20).

Case Study 20: Smart City Blueprint, Hong Kong, China

Hong Kong, China has committed to reducing total greenhouse gas emissions by 26-36 per cent by 2030. Its Climate Action Plan 2030+ incorporates the use of smart technologies to mitigate and adapt to climate change, and its Smart City Blueprint envisions an increased use of AI, big data analytics, chatbot, cloud computing and IoT to achieve the targets set in the Climate Change Action Plan 2030+.

The government's Chief Information Officer is responsible for leading the various smart initiatives, and has been engaging stakeholders and citizens in formulating the Smart City Blueprint.

In Hong Kong, buildings and vehicles are the main sources of greenhouse gas emissions, and thus, many initiatives have focused on making buildings and transportation systems smarter through the use of ICTs. Hong Kong is also leveraging ICTs to better prepare for extreme weather events and rising sea levels caused by climate change.

As part of Hong Kong's smart transportation development, the mass transit railway and the tramway have opened up their transport data to the public. The Citymapper app has made use of all the open transport data to help users plan their routes and modes of transport to reach their destinations in the shortest time.

More broadly, to stimulate innovation, the government has been building its open data portal that has about 3,100 unique datasets from government bureaus and departments, and about a thousand APIs. The government is providing financial and technical support to entrepreneurs and startups, and is reviewing regulations to further promote innovation.

Source: Smart City HK, https://www.smartcity.gov.hk/.

Something to do

Refer to the key principles for deploying ICTs to combat climate change and Case Study 20.

Consider the extent to which your country's deployment of ICTs to combat climate change is in line with the key principles.

Enabling green investments

Case Study 21: Shenzhen Green Finance Committee, China

The Energy Blockchain Labs, International Institute of Green Finance, China Emissions Exchange and Shenzhen Stock Exchange, coordinated by the Shenzhen Green Finance Committee, established a project to digitize and automate the process of green finance certification using IoT and blockchain.

The project aims to leverage the power of digital finance to solve problems in the green finance certification system, including insufficient information disclosure and limited efficiency in the certification process.

IoT chips embedded in green assets such as panels in solar power plants gather data for green finance certification. AI algorithms and smart contracts process the data, and evaluation results are transmitted and recorded on the blockchain to ensure the evaluation process is transparent, standard compliant and tamper resistant. Certification results are stored on a blockchain in a distributed way, and can be accessed by all relevant parties, including project managers, financial intermediaries and regulators.

This digital green certification process brings a number of benefits. Green certificates enable the owners of the green assets to access financial resources at lower costs.

The distributed nature of blockchain technology enables the system to capture and record small-scale green assets like roof-mounted solar power systems, which can benefit disadvantaged and broader segments of society.

Financial intermediaries can have access to authentic data without high auditing expenses, and regulators can conduct real-time risk assessments as they have access to granular information on the daily operation of the assets underlying a given financial product.

Source: Extracted from Sustainable Digital Finance Alliance, "Digital Technologies for Mobilizing Sustainable Finance", October 2018. Available at http://unepinquiry.org/wp-content/uploads/2018/10/Digital_Technologies_for_Mobilizing_Sustainable_Finance.pdf.

One of the key challenges is the mobilization of capital to support sustainable growth. Digital financial technologies together with AI, big data, blockchain, mobile platforms and IoT can support sustainable financing.

There has been a growing number of crowdfunding platforms such as Australia's CleanTekMarket that connects clean technology projects and organizations with finance. However, more generally, ICTs have increased access to data for more informed investment decisions and have enhanced transparency (see Case Study 21).

Social media for climate action

Social media has been extensively used in the last decade to enable two-way communication between government and the general public at times of crisis.

For example, in the Philippines, Rappler, a social news network has developed a system that scans social media, including SMS sent to a unified number, for appeals for help and situation reports nationwide.

Using natural language processing technology, it automatically analyses and organizes unstructured data into structured content that is mapped on its Agos platform, and can be used by government officials and responders to identify areas in need of help and what exactly is needed.[141]

Social media platforms have also helped climate advocacy and engagement, as well as shift consumption decisions towards sustainable, low-carbon choices.

In China, for example, the “Ant Forest” platform is the world’s first large-scale pilot to green citizens’ consumption patterns by using mobile payment platforms, big data and social media (see Case Study 22).

[141] Rappler, “Agos, powered by eBayanihan”. Available at https://agos.rappler.com/map.

Case Study 22: Ant Forest, China

China's Ant Financial (a related company of Alipay) that has captured over half of China's mobile payments market has over 800 million customers. In 2016, the "Ant Forest" app was launched that gamifies and rewards low emissions behaviour. Five hundred million users have signed up for the app.

Ant Forest encourages users to reduce their carbon footprint through a three-part approach:

1. Providing individualized carbon savings data to people's smartphone based on their financial transactions data;

2. Connecting their virtual identity and status to their earnings of green energy points for reduced carbon emissions; and

3. Providing carbon offset rewards through a physical tree planting programme.

For example, if a user pays for household utilities online rather than in person, or commutes by walking instead of driving, the avoided carbon emission will be recorded as saved energy, earning them green energy points.

Once an individual has accumulated enough green energy points to grow an entire virtual tree, Ant works with its ecological partners to plant a real tree in the desert. Users can view images of their trees in real time via satellite. The game is social in that it allows users to steal small amounts of energy points from friends or use their own to water the trees of peers.

As of April 2019, it is reported that 3 million tonnes of CO_2 emissions have been avoided due to behaviour changes through the app and 100 million trees have been planted as part of the scheme.

In June 2019, GCash Forest, launched by Alipay's partner in the Philippines, became the first Ant Forest replicator outside China. GCash Forest aims to plant 365,000 trees in 365 days in the Ipo Watershed, a protected rainforest area that supplies most of the fresh water needs of Metro Manila.

Sources: Green Digital Finance Alliance, "Scaling Climate Finance through Emerging Technology". Available at https://greendigitalfinancealliance.org/wp-content/uploads/2019/11/Scaling-Citizen-Action.pdf; and Green Digital Finance Alliance, "Tech for Trees", April 2020. Available at https://greendigitalfinancealliance.org/wp-content/uploads/2020/04/Tech-for-Trees_4-15-20.pdf.

It is important to note that social media platforms can also drive emissions upwards as they improve behavioural prediction to drive consumer demand for unsustainable products and services.

In addition, they are designed to accelerate the spread of emotionally-charged information, including disinformation. This is contributing to a rise in national populist movements that are often hostile to climate policies, international cooperation and even science.[142]

Technologies alone cannot solve the climate crisis. Policies are needed to change behaviour of markets and people, such as the elimination of fossil fuel subsidies, adoption of carbon pricing approaches, development of emission standards, improving access to finance for renewables, and incentivizing innovation, use and scaling of sustainable solutions.

4.2.4 SDG 14: Life Below Water and SDG 15: Life On Land

As billions of people depend on oceans for their livelihood and food source, increased efforts are needed to conserve and sustainably use ocean resources.

Since much of what happens in the oceans is hidden, it can prove challenging to engage people compared with other SDGs. Many people may believe that what is happening in the oceans do not affect them as urban residents or land dwellers.

On the contrary, our ability to continue to live as we do depends directly on oceans continuing their functions of providing food, and moderating global temperature, water salinity, water storage and weather systems, among others.

Complex challenges currently affecting the oceans include marine pollution, ocean acidification, the degradation of ecosystems, rising temperatures, large-scale disruption to marine life and overfishing, rising sea levels and increased ocean activity, to name just a few.[143]

On land, although forest loss is slowing down, land degradation continues, biodiversity loss is occurring at an alarming rate, and the illicit poaching and trafficking of wildlife continue to hinder efforts to protect and restore vital ecosystems and species.[144]

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[142] Exponential Roadmap version 1.5.1. Available at https://exponentialroadmap.org/ (accessed on 18 May 2020).

[143] Kitack Lim, "Conserve and Sustainably Use the Oceans, Seas and Marine Resources for Sustainable Development", in ITU, *Fast-forward Progress: Leveraging tech to achieve the global goals* (Geneva, no date), pp. 108-113. Available at https://www.itu.int/en/sustainable-world/Documents/Fast-forward_progress_report_414709%20FINAL.pdf.

[144] United Nations SDG Knowledge Platform, "SDG 15: Progress of Goal 15 in 2019". Available at https://sustainabledevelopment.un.org/sdg15.

Case Study 23: Wildscan helps combat illegal wildlife trade in Asia

A number of initiatives and specialized mobile apps have emerged, providing tools that help identify wildlife trade and spot illegal products.

One such example, the Wildscan app, is a comprehensive species identification and response mobile app designed to help frontline wildlife law enforcement agencies correctly identify, report and handle marine, freshwater and terrestrial animals caught in the illegal wildlife trade.

The Wildscan app, launched in 2014, is an initiative of the Association of Southeast Asian Nations (ASEAN) Wildlife Enforcement Network, United States Agency for International Development and Freeland.

WildScan contains photos and important information for more than 350 endangered species and illegal wildlife products commonly trafficked into and throughout South-East Asia. The app is meant to help properly identify the animals and create a rapid response to rescue them.

In 2016, the app was localized into Khmer for use in Cambodia.

Sources: Phak Seangly, "WildScan app to help fight animal trafficking", *The Phnom Penh Post*, 15 July 2016. Available at https://www.phnompenhpost.com/national/wildscan-app-help-fight-animal-trafficking; and ASEAN Wildlife Enforcement Network, "Wildscan: Species Identification and Response". Available at http://wildlifeprotectiontools.net/wp-content/uploads/2019/07/WildScan-USER-GUIDE-ENG.pdf.

ICTs can contribute to SDGs 14 and 15 in a number of ways:

- Satellite, remote sensing and other space-based technologies, as well as drones, contribute to real-time monitoring and measuring of land, oceans and wildlife for more effective conservation management (an example is World Resource Institute's Global Forest Watch);[145]
- Data obtained from monitoring can be analysed and visualized with the help of AI and big data analytics to provide evidence of climate impacts and the potential effects of policies, as well as the relationship between land-based activities and the ocean;
- Mobile phones and apps allow small-scale fishers and farmers to access information such as catch availability, weather information and current price levels that can help to enhance production capabilities and enable better functioning markets, while guaranteeing the sustainability of fisheries;

[145] Global Forest Watch. Available at https://www.globalforestwatch.org/.

- Social media and mobile apps can raise awareness and enable increased stakeholder participation through crowdsourcing solutions, both for data collection purposes, as well as for increasing the frontline capabilities, such as agencies tasked with combating poaching and trafficking (see Case Study 23).
- Blockchain and IoT are being used for traceability and responsible sourcing (see Case Study 24).

Case Study 24: TraSeable supporting seafood sustainability, Fiji

TraSeable Solutions is a Fijian tech startup that supports seafood sustainability and helps stop illegal fishing and human rights abuses by using blockchain and IoT to track fish from vessel to market.

The startup aims to leverage and integrate blockchain and IoT to facilitate transparency by providing regulators with the means of verifying and validating end-to-end traceability and tracking of seafood products to ensure that it is not illegal, unreported or unregulated. Local fish stocks can also be controlled to avoid overfishing.

Fishers will benefit as well by having an immutable catch record that enables them to obtain credit and reduce their reliability on third-party intermediaries.

In 2017, TraSeable Solutions was involved in a pilot project with WWF and ConsenSys in Fiji that demonstrated the potential of blockchain technology for the Pacific subregion.

It is reported that about six companies are using the technology with some 50,000 fish tracked, but implementing end-to-end traceability will take time as there are multiple challenges to overcome along the seafood supply chain.

First, a lot of the documentations remain paper-based in the Pacific. Second, Internet connectivity is poor on land and when boats are at sea they do not have Internet access and therefore, cannot send data in real time.

For companies involved in the pilot, they were given a tablet-based app that allows fishers to input data on shore. However, other players in the supply chain also need to be connected to the system, including the seafood processors, importers, distributors and buyers, as well as the regulatory authorities to provide third-party verification. The third major challenge is obtaining buy-in from all the players.

Fourth is the lack of interoperability in blockchain technology. Globally, there currently exist many blockchain protocols that cannot communicate with each other, which will hamper its adoption and growth.

Sources: TraSeable Solutions. Available at https://www.traseable.com/; Aaron Orlowski, "TraSeable's blockchain-based traceability technology overcomes challenges in the Pacific", *Seafood Source*, 8 January 2020. Available at https://www.seafoodsource.com/news/environment-sustainability/traseable-s-blockchain-based-traceability-technology-overcomes-challenges-in-the-pacific; and WWF, "New Blockchain Project has potential to revolutionise seafood industry". Available at https://www.wwf.org.nz/what_we_do/marine/blockchain_tuna_project/.

4.2.5 Key Points

- SDGs 6 and 12 to 15 draw attention to the dangerous consequences that inequitable distribution of resources and overexploitation of natural resources have created for the survival of the Earth. The global community is charged with reversing the damage of global climate changes and there are numerous ways in which ICTs can be used to protect our ecosystems.

- The Asia-Pacific region has regressed the most on SDG 12 on sustainable consumption and production along with SDG 13 on climate action. There is therefore an urgent need to shift to more resource-efficient systems of consumption and production in order to accelerate economic progress in a sustainable manner.

- ICTs have contributed to SDGs 6 and 12 to 15 in the following ways:

    - Collect, manage, analyse and visualize data on greenhouse gas emissions and climate-related risks;

    - Create platforms to facilitate multi-sector and multi-stakeholder engagements for dialogue, collaboration, technical support and financing (e.g., crowdfunding) at local, national, regional and global levels;

    - Promote awareness, knowledge exchange, technical cooperation, capacity building and incentives for action;

    - Improve early warning systems and disaster risk management, including the provision of timely information for quick rescue and response;

    - Improve energy efficiency in cities, buildings, transportation, and the production of goods and services through smart applications (thus, reducing energy consumption and material waste);

    - Enable farmers, fishers and foresters to access information and choose among diverse methods of achieving sustainable production;

    - Dematerialize or substitute high-carbon products and activities with low-carbon alternatives, e.g., remote working, online learning, e-payment and sharing economy; and

    - Enhance transparency and traceability of transactions along supply chains to verify that products are produced sustainably (e.g., using blockchain).

- However, technologies alone cannot solve the climate crisis. Policies are needed to change behaviour of markets and people, such as the elimination of fossil fuel subsidies, adoption of carbon pricing approaches, development of emission standards, improving access to finance for renewables, and incentivizing innovation, use and scaling of sustainable solutions.

- With climate change giving rise to more frequent extreme weather events and natural disasters, and as the COVID-19 pandemic shows, the ICT infrastructure is a lifeline, essential for effective and quick response and recovery. E-resilience, or the ability of ICT systems to withstand and recover from external disturbances such as a natural disaster, is important.

- To address the scarcity, quality and distribution of water supplies in ways that support SDG 6, ICTs can reduce the duration and costs of monitoring and inventory activities; improve efficiency gains of water service providers throughout the supply chain; improve collection rates of water service providers through ICT-based payment systems; ensure better services to the poor; and strengthen citizen voice and accountability framework.

- Like other sectors, water management and governance must adopt a holistic and cross-sectoral approach in working with multiple stakeholders to achieve the SDGs. For example, improving the efficiency of the agriculture sector will play a major role in the sustainability of the world's water resources.

- It is important to recognize that the ICT industry in the region is a major contributor to unsustainable consumption and production through **e-waste**.

- The illegal dumping and informal recycling of e-waste are not only hazardous for the recyclers, their communities and the environment, but they are also inefficient, as they are unable to extract the full value of the processed products.

- For low-income countries, rather than becoming dumping grounds for the toxic waste coming from more developed countries, there are opportunities to pioneer new methods of recycling and new materials that are either biodegradable, re-usable or simply long-lasting.

- Governments can foster a **circular economy** that replenishes the resources used in consumption and production. For example, prioritizing the safe and efficient recovery of metals from e-waste using bioleaching, formalizing the e-waste sector, and supporting its development while improving labour conditions, extraction techniques and resource management.

4.3 Prosperity

4.3.1 SDG 7: Ensure access to affordable, reliable, sustainable and modern energy for all

Asia-Pacific countries are progressing across the three main pillars of sustainable energy—access, efficiency and deployment of renewable energy. Bringing electricity to growing populations of Asia-Pacific is among governments' priorities and most countries have established clear policy targets that are increasingly backed by supportive programmes and economic measures.[146]

However, many challenges remain, especially with regards to bridging the gap between urban and rural areas. Other challenges include low quantity, quality and reliability of the power supply, implementation of and compliance with regulations, as well as affordability of energy. Further, almost half of the population is lacking access to clean fuels and technologies for cooking.[147]

The region has demonstrated notable progress in improving its energy efficiency indicators. However, large and sustained improvements in both supply- and demand-side energy efficiency are still needed to meet the SDG 7 energy intensity targets.[148]

Asia-Pacific has emerged as the global leader in renewable energy investments, installed capacity and consumption. Modern renewables are rapidly gaining traction and promising upward trends in production are being observed, underpinned by large increases in hydropower production. Wind and solar power productions are also increasing at exponential rates, although they have yet to compete with more conventional energy sources. As a result of rapid demand growth, the share of renewable energy in the energy mix is declining rather than increasing in the region.[149]

ICTs are recognized as both part of the problem and part of the solution when it comes to energy consumption and production, and greenhouse gas emissions.

ICTs are part of the problem because:

- The production of digital devices is energy-consuming and uses potentially hazardous waste that often finds its way into landfills and from there into the earth, rivers and oceans;

[146] ESCAP, "SDG 7: Affordable and Clean Energy". Available at https://www.unescap.org/sites/default/files/SDG%207%20Goal%20Profile.pdf.
[147] Ibid.
[148] Ibid.
[149] Ibid.

- Computers and other devices, particularly, data centres consume a lot of electricity. In 2017, data centres consumed over 400 terawatts of electricity, or roughly three per cent of the world's electricity generated;[150] and
- Cryptocurrency mining and blockchain technology also consume a lot of electricity. Bitcoin mining alone consumes annually close to 70 terawatts of electricity.[151]

ICTs are part of the solution because:

- They can increase the efficiency of traditional energy production through the use of automated processes that better match output and distribution;
- They enable the spread of renewable energy technologies;
- Through smart metering they can help redistribute consumption from peak to off-peak hours; and
- Across the energy-consuming industrial economy they can make energy usage more efficient, for example, through smart buildings, smart manufacturing, smart logistics, etc.

Delivery of broadband and power lines

For over two decades, telecommunications and electricity utilities have been experimenting unsuccessfully with the idea of providing the broadband infrastructure over power lines looped from tower-to-tower across long distances, known as "broadband power lines". One problem is signal attenuation, so signal boosters called repeaters are required, but the major barrier has been signal interference between the electricity and telecommunications frequency channels.

Since 2013, the American telecom company, AT&T, has been trialling an innovation that physically separates the two signals, sending the broadband waves over rather than through the electricity wire.[152] This is one possible technology for the future which, if it works, could contribute to solving the delivery of broadband and power simultaneously to rural areas.

For the most remote areas the delivery of broadband, but not power, is more likely through satellite or terrestrial microwave, in which case power supplies are more likely to remain local, such as through solar power systems. This will place importance upon research and development of battery storage that offers greater capacity and longer life at no greater cost than at present. However, battery technology needs to be chosen

[150] vXchnge Blog, "Power Hungry: The Growing Energy Demands of Data Centers", 2019. Available at https://www.vxchnge.com/blog/power-hungry-the-growing-energy-demands-of-data-centers.
[151] Vox, "Bitcoin is an energy hog. Where is all that electricity coming from?" 18 June 2019. Available at https://www.vox.com/2019/6/18/18642645/bitcoin-energy-price-renewable-china.
[152] AT&T, "Project AirGig: 500 Patents and Applications, One Great Idea", 19 March 2019. Available at https://about.att.com/innovationblog/2019/03/project_airgig.html.

according to the principles of recycling where the disposal of the toxic waste of batteries is built into the decision to manufacture or import them.

Renewable energy and distributed systems

Rising greenhouse gas emissions from fossil fuel use, local air pollution and its negative impact on health call for cleaner energy to displace traditional carbon-based sources (i.e., coal, oil and natural gas).

Decentralized energy systems provide promising opportunities for deploying locally-available renewable energy sources, such as hydro, wind and solar power. They can also expand access to clean energy services to remote communities.

A decentralized energy system is characterized by locating energy production facilities closer to the site of energy consumption, resulting in more optimal use of renewable energy, reduces fossil fuel use and increases efficiency.[153]

Distributed electricity generation can be connected to a central grid, and with the incorporation of ICTs, create smart grid and smart metering systems (see Box 4) that enable real-time monitoring and communication between producers and consumers of electricity to optimize grid usage. Moreover, with distributed generation and storage, consumers of electricity can become producers and feed surplus electricity back to the grid.

This would require regulations for the smart grid infrastructure to allow for decentralized power production, and new interconnections between regions should be added to utilize potential cost reductions in generation. Also, fair grid access and transparent competitive markets for balancing power are important for renewable energy developers.[154]

[153] ESCAP, “Low Carbon Green Growth Roadmap for Asia and the Pacific: Fact Sheet – Decentralized energy system". Available at https://www.unescap.org/sites/default/files/14.%20FS-Decentralized-energy-system.pdf.
[154] Exponential Roadmap version 1.5.1. Available at https://exponentialroadmap.org/ (accessed on 18 May 2020).

Box 4: What is a smart grid?

A smart grid is an electrical grid that intelligently controls various aspects of electricity delivery in an efficient manner from source to end user. This is achieved via smart meters, sensors and renewable sources of energy, which help ensure proper electricity resource management.

A regular electrical grid provides electricity to the end user which is then billed to the consumer who then pays the amount at the end of a stipulated period of time. Smart grids, however, have sensors that detect and send information about electricity usage back to the utility provider and the consumer. This information can then be used to monitor electricity usage and improve efficient use of electricity.

For example, with electricity usage information, a utility provider will be able to better allocate electricity resources accordingly depending on demand patterns throughout the day. Sometimes, with the use of sensors and networked computers, this can be done automatically.

Besides that, through net metering and feed-in tariff programmes, commercial and residential users that have rooftop solar panels or home wind turbines can feed surplus electricity back to the electricity grid. This not only significantly reduces electricity costs but also reduces dependency on traditional fossil fuel-based power plants.

Source: Extracted from Angaindrankumar Gnanasagaran, "Making Southeast Asian electricity grids smarter", *The ASEAN Post*, 22 November 2018. Available at https://theaseanpost.com/article/making-southeast-asian-electricity-grids-smarter.

Pay-as-you-go solar home systems with mobile money

The use of renewables still has a long way to go before it replaces coal nationally (and maybe wood locally) as the most used source of energy, but for poor people in remote areas without regular supplies of electricity there are interesting experiments in bundling mobile services with distributed solar home systems.

Advancements in distributed solar technologies and growing access to mobile networks and mobile money services have led to the emergence of “distributed energy services companies” that offer pay-as-you-go solar home systems.[155]

The solar home systems are effective in connecting off-grid areas and leapfrogging communities to clean energy solutions.

[155] Anna Lerner, Roku Fukui and Doyle Gallegos, “Electricity and the internet: two markets, one big opportunity”, *World Bank Blogs*, 25 May 2017. Available at https://blogs.worldbank.org/digital-development/electricity-and-internet-two-markets-one-big-opportunity.

The pay-as-you-go business model makes it possible for low-income customers to pay small amounts digitally, making the solar units affordable and allowing households to gradually own these systems (see Case Study 25).

These distributed energy services companies have cumulatively sold more than 2 million pay-as-you-go solar home systems.[156] The pay-as-you-go business model is being replicated in many countries and in other sectors such as water, irrigation, clean cooking and sanitation.

Case Study 25: Pakistan's pay-as-you-go home solar solution

A large proportion of Pakistan's rural population lacks access to electricity and depends on expensive, inefficient fuel-based sources. Challenges include lack of energy-related savings and payment services, since less than one-third of the population has bank accounts.

Telenor Pakistan engaged in one of the first trials to address the challenges by partnering its mobile money solution, Easypaisa, with the Pakistani energy service company, Roshan Energy, to launch an innovative solar home solution for marginalized poor communities living in off-grid areas.

Developed on the pay-as-you-go business model, the product enables customers to purchase solar home systems with an upfront payment of 15 per cent, with the remaining payments being paid within 18 months through Easypaisa.

This model allows users to top-up their solar home system from any of the 70,000 Easypaisa shops across the country or directly through their Easypaisa mobile accounts. This unique model has empowered customers to pick whether they want their solar equipment to work for a full month or just for a day.

Access to a solar home system not only provides electricity but can also improve household health by reducing the indoor use of kerosene lamps. In Pakistan, many pay-as-you-go solar home solutions have emerged.

Sources: GSMA, *The power of mobile to accelerate digital transformation in Pakistan* (2019). Available at https://www.gsma.com/mobilefordevelopment/wp-content/uploads/2019/10/The-Power-of-Mobile-to-Accelerate-Digital-Transformation-in-Pakistan-2019.pdf; and GSMA, 2016 *Mobile Industry Impact Report: Sustainable Development Goals* (2016). Available at https://www.gsma.com/betterfuture/wp-content/uploads/2016/09/_UN_SDG_Report_FULL_R1_WEB_Singles_LOW.pdf.

[156] GSMA, *2019 Mobile Industry Impact Report: Sustainable Development Goals* (2019). Available at https://www.gsma.com/betterfuture/wp-content/uploads/2019/10/2019-09-24-a60d6541465e86561f37f0f77ebee0f7-1.pdf.

Green assets like solar home systems and efficient cooking stoves improve household health by reducing the indoor use of solid fuels that is estimated to be responsible for 4 million deaths every year.[157]

Something to do

Is the pay-as-you-go business model being used in your country to provide access to electricity in remote areas?

In a small group of three to five people, share experience of what worked and what did not work in the implementation of the pay-as-you-go model for energy access.

4.3.2 SDG 8: Promote sustained, inclusive and sustainable economic growth, full and productive employment, and decent work for all

Due to the broad nature of SDG8, this section focuses on two key ways in which ICTs have had a significant impact on—financial inclusion, and youth employment and skills training.

Digital financial inclusion

A key aspect of prosperity is access to financial services. Women are less likely than men to have access to financial institutions or have a bank account. While 65 per cent of men report having an account at a formal financial institution, only 58 per cent of women do worldwide.[158]

Financial inclusion refers to a state in which all working age adults, including those currently excluded by the financial system, have access to financial services, such as savings, credit, insurance, payments and remittances.[159] Access to financial services helps increase incomes and build resilience.

Besides “access” to finance, financial inclusion encompasses financial use, financial literacy, and favourable regulations that support financial inclusion and consumer protection.

[157] ESCAP, 75th session: Universal access to energy in Asia and the Pacific: evidence-based strategies to achieve empowerment, inclusiveness and equality through Sustainable Development Goal 7 - Note by the secretariat, ESCAP/75/13, 15 March 2019. Available at https://www.unescap.org/commission/75/document/E75_13E.pdf.

[158] UN Women, "Facts and Figures: Economic Empowerment". Available at https://www.unwomen.org/en/what-we-do/economic-empowerment/facts-and-figures.

[159] Global Partnership for Financial Inclusion, "Global Standard-Setting Bodies and Financial Inclusion for the Poor", no date.

ICTs have enabled access to and delivery of financial services. In particular, the rapid growth in mobile phone uptake has resulted in its innovative use to deliver financial services.

Mobile money service has allowed households to pay for essential utility services, smallholder farmers to receive payment more quickly and conveniently, and migrants to benefit from faster, safer and cheaper international remittances and humanitarian cash assistance.[160]

The digital finance ecosystem has allowed new players to enter the financial and banking sector that has evolved from state banks, microfinance institutions and cooperatives to a broader range of providers that now include mobile operators, mobile agent networks, e-commerce platforms and Internet companies.

Digital finance technologies with its less stringent requirement for identification and documentation, and lower fees for opening and maintaining accounts are factors where most digital finance innovations are different from traditional financial institutions. Also, the digital financial service platforms often integrate various services, improving the ease and convenience of making transactions.

Recently, a number of large platform businesses that have grown beyond their initial core business to target several other areas, are offering financial services in emerging markets. For example, Facebook offers payment services through WhatsApp in India and through Facebook Messenger in the Philippines.[161]

Grab, a ride-hailing company, expanded its service platform to offer food delivery and financial services such as payment, peer-to-peer lending, credit and insurance. Grab Kios connects e-commerce players and online merchants with offline customers through agents, onboarding the unbanked into digital transactions.

Bukalapak that initially started as an Indonesian online marketplace also offers a range of financial services such as:

- Digital wallet to store funds and make quick and secure purchases;
- Loans to small merchants with credit based on their Bukalapak sales history;
- Loans to consumers with credit of up to USD 1,643, with interest starting at 1.5 per cent per month; and
- Digital insurance.

[160] GSMA, *2019 State of the Industry Report on Mobile Money* (2020). Available at https://www.gsma.com/sotir/wp-content/uploads/2020/03/GSMA-State-of-the-Industry-Report-on-Mobile-Money-2019-Full-Report.pdf.
[161] Maria Fernandez Vidal, "Platform Business Models: Financial services for poor people in the digital economy", *CGAP*, May 2020. Available at https://www.cgap.org/research/slide-deck/platform-business-models.

These platforms increase access to financial services. However, they also create a number of risks as follows:[162]

- **Digital divide** – Platforms can widen the digital divide by serving only those with access to smartphones and Internet connectivity, and risk deepening exclusion for those offline as more opportunities move online. Some platforms, however, employ agent networks to reach those who are not connected;

- **Data privacy and security** – Data that platforms collect from users can be used to provide better services, but they can also be used to exclude or harm vulnerable people. Data may be sold to third parties or accessed through a data breach. This can undermine financial inclusion efforts by making people lose trust;

- **Quality of work** – Platforms and technology can expand income opportunities for low-income people. However, these jobs generally lack the security of a fixed salary and benefits like paid sick leave; and

- **Competition** – As platforms need to scale, the space is likely to be dominated by only a few players. Limited competition can affect fees and prices.

Another trend is the emergence of a number of financial credit agencies that are using AI and big data to assess the credit worthiness of those who lack formal credit histories.[163]

Again, this raises privacy, security and ethical concerns, as users give credit-scoring apps permission to access things like text and call logs, GPS data, contacts, calendar, apps installed, digital transactions and social media profiles.

A clear privacy policy on what data is stored and processed for how long, and security safeguards such as the use of encryption are crucial. Measures to address algorithmic biases also need to be in place to ensure that discrimination is not introduced into the lending process.

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[162] Ibid.

[163] Privacy International, "Fintech's dirty little secret? Lenddo, Facebook and the challenge of identity", 23 October 2018. Available at https://privacyinternational.org/long-read/2323/fintechs-dirty-little-secret-lenddo-facebook-and-challenge-identity; and Emily Bary, "How artificial intelligence could replace credit scores and reshape how we get loans", *Market Watch*, 29 October 2018. Available at https://www.marketwatch.com/story/ai-based-credit-scores-will-soon-give-one-billion-people-access-to-banking-services-2018-10-09.

Based on the trends and risks described above, the complex challenges that policymakers and regulators need to tackle in enabling digital finance include the following:[164]

- Innovative digital financial services typically involve multiple providers that will be storing and managing customer's data and funds. There may be risks related to real-time accuracy and reconcilability of records;

- When products are bundled, regulation and monitoring become more complicated, requiring coordination among providers and regulators;

- There is a need to ensure fair play among both bank and non-bank providers, and both large and small providers through competition laws and regulations;

- There is also a need to ensure standardization and interoperability, which will enable more open and inclusive systems, and contribute towards their affordability for the underserved (see Case Study 26).

- Agents, agent networks and the customer interface for digital financial services introduce new risks including fraud, agent error, poor cash management by the agent and poor data handling;

- The quality and reliability of the ICT infrastructure and system affect the risk of disrupted service and lost data, and risk of privacy or security breach; and

- In the event the consumer suffers a loss, liability can be unclear due to the multiple providers involved in service delivery.

[164] Internet Society, “Issue Paper, Asia-Pacific Bureau: Policies and Regulations for the Digital Economy and Society”, 26 July 2017. Available at https://www.internetsociety.org/resources/doc/2017/issue-paper-asia-pacific-bureau-policies-and-regulations-for-the-digital-economy-and-society/.

Case Study 26: Thailand's standardized PromptPay QR code

In order to encourage enterprises to innovate in financial services, the Government of Thailand created a controlled environment of lowered regulatory requirements or "sandbox" for testing and learning.

The standardized PromptPay QR code was one of the first innovations to take advantage of the regulatory sandbox.

In many countries, QR systems are proprietary and a customer would have to be using the same provider as the merchant in order to pay (in practice many merchants sign on to multiple systems to be able to serve more customers and must manage funds across those separate accounts).

The Bank of Thailand guided the industry towards an interoperable common solution built on open infrastructure. Industry collaborated to establish standards and business rules. Eleven banks jointly tested the technology, customer service and security aspects of a common QR system in the regulatory sandbox from August to December 2017.

The QR system was rapidly adopted by merchants. By mid-2019, more than 3.7 million merchants were accepting PromptPay QR payments, compared to 140,000 merchants accepting credit cards.

PromptPay has contributed significantly to the growth in digital payments in Thailand, reduced costs for making and accepting digital payments, increased security and convenience for customers, and improved operations and transparency for merchants.

Cross-border QR payment is now available in several countries where Thai banks have partnered with foreign banks—e.g., Krungsri Bank in Thailand with MUFG Bank in Japan—to enable Thai customers to use their Thai QR system in Japan.

The Bank of Thailand and National Bank of Cambodia entered into an agreement in 2019 to create an interoperable Cambodian-Thai QR system, which three Cambodian banks have set to implement.

This case study highlights the need for policymakers and industry to work together to achieve robust, open and efficient digital finance infrastructure. This includes retail and online payment systems that are interoperable and linked to a wide range of points-of-sale, ATMs and agent networks.

Source: Adapted from World Bank, "Digital Financial Services", April 2020. Available at https://pubdocs.worldbank.org/en/230281588169110691/Digital-Financial-Services.pdf.

Something to do

Find out how governments in different countries are addressing some of the challenges described above. How are they balancing innovation and risk to achieve digital financial inclusion?

List three key strategies and share them in a small group.

Generally for government, digital finance brings more people into the formal economy. It improves efficiency, and increases accountability and transparency. When the Indian government made social security pension payments through digital smart cards instead of manual cash payouts at the village level, there was a 47 per cent reduction in bribe demands.[165]

Digital financing also reduces tax evasion by companies and individuals, and provides vast amounts of financial data on which to base economic decisions. Governments can use the information gathered through registration processes to build an effective database for policymaking.

For business, especially for financial services, digital finance expands the reach, and thus brings in more business. It also enables the provision of customized and personalized services, while at the same time provides vast amounts of data for decision-making. For small businesses, going digital helps to access larger markets, makes supply chain management and accounting easier, and reduces the costs of doing business, thus improving incomes.

For the poor, for women, and for both the financially excluded and the already financially included but underserved, digital finance has increased access to financial services, which in turn has unlocked other benefits and opportunities to improve their livelihood. But much remains to be done in building their financial literacy and capabilities, and in ensuring that consumer protection and policies take the conditions and constraints of poor families in the informal economy into account.

[165] Sustainable Digital Finance Alliance, "Digital Technologies for Mobilizing Sustainable Finance", October 2018. Available at http://unepinquiry.org/wp-content/uploads/2018/10/Digital_Technologies_for_Mobilizing_Sustainable_Finance.pdf.

Financial literacy and education comprise four elements:

1. **Financial literacy** – Skills and knowledge to make informed financial decisions;
2. **Financial education** – The process of building knowledge, skills and attitudes to become financially literate. It introduces people to good money management practices with respect to earning, spending, saving, borrowing and investing;
3. **Financial capability** – The ability and opportunity to use the knowledge and skills implied in financial literacy; and
4. **Digital literacy** – The ability to use ICTs to access and use financial services safely, with awareness of the possible risks and ways to avoid them.

Financial inclusion must be gender sensitive

Access to financial services can unlock access to other services that help build sustainable livelihoods, and contribute to economic growth and other SDGs. However, access is unequal between women and men, and policies promoting financial inclusion must be gender sensitive (see Box 5).

Box 5: Finance and gender inclusiveness

Despite significant progress towards achieving global financial inclusion, women continue to lag behind men in terms of access to financial services.

GSMA reports that the gender gap in mobile money account ownership across lower- and middle-income countries has only slightly narrowed from 36 per cent in 2014 to 33 per cent in 2017.

Relating to mobile money adoption, it is important to note the gender gap in mobile phone ownership, which needs to be addressed to enable financial inclusion through mobile services.

As financial technologies become more advanced, easier to use, and more readily accessible, the impact they can have on addressing the gender gap is becoming more substantive.

The Consultative Group to Assist the Poor (CGAP) proposes four regulatory enablers for women's financial inclusion:

1. Enable the growth of non-bank financial institutions as they often have much larger female customer-bases than traditional banks;
2. Use of third-party agents, such as retail shops and kiosks, to offer digital financial services, particularly female agents who are often more successful in fulfilling customer needs, especially among other women
3. Allow the use of more flexible forms of identification as many women do not possess official identification documents; and
4. Encourage the provision of more women-friendly environments, including patient assistance with digital usage where women may not have digital skills.

The United Nations Capital Development Fund (UNCDF) has developed a **gender-assessment toolkit for financial service providers** as part of its ASEAN programme. The toolkit supports financial service providers in enhancing their institutional policies and practices towards development of gender-sensitive products and services, and promotion of gender diversity in their workforce. See https://www.uncdf.org/article/4823/gender-self-assessment-toolkit-for-financial-service-providers.

Sources: ADB Institute, "Policy Brief: Closing the Gender Gap in Financial Inclusion through Fintech", No. 2019-3, April 2019. Available at https://www.adb.org/sites/default/files/publication/498956/adbi-pb2019-3.pdf; CGAP, “4 Regulatory Enablers for Digital Finance: A Gender Perspective”, 10 October 2018. Available at https://www.cgap.org/blog/4-regulatory-enablers-digital-finance-gender-perspective; GSMA, *2019 State of the Industry Report on Mobile Money* (2020). Available at https://www.gsma.com/sotir/wp-content/uploads/2020/03/GSMA-State-of-the-Industry-Report-on-Mobile-Money-2019-Full-Report.pdf; and World Bank, "Press Release: Financial Inclusion on the Rise, But Gaps Remain, Global Findex Database Shows", 19 April 2018. Available at https://www.worldbank.org/en/news/press-release/2018/04/19/financial-inclusion-on-the-rise-but-gaps-remain-global-findex-database-shows.

Youth employment and skills training

In 2018, one-fifth of the world's youth were not in education, employment or training, meaning that they were neither gaining professional experience nor acquiring or developing skills through educational or vocational programmes in their prime years. There is a stark gender difference. Young women were more than twice as likely as young men to be unemployed or outside the labour force and not in education or training.[166]

Rapid technological advancements are changing the labour market and skills requirements. The latest report of the International Labour Organization (ILO) on global employment trend for youth[167] finds that despite being enthusiastic early adopters of new technologies, young people tend to worry the most about the possibility of their jobs being replaced by robots and AI. In both high- and low-income countries, there is widespread concern that such technologies may not lead to the creation of new, better-paying jobs.

Such anxieties are understandable given that the risk of job automation peaks among young workers, who are more likely to be in occupations with a greater proportion of automatable tasks. An integrated policy framework to support young people in securing decent jobs in this context is critical for future socioeconomic progress.

The Asian Development Bank (ADB)[168] and ILO[169] call for a review of education, training and lifelong learning policies. This is because without effective policies, the gap between skilled and non-skilled workers will increase income inequality, leading to social instability and undermining inclusive growth efforts.

Broadly, policies are required to:[170]

- Generate a sufficient number of decent jobs to equip youth with the skills required for those jobs;
- Ensure that youth enjoy social protection and have rights at work; and

[166] United Nations SDG Knowledge Platform, "SDG 8: Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all". Available at https://sustainabledevelopment.un.org/sdg8.
[167] ILO, *Global Employment Trends for Youth 2020* (Geneva, 2020). Available at https://www.ilo.org/wcmsp5/groups/public/---dgreports/---dcomm/---publ/documents/publication/wcms_737648.pdf.
[168] Jinyoung Kim and Cyn-Young Park, "Education, Skill Training, and Lifelong Learning in the Era of Technological Revolution", ADB Economics Working Paper Series, No. 606, January 2020. Available at https://www.adb.org/sites/default/files/publication/559616/ewp-606-education-skill-training.pdf.
[169] ILO, *Global Employment Trends for Youth 2020* (Geneva, 2020). Available at https://www.ilo.org/wcmsp5/groups/public/---dgreports/---dcomm/---publ/documents/publication/wcms_737648.pdf.
[170] For detailed policy recommendations, refer to: ILO, *Global Employment Trends for Youth 2020* (Geneva, 2020). Available at https://www.ilo.org/wcmsp5/groups/public/---dgreports/---dcomm/---publ/documents/publication/wcms_737648.pdf.

- Encourage youth to join workers' and employers' organizations so that they are represented in tripartite dialogue and decision-making.

Case Study 27 presents an example of a state government taking an inclusive approach to vocational training.

Case Study 27: Utkarsh Bangla – An inclusive approach to vocational training, India

The Utkarsh Bangla programme is steered by the Government of West Bengal in India to promote integrated skills development. Catering to youth who are mostly from underprivileged backgrounds, the programme aims to create a pool of skilled candidates who are industry ready.

The Utkarsh Bangla uses existing government ICT and training infrastructure at state and district levels, connecting all the industrial training institutes, polytechnics, vocational training centres and private training partners, including dedicated training institutes for women and persons with disabilities.

The training modules have been designed with industry inputs and their quality is monitored through training of trainers, assessments and certification by professional assessment bodies. These modules are delivered both face-to-face and online.

The programme has partnered with different government agencies and the private sector to design and deliver training on a variety of vocations, in the agriculture, automobile, electronics, hospitality and retail sectors, among others. For example, the programme has partnered with:

- Animal Resource Department to develop the skills of poultry farm workers;
- Municipal Corporation of Kolkata to train plumbers in sustainable utilization of water and sewage system management;
- Industries, Commerce and Enterprises to develop the skills of tea garden workers;
- Forest Department for training the Joint Forest Management Committee members; and
- Maruti Suzuki to provide training and apprenticeships in their automobile dealer network.

The Utkarsh Bangla also runs specialized projects for marginalized groups. For example, online training was delivered to inmates of correctional homes in partnership with the Correctional Services Department as part of the effort to bring reformed inmates into formal employment. The programme also has an "Include, Upskill and Innovate" initiative targeted at training young women and girls.

Trainees of Utkarsh Bangla are encouraged to open their own bank accounts so that the government can deposit allocated training allowances directly to them, as incentive for trainees to complete their training, thus promoting financial literacy and inclusion at the same time.

Source: ITU, *WSIS Stocktaking Success Stories 2019* (Geneva, 2019). Available at https://www.itu.int/net4/wsis/forum/2019/Files/Outcomes/DRAFT-WSISStocktakingSuccessStories2019-en.pdf.

Frontier technologies have given rise to new business models and forms of work: the gig economy, platform work, on-demand economy and sharing economy are becoming more common.

The adoption of e-commerce has also been rising steadily, enabling small producers to sell their products nationwide and worldwide. In China, for example, an estimated 10 million SMEs sell on the Taobao platform—nearly half the entrepreneurs on the platform are women, and more than 160,000 are persons with disabilities.[171]

However, not everyone is able to reap the benefits of these digital platforms due to barriers such as access to affordable devices and broadband, as well as skills development and entrepreneurship financing, poor trade logistics infrastructure, and the lack of a legal framework for electronic transactions, data protection and online consumer protection in countries.[172]

Some countries like Malaysia are promoting the gig economy (see Case Study 28). While the gig economy can boost labour market participation, effective protection for workers needs to be ensured. In Malaysia's case study, the Malaysia Digital Economy Corporation (MDEC), a government agency, has incorporated training in the gig economy platform and is looking into ways to protect workers. In parallel, MDEC is supporting entrepreneurs and SMEs in moving their businesses online.

Case Study 28: The eRezeki programme, Malaysia

MDEC introduced the eRezeki programme in 2015. The eRezeki matches jobs or tasks offered by various marketplace platforms via profiling and training. The main target group of eRezeki are individuals from lower-income households, unemployed and underemployed, pensioners, veterans as well as individuals with disabilities. To date, more than 450,000 Malaysian citizens have registered with the eRezeki programme and more than 100,000 have benefited from earning additional income on digital platforms. MDEC is in discussion with the Employees Provident Fund and insurance companies to provide a retirement plan for freelancers.

Sources: ITU, "WSIS Prizes 2020: Nominated Projects - Digital Income Opportunities via Crowdsourcing / Sharing Economy Model". Available at https://www.itu.int/net4/wsis/stocktaking/Prizes/2020/Nominated; and Balqis Lim, "MDEC's eRezeki and eUshawan initiatives are revolutionising the local cottage industry", *New Straits Times*, 26 March 2018. Available at https://www.nst.com.my/lifestyle/bots/2018/03/349416/mdecs-erezeki-and-eushawan-initiatives-are-revolutionising-local.

[171] UNDP, *Human Development Report 2019* (New York, 2019). Available at http://hdr.undp.org/en/2019-report.
[172] United Nations Conference on Trade and Development, *Digital Economy Report 2019* (New York, 2019). Available at https://unctad.org/en/PublicationsLibrary/der2019_en.pdf.

Rapid technological progress and policies for i4.0 are reshaping labour markets and impacting workers and households in significant ways. Social protection systems need to be reviewed to address these impacts, including ways to cover a growing number of people under non-standard working arrangements, such as those working in the gig economy. The share of women in informal employment in developing countries is 4.6 percentage points higher than that of men, when including agricultural workers, and 7.8 percentage points higher when excluding them.[173]

4.3.3 SDG 9: Build resilient infrastructure, promote inclusive and sustainable industrialization, and foster innovation

This section focuses on countries' development of i4.0, the co-deployment of infrastructure and the fostering of ICT innovation.

i4.0

In some of the countries' ICT plans, reference is made to the vision of a Fourth Industrial Revolution, Industry 4.0 or i4.0. The plan of Japan even refers to i5.0.

The term i4.0 originates from the Industry 4.0 Working Group in Germany in 2012.[174] This was to provide a *techno-logical* architecture for Germany's industrial production processes: *technically* based upon automation and computerization, and *logically* based upon each sequential step of a fully networked supply chain.

The implication is that the concept of i4.0 can be applied across the entire economy and not limited to any one sector. There can, in principle, be a sectoral strategy, such as Malaysia's Health i4.0 where healthcare is being targeted as the driver of i4.0 applications.[175]

Japan probably has the most ambitious vision that extends to an ideal Society 5.0 in which AI, big data analytics, IoT and robotics contribute to achieving each of the SDGs (Figure 11).[176]

Implementing Society 5.0 is a government–industry collaboration that has extended to a wide range of fields. Under the "Growth Strategy Council – Investing for the Future", which is composed of ministers, company chief executives and academicians,

[173] ILO, *Women and men in the informal economy: A statistical picture,* third edition (Geneva, 2018). Available at: http://www.ilo.org/global/publications/books/WCMS_626831/lang--en/index.htm.
[174] Stefan Ferber, "Industry 4.0 – Germany takes first steps toward the next industrial revolution", *Bosch*. Available at https://blog.bosch-si.com/industry40/industry-40-germany-takes-first-steps-toward-next-industrial-revolution/.
[175] Alita Sharon, "Malaysia Rapidly Employing IR4 Tech in Healthcare", *OpenGov Asia*, 2 January 2020. Available at https://www.opengovasia.com/malaysia-rapidly-employing-ir4-tech-in-healthcare/.
[176] Cabinet Office, Japan, "Society 5.0". Available at https://www8.cao.go.jp/cstp/english/society5_0/index.html.

committees have been established for five key themes: (1) next-generation mobility / smart city; (2) smart public services; (3) next-generation infrastructure; (4) financial technology / cashless society; and (5) next-generation healthcare.[177]

Figure 11: Japan's vision of Society 5.0

Source: Cabinet Office, Japan, "Framework of 'STI for SDGs Roadmap': Case in Japan", 8 May 2018. Available at https://www8.cao.go.jp/cstp/english/egm_presentation.pdf.

Within this structure, visions and strategies for deploying digital technologies are discussed, as are challenges related to human resources, regulatory reform, open data and cybersecurity.

The term i4.0 is not limited to high-income countries like Germany or Japan. Cambodia, Indonesia,[178] Thailand[179] and Viet Nam[180] have announced policies for i4.0. Transforming a predominantly agrarian economy into i4.0 can be done by leapfrogging, which is possible at the technological level with ICTs. The real challenge, assuming finance is available, is the human task of managing the process. Case Study 29 presents an ambitious experimental project in Cambodia that draws upon i4.0 ideas.

[177] UNESCO, "Japan pushing ahead with Society 5.0 to overcome chronic social challenges", 21 February 2019. Available at https://en.unesco.org/news/japan-pushing-ahead-society-50-overcome-chronic-social-challenges.
[178] Indonesia Investments, "Widodo Launches Roadmap for Industry 4.0: Making Indonesia 4.0", 6 April 2018. Available at https://www.indonesia-investments.com/business/business-columns/widodo-launches-roadmap-for-industry-4.0-making-indonesia-4.0/item8711.
[179] Archanun Kohpaiboon, "Thailand 4.0 and its challenges", *East Asia Forum*, 17 April 2020. Available at https://www.eastasiaforum.org/2020/04/17/thailand-4-0-and-its-challenges/.
[180] Samaya Dharmaraj, "Vietnam creates policies for Industry 4.0", *OpenGov Asia*, 2 October 2019. Available at https://www.opengovasia.com/vietnam-creates-policies-for-industry-4-0/.

Case Study 29: Cambodia i4.0 SME Cluster Project

An ambitious and innovative project in Cambodia that draws upon the concept of i4.0 is the SME Cluster Project proposal from Worldbridge, a local housing and construction conglomerate.

The concept brings together farmers and SMEs in close locational proximity to each other to form a physical and logical supply chain using agricultural raw materials for processing into higher value-added products. Outputs such as rice cakes, cosmetics and cooking oil can come from inputs such as rice, maize, construction materials from laminated bamboo, and many other products.

By bringing the farmers and SME processors into the same production complex, the idea is to create an ecosystem that leverages automation from one end of the supply chain, starting with the delivery of rice into a storage silo, to packaging and distribution. The SME cluster therefore becomes a fully connected on-site automated i4.0 demonstration using ICTs.

Figure 12: Artist impression of the physical layout of the SME Cluster

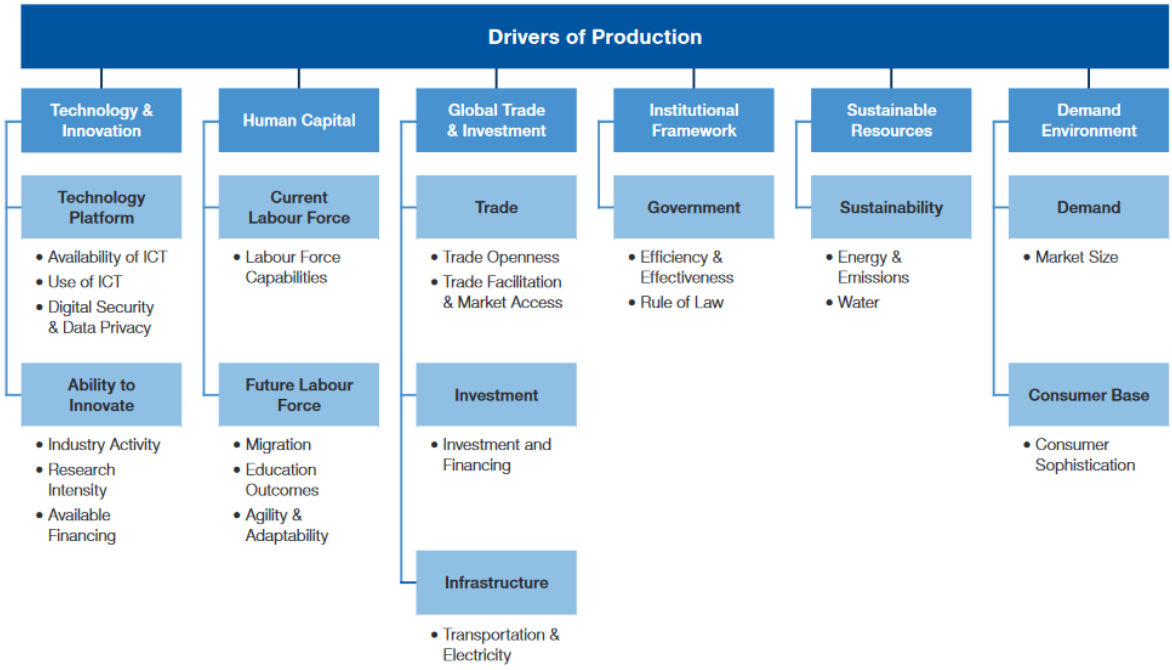
The project as a prototype and proof-of-concept can in principle be replicated anywhere in Cambodia or other country. It is ambitious as a technology project, although with IoT and automated processes it is feasible. However, the real challenge will be bringing the necessary human resources together, including the buy-in of small rural farmers and entrepreneurs of the SME processing enterprises, and the servicing of markets for end products.

Sources: Charles J. Esterhoy III, CEO, Worldbridge, interview on 11 December 2018; and Sok Chan, "Worldbridge to open first SME industrial park," *Khmer Times*, 27 June 2018. Available at https://www.khmertimeskh.com/505212/worldbridge-to-open-first-sme-industrial-park/.

Developing the SME Cluster is one of many aspects of i4.0. The World Economic Forum developed an i4.0 readiness framework that is based on six drivers of production: (1) technology and innovation; (2) human capital; (3) global trade and investment; (4) institutional framework; (5) sustainable resources; and (6) demand environment (Figure 13).[181]

Multi-stakeholder collaboration involving government, private sector, civil society and academia will be crucial for i4.0.

Figure 13: i4.0 readiness framework



Source: World Economic Forum, *Readiness for the Future of Production Report 2018* (Geneva, 2018). Available at http://www3.weforum.org/docs/FOP_Readiness_Report_2018.pdf.

As Figure 13 shows, i4.0 has the potential to improve productivity and competitiveness, increase energy and resource efficiency, and hence protect the environment. It can enable the transition to a circular economy in which end-of-life products are reused, remanufactured and recycled. Taken together, these developments can lead to more sustainable consumption and production patterns.

[181] World Economic Forum, *Readiness for the Future of Production Report 2018* (Geneva, 2018). Available at http://www3.weforum.org/docs/FOP_Readiness_Report_2018.pdf; and Cambodia Development Resource Institute, "Industry 4.0: Prospects and Challenges for Cambodia's Manufacturing Sector". Available at https://cdri.org.kh/wp-content/uploads/Industry-4.pdf.

Something to do

Study the World Economic Forum's Readiness for the Future of Production Index at http://www3.weforum.org/docs/FOP_Readiness_Report_2018.pdf and assess your country's readiness for i4.0.

Infrastructure co-deployment[182]

With countries implementing i4.0, there is an urgent demand for a robust and resilient broadband infrastructure that can support the application of frontier technologies.

As the cost of building the broadband infrastructure is high, ESCAP, through its Asia-Pacific Information Superhighway initiative has been promoting and supporting member States in the co-deployment of the ICT infrastructure with the transportation and energy infrastructures.

ESCAP defines fibre-optic cable infrastructure co-deployment as the concomitant deployment of ducts and/or cables during the construction of infrastructure such as new roads, highways, railways, power transmission lines and oil / gas pipelines.

Studies have demonstrated the benefits of co-deployment in both the construction and maintenance of the infrastructure. Fibre-optic cable co-deployment along infrastructure such as major roads, railways, power transmission lines and pipelines could save significant costs and resources as it allows one-time investment in land acquisition and construction.

More specifically, co-deployment could save significant costs in construction by eliminating duplicated civil works such as excavation, laying of cables, backfilling and reinstatement, since they constitute about 70-80 per cent of investment costs.

An ESCAP study that compares the cost of fibre-optic cable co-deployment during highway construction with their separate deployment in Cambodia and Myanmar shows that co-deployment could save USD 7,379 per km, or 56.83 per cent of total costs.

Most of the cost savings in co-deployment are derived from eliminating overlapping civil works. Other benefits of co-deployment include the ease of obtaining rights of way and various other permits and approvals, minimization of disruptions to road traffic or

[182] This subsection is drawn from: ESCAP, "ICT Infrastructure Co Deployment with Transport and Energy Infrastructure in North and Central Asia", February 2020. Available at https://www.unescap.org/resources/ict-infrastructure-co-deployment-transport-and-energy-infrastructure-north-and-central.

the functioning of utilities as a result of repeated civil works, and streamlining of maintenance and repairs.

For the infrastructure agencies involved in the co-deployment, it could create economic opportunities and generate additional revenues by leasing out the telecommunications ducts or cables, and using the broadband network to improve their business operations.

To promote fibre-optic cable co-deployment and the joint use of telecommunications facilities, an enabling environment is important in motivating road and rail authorities, utilities and telecom operators to cooperate with each other.

National development strategies and plans need to promote cross-sectoral and cross-border cooperation in the development of infrastructure, and incorporate “single installation” and “dig once” principles.

This is because in many low-income countries, infrastructure planning and development are carried out in institutional and sectoral silos, and thus, a mechanism for joint planning and construction should be established.

To identify opportunities for co-deployment, the development of a national spatial information management system is recommended. Revision of legislations and regulations may also be required to mandate cooperation in infrastructure planning and construction.

Innovation

A study of the World Economic Forum finds that innovation is increasingly based on digital technologies and on the new business models they allow.[183] Technologies available today, however, do not necessarily respond to the needs of vulnerable groups. They are often developed by profit-seeking companies and naturally respond to the needs of more wealthy markets. Policymakers can take multiple approaches that support the development of ICTs and innovative solutions that respond to the needs of vulnerable groups (Table 3).

Innovation activities, including the commercialization and transfer of technologies, and policies promoting the adoption and diffusion of technologies, are important. Just as important are activities that empower poor and vulnerable communities to realize their own innovative potential, which include access to finance and credit, and opportunities to acquire skills, including ICT skills.

[183] World Economic Forum, *The Global Information Technology Report 2016* (Geneva, 2016). Available at https://www.weforum.org/reports/the-global-information-technology-report-2016.

Table 3: Policy approaches to promote ICTs that address the needs of vulnerable groups

Type of policy approach	Example	Characteristics
Mission-oriented policies to address complex society challenges	• Supporting financial inclusion in India • Promoting renewable energy adoption in China	• Aim to change the direction of technological systems • Focus on diffusion of technologies • Seek the development of radical and incremental innovations • Require leadership from the top, long-term investments and comprehensive policies
Grand challenge competition	Water Abundance XPRIZE[184]	• Incentivize researchers, engineers and development agencies to come up with concrete solutions • High upfront costs • Addressing the challenges may require regulatory changes beyond the sphere of influence of competition organizers
Social-problem research that specifically searches solutions to development problems	Republic of Korea's social-problem research programme	• Multi-departmental research projects driven by demand instead of supply • Require joint planning and implementation across different research departments • Require sound participation of civil society and citizens
Promotion of grass-roots innovations through projects designed by local communities and/or inventions designed to meet specific local needs	India's National Innovation Foundation[185]	These innovations are driven by grass-roots organizations, but governments can also encourage them
Women-centered approach to highlight the needs of women	ESCAP and UNCDF's Women Fintech MSME Innovation Fund	Provide risk capital and technical assistance to pilot technology-enabled financial service solutions for women-led enterprises (see Case Study 6)

Sources: ESCAP, *Inequality in Asia and the Pacific in the Era of the 2030 Agenda for Sustainable Development* (Bangkok, 2018). Available at http://sdghelpdesk.unescap.org/sites/default/files/2018-09/ThemeStudyOnInequality.pdf; and ESCAP, "10 digital solutions for women entrepreneurs win support from United Nations' FinTech Innovation Fund", Press Release, 27 June 2019. Available at

[184] Water Abundance XPrize. Available at https://www.xprize.org/prizes/water-abundance.
[185] National Innovation Foundation, India. Available at http://nif.org.in/.

https://www.unescap.org/news/10-digital-solutions-women-entrepreneurs-win-support-united-nations-fintech-innovation-fund.

4.3.4 SDG 10: Reduce inequality within and among countries

Despite some positive signs towards reducing inequality in some dimensions, such as reducing relative income inequality in some countries and preferential trade status benefiting lower-income countries, inequality still persists in all forms.[186]

ICTs, particularly frontier technologies, can increase inequalities as technological capabilities are not equally distributed across countries and people in the Asia-Pacific region. To address ICT-induced inequality in the region, the ICT infrastructure, notably broadband networks, must be accessible, affordable, reliable and resilient. Policies must also emphasize the building of ICT skills and competencies, including the need for re-skilling and lifelong learning.

This section examines the role of social protection in reducing inequalities and how ICTs enhance social protection. The importance of inclusiveness has been stressed throughout this module, particularly the need to address gender inequality (see Section 4.1.2). The module has also discussed inequalities faced by children in education (Section 4.1.5) and by youth in skills development and employment (Section 4.3.2).

This section, therefore, examines how ICTs have both impacted and empowered marginalized groups, such as the elderly and persons with disabilities, and migrants, refugees and internally displaced persons.

Social protection

Social protection is an effective measure to tackling inequalities and building resilience against shocks and crises. ESCAP has promoted social protection as part of an overall strategy to reduce inequality, particularly by addressing the exclusion of the most vulnerable groups and offering a path out of poverty.[187]

[186] United Nations Economic and Social Council, Progress towards the Sustainable Development Goals: Report of the Secretary-General - Summary, 2020 Session, 25 July 2019 - 22 July 2020. Available at https://sustainabledevelopment.un.org/content/documents/26158Final_SG_SDG_Progress_Report_14052020.pdf.

[187] ESCAP, *Time for Equality: The Role of Social Protection in Reducing Inequalities in Asia and the Pacific* (Bangkok, 2015). Available at http://sdghelpdesk.unescap.org/sites/default/files/2019-06/SDD%20Time%20for%20Equality%20report_final.pdf.

Social protection refers to a broad set of government transfers of income or services, such as healthcare, education or labour market programmes, designed to reduce vulnerability and build resilience.[188]

Case Study 30: The Mahatma Gandhi National Rural Employment Guarantee Scheme, India

The Mahatma Gandhi National Rural Employment Guarantee Scheme is India's effort to reduce rural poverty by providing 100 days of wage employment in a year. If employment is not provided, an unemployment allowance is granted. It is one of the world's most complex and ambitious projects to implement.

The scheme started in 2005 and is still ongoing today. In 2019, 79 million individuals benefited from the scheme, 50 per cent of whom were women, while 40 per cent belonged to scheduled castes and scheduled tribes.

An ICT system for the scheme was envisioned and developed from the start to provide information about the scheme to the rural poor, and offer tools for government officials to manage the scheme and monitor progress, as well as ensure transparency. The ICT system has continually been improved upon as technologies advance.

Communication

To communicate information about the scheme to the rural poor, a range of ICT channels are used, including community radio, television, public address systems and *panchayat* (village council) websites.

Planning and monitoring

In 2006, most of the muster rolls used to calculate wages, and other data such as persons employed, wage rates, hours worked, etc. were maintained in hard copy. By 2011, muster rolls and other data were digitized and 90 per cent of the scheme's expenditure information was accessible online on the scheme's portal.

With data digitized, a number of information management systems were created to link up the various databases and support implementation. Examples include the National Electronic Fund Management System to track and authenticate fund flow, and Works Management System to track and authenticate employment records.

Payment process

[188] Ibid.

One of the major criticisms of the scheme has been the delayed payment of wages or the non-payment of unemployment allowances to beneficiaries. Most states have struggled in identifying an effective and speedy payment transfer mechanism.

Initially, the wages were transferred into *panchayat* bank accounts and the workers had to collect their wages from the government office. However, with the introduction of Jan Dhan (national financial inclusion initiative), Aadhar (the biometric digital identification initiative) and mobile payments—collectively known as the JAM trinity—validation of beneficiaries and payment transfers have been easier.

According to the scheme's portal, the percentage of payments generated within 15 days jumped from 43 per cent in 2016 to 95 per cent in 2019.

Grievance redressal

Citizens can register grievances either at the *panchayat* offices or on a mobile app, and citizens can track progress online.

Overall, the use of ICTs have helped the scheme improve payment processes, and enhance transparency and accountability.

Yet, studies show that problems remain related to errors in recording, lost muster rolls, Aadhar number linked to wrong bank account and the lack of capacity of *panchayats* to manage the process. These problems cannot be addressed using technology alone.

Future plans

Going forward, the Government of India is planning to expand the number of jobs available to workers under the scheme, upskill the workers it has enlisted, and use the digital infrastructure to expand the scheme to offer micro-insurance, micro-pensions and micro-credit.

Sources: Ministry of Rural Development, Government of India, "The Mahatma Gandhi National Rural Employment Guarantee Act 2005". Available at https://nrega.nic.in/netnrega/mgnrega_new/Nrega_home.aspx; World Bank, "Schemes to Systems: The Unfinished Agenda of Mahatma Gandhi Rural Employment Guarantee Scheme", 23 February 2019. Available at https://www.worldbank.org/en/news/feature/2019/11/25/schemes-to-systems-mahatma-gandhi-rural-employment-guarantee-scheme-india; M. Galaiah and A. Srinivasacharyulu, "Role of ICT in Rural Development: Opportunities and Challenges (A study of MGNREGS in India)", *International Journal of Research in Social Sciences*, vol. 8, no. 5 (May 2018). Available at https://www.ijmra.us/project%20doc/2018/IJRSS_MAY2018/IJMRA-13804.pdf; Prabhjote Gill, "Technology plugged the leaks in India's INR 60,000 crore rural employment guarantee scheme", *Business Insider India*, 4 July 2019. Available at https://www.businessinsider.in/india-economic-survey-2019-says-mgnrega-leaks-plugged-by-tech/articleshow/70071348.cms; Ankita Aggarwal, "Ten Ways MGNREGA Workers Do Not Get Paid", *Economic & Political Weekly Journal*, vol. 52, no. 6 (11 February 2017). Available at https://www.epw.in/journal/2017/6/web-exclusives/ten-ways-mgnrega-workers-do-

not-get-paid.html; and Debmalya Nandy, "MGNREGA is failing: 10 reasons why", *Down To Earth*, 5 November 2018. Available at https://www.downtoearth.org.in/blog/economy/mgnrega-is-failing-10-reasons-why-62035.

It includes social assistance contributory schemes such as health insurance, old-age pensions and unemployment, maternity, sickness and disability benefits. It also includes social assistance non-contributory schemes in the form of cash transfers (often conditional) to poor households, persons with disabilities and other vulnerable groups.

ICTs can help to manage and monitor the implementation of social protection initiatives, including efficient disbursement to beneficiaries and reduced opportunities for fraud (see Case Study 30).

Ageing and disability

In Asia and the Pacific, an estimated 690 million people live with some form of disability.[189] The population of persons with disabilities is likely to increase because of the combined effects of population ageing, poverty, the rapid spread of non-communicable diseases, natural disasters and humanitarian crises. The current COVID-19 pandemic has an effect of increased stress level among people, some of whom may develop mental health conditions or worsen their existing mental health issues.[190]

The region is experiencing population ageing at an unprecedented rate, with the number of older persons (age 65 or older) expected to more than double, from 535 million in 2015 to about 1.3 billion by 2050.[191] Trends show that overall life expectancy is growing faster than healthy life expectancy, which means people live longer, but they also spend a longer period of their life with a disability. Statistics also show that women tend to spend more years with disabilities than men.

These trends raise the demand for quality and long-term healthcare. ESCAP reports that many healthcare systems in the region are not equipped to meet this increased

[189] ESCAP, *Building Disability-Inclusive Societies in Asia and the Pacific* (Bangkok, 2018). Available at https://www.unescap.org/sites/default/files/publications/SDD%20BDIS%20report%20A4%20v14-5-E.pdf.
[190] WHO, "Mental health and COVID-19". Available at https://www.euro.who.int/en/health-topics/health-emergencies/coronavirus-covid-19/technical-guidance/mental-health-and-covid-19.
[191] ESCAP, *Addressing the Challenges of Population Ageing in Asia and the Pacific* (Bangkok, 2017). Available at https://www.unescap.org/sites/default/files/publications/Addressing%20the%20Challenges%20of%20Population%20Ageing%20in%20Asia%20and%20the%20Pacific.pdf.

demand by older persons, plus there is a shortage of qualified caregivers throughout the region, even where a highly developed long-term care system exists.[192]

An ESCAP survey indicates that two-third of ESCAP member countries are implementing measures to increase the quality of long-term care services for older persons through a range of initiatives, including innovative technology solutions.[193]

The healthcare sector has started to explore how AI and big data can contribute to long-term care for older persons, from early diagnosis and more effective treatment of diseases and mental health issues, to at-home health monitoring and fall detection. Generally, AI and big data can be used for the following:[194]

- At-home monitoring can detect changes in activity and behaviour patterns for early detection of health issues;
- Voice-based virtual assistants can enable medication adherence and care coordination;
- Smart wearable biometric trackers can check inconsistencies in biometric data, detect a significant or hard fall and sound an alarm;
- Robotic helpers can help older persons who live alone and require daily assistance and/or companionship; and
- Health research.

An example of how the Republic of Korea is using AI to improve care for older persons is shown in Case Study 31.

[192] Ibid.
[193] Ibid.
[194] Shourjya Sanyal, "How Is AI Revolutionizing Elderly Care", *Forbes*, 31 October 2018. Available at https://www.forbes.com/sites/shourjyasanyal/2018/10/31/how-is-ai-revolutionizing-elderly-care/#6949aa01e07d.

Case Study 31: AI care for older persons in the Republic of Korea

Since 2018, the mobile operator, SK Telecom, has been collaborating with local governments and businesses offering home and nursing care services to develop and roll out an AI speaker for older persons living alone, and a mobile app that enables caregivers to check the status of older persons.

The Korean government provides subsidies to those with mobility issues but the subsidies are only sufficient to hire a caregiver for about four hours a day (this can vary depending on the physical function or disease of each older person). The AI speaker and mobile app aim to support and complement caregiving.

The AI speaker can be used by older persons to access a range of services through voice commands, such as making appointments, psychosocial counselling, emotional support and emergency SOS calls. SK Telecom plans to introduce new choices such as gaming to help prevent dementia.

SK Telcom is also collaborating with Pusan National University Hospital to develop virtual reality-based rehabilitation solutions that will enable older persons and others with mobility difficulties to take part in home-based rehabilitation programmes.

Sources: GSMA, *2019 Mobile Industry Impact Report: Sustainable Development Goals* (2019). Available at https://www.gsma.com/betterfuture/wp-content/uploads/2019/10/2019-09-24-a60d6541465e86561f37f0f77ebee0f7-1.pdf; Shim Woo-hyun, “South Korean telecom firms expand AI-based senior care services", *The Korea Herald*, 4 May 2020. Available at http://www.koreaherald.com/view.php?ud=20200504000206; and SK Telecom, "News: SK Telecom’s AI Care to Provide 24/7 Care for the Elderly", 22 April 2020. Available at https://sktelecom.com/en/press/press_detail.do?idx=1454.

Major barriers in the adoption of such technologies include the inadequate ICT infrastructure and systems to support frontier technologies like AI and big data, and the users' lack of digital skills/ability to use and benefit from them.

Populations affected by aging and disability also face challenges in terms of ICT accessibility. To overcome these issues, investing in accessibility through integrating principles of universal design is the first step forward.[195]

[195] ESCAP, *Disability at a Glance 2019: Investing in Accessibility in Asia and the Pacific – Strategic Approaches to Achieving Disability-inclusive Sustainable Development* (Bangkok, 2019). Available at https://www.unescap.org/sites/default/files/publications/SDD-DAG-2019.pdf.

Universal design, contained in the Convention on the Rights of Persons with Disabilities is defined as, “the design of products, environments, programmes and services to be usable by all people, to the greatest extent possible, without the need for adaptation or specialized design. Universal design shall not exclude assistive devices for particular groups of persons with disabilities where this is needed”.[196]

The Incheon Strategy to “Make the Right Real” for Persons with Disabilities in Asia and the Pacific, the regional mandate on disability-inclusive development, also promotes universal design as a key principle, while the Beijing Declaration and Action Plan to Accelerate the Implementation of the Incheon Strategy recommends that governments develop policies and programmes that integrate universal design. The ITU further promotes digital accessibility to achieve the SDGs.[197]

For persons with disabilities, applications that assist access to the Internet—such as screen readers, speech recognition software, and video communication that incorporates sign language and visual assistance—are increasing and becoming more affordable. Some of these applications are integrated in mobile devices, and have enabled persons with disabilities to live independently.

Unfortunately, many websites and mobile apps are not accessible to them, which means the websites and apps are designed in such a way that make them difficult or impossible for persons with disabilities to use. The lack of good Internet connectivity in many parts of the region is also a barrier to accessing information.

Governments in the Asia-Pacific region have developed policies, legislations and guidelines to ensure digital accessibility. In some countries, the focus is on the accessibility of websites (e.g., New Zealand), and in other countries the coverage is broader and includes other ICTs, such as mobile apps (e.g., Japan and the Republic of Korea). In many countries, compliance is expected from public sector organizations only (e.g., Hong Kong, China), but in India and the Republic of Korea, private sector organizations are also expected to ensure that their products and services are accessible to persons with disabilities.[198]

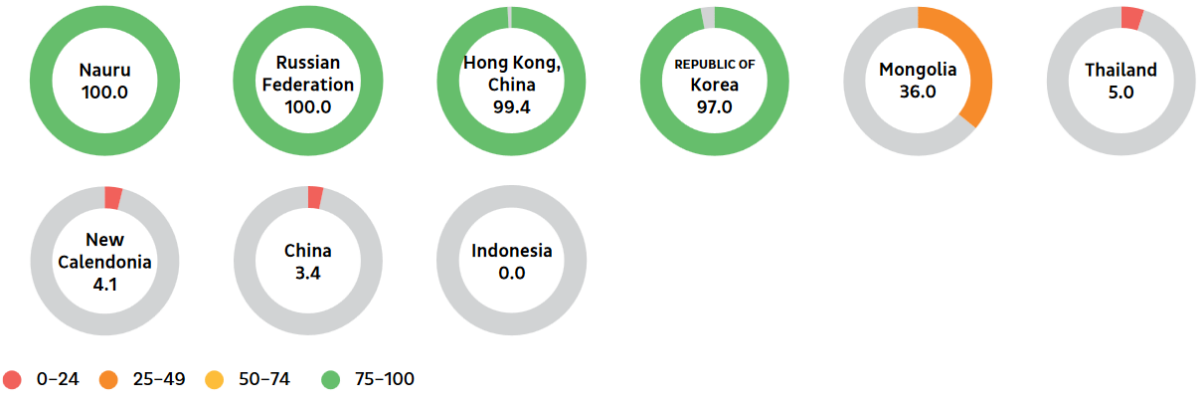
Yet, progress in achieving digital accessibility has been slow despite legislation. Only about 40 per cent of government websites in the region are accessible by persons

[196] United Nations Department of Economic and Social Affairs, “Convention on the Rights of Persons with Disabilities: Article 2 – Definitions”. Available at https://www.un.org/development/desa/disabilities/convention-on-the-rights-of-persons-with-disabilities/article-2-definitions.html.
[197] ITU, "ICT / Digital Accessibility". Available at https://www.itu.int/en/ITU-D/Digital-Inclusion/Persons-with-Disabilities/Pages/Persons-with-Disabilities.aspx.
[198] Internet Society, "Issue Paper, Asia-Pacific Bureau: Digital Accessibility", May 2017. Available at https://www.internetsociety.org/wp-content/uploads/2017/09/APAC-Issue-Papers-Digital-Accessibility.pdf.

with disabilities—the national accessibility rates vary between 3.4 per cent and 100 per cent (Figure 14).[199]

Some governments, including China, India, the Republic of Korea and Thailand, have conducted accessibility audits on websites based on pre-established technical guidelines that meet international accessibility standards, such as the Web Content Accessibility Guidelines 2.1.[200] These guidelines are also relevant for ensuring that websites and mobile apps are accessible to older persons.

Figure 14: Proportion of accessible government websites in selected countries



Source: ESCAP, *Building Disability-Inclusive Societies in Asia and the Pacific* (Bangkok, 2018). Available at https://www.unescap.org/sites/default/files/publications/SDD%20BDIS%20report%20A4%20v14-5-E.pdf.

For instance, to ensure that websites and mobile apps are accessible to those visually impaired, font size needs to be adjustable and images should contain descriptive text alternative. To benefit those hard of hearing, video content must include captioning. Increasingly, autogenerated captioning systems are being integrated as a feature of online communication mechanisms. However, there is still much room for improvement in terms of accuracy of content and, for real-time captioning, timely projection of the captioning.

Incentives, awareness and support are needed to boost the low enforcement and implementation of digital accessibility. For example, Viet Nam offers tax exemption and reduction, concessional loans and other support for the research, manufacture and production of products and services that enable persons with disabilities to access

[199] ESCAP, *Building Disability-Inclusive Societies in Asia and the Pacific* (Bangkok, 2018). Available at https://www.unescap.org/sites/default/files/publications/SDD%20BDIS%20report%20A4%20v14-5-E.pdf.

[200] W3C, "Web Content Accessibility Guidelines (WCAG) 2.1", 5 June 2018. Available at https://www.w3.org/TR/WCAG21/.

ICTs. Viet Nam also does not impose import taxes on assistive devices for persons with disabilities.[201]

In Hong Kong, China, the Office of the Government Chief Information Officer (OGCIO) runs a campaign to promote awareness and wider adoption of accessibility design in government and private sector websites and mobile apps (see Case Study 32).

Case Study 32: Web / Mobile App Accessibility Campaign, Hong Kong, China

The OGCIO has been leading a Web / Mobile App Accessibility Campaign and adopts a multi-pronged strategy to drive the adoption of accessible design in websites and mobile apps of both public and private sectors:

- With effect from 1 January 2013, the Government of Hong Kong, China requires all government websites to meet the stringent requirements under Level AA standard of the Web Content Accessibility Guidelines version 2.0.
- To supplement the guidelines, the OGCIO has produced manuals for web and mobile app developers, as well as guides for preparing the procurement specifications for accessible websites and mobile apps.
- The OGCIO has organized seminars and technical workshops to help businesses and organizations better understand the importance of web / mobile app accessibility, and share best practices and related skills for making their websites and mobile apps accessible.
- The OGCIO has incorporated web / mobile app accessibility into the ICT curriculum of higher education institutions.
- Since 2013, the OGCIO and the Equal Opportunities Commission have jointly organized the Web Accessibility Recognition Scheme to encourage local enterprises to adopt accessibility design in their websites and mobile apps.

Source: OGCIO, Hong Kong, "Web/Mobile App Accessibility Campaign: Making Digital Content Available for All". Available at https://www.ogcio.gov.hk/en/our_work/community/web_mobileapp_accessibility/.

Something to do

Test to see if the website or mobile app of your organization is digitally accessible.

Check the following links for digital accessibility evaluation tools:

- W3C, “Web Accessibility Evaluation Tools List”. Available at https://www.w3.org/WAI/ER/tools/.

[201] Internet Society, "Issue Paper, Asia-Pacific Bureau: Digital Accessibility", May 2017. Available at https://www.internetsociety.org/wp-content/uploads/2017/09/APAC-Issue-Papers-Digital-Accessibility.pdf.

- Clemson University, "Do-It-Yourself Digital Accessibility Auditing". Available at https://www.clemson.edu/accessibility/auditing-tools.html.

In addition to digital accessibility, there is a need to ensure the accessibility of telephone-based communication. When making an emergency call where the Internet is unavailable, such as in a situation where only telephone-based medical emergency calls are available, deaf and hard-of-hearing people face enormous difficulties. Telephone relay services provide a solution whereby an intermediary operator can translate sign language or typed messages to spoken language, and vice versa. However, only about 25 governments in the world have the system as of June 2020.[202] In Japan, the national law to support telephone relay systems has just been passed in June 2020.[203]

All players in the ICT ecosystem must consider accessibility, not as an afterthought but as an integral part of the system, incorporating universal design principles. Producers, including device manufacturers, network and app developers, and content developers, need to commit to promoting accessibility for persons with disabilities. Service providers, including governments, banks, educational institutes and employers need to ensure that the products they procure and use do not present access barriers to employees or customers with disabilities.

For example, the Republic of Korea's National Informatization Act mandates national government agencies, providers of ICT services, designers and manufacturers of ICT products, and organizations procuring ICT products to guarantee accessibility.[204]

Migrants, refugees and internally displaced persons

Of the world's estimated 258 million international migrants, about 40 million live in Asia and the Pacific and 77.2 million people born in the region are outside of their countries of origin.[205]

The migration drivers range from income inequality and demography to conflict and the environmental impact of climate change. Regional connectivity and regional integration also contribute to greater mobility. Temporary, circular and irregular migration is widespread in the region, with almost half of the migrants being women.

[202] Minutes of the 1st Working Group on telephone-relay service (in Japanese). Available at https://www.soumu.go.jp/main_content/000596719.pdf.
[203]Chokakushougaisha ni yoru Idouno enkatuka ni kansuru hou (in Japanese). Available at http://www.shugiin.go.jp/internet/itdb_gian.nsf/html/gian/honbun/houan/g20109027.htm.
[204] Republic of Korea Framework Act on National Informatization – Article 32: Guaranteeing Access to and Use of Information by Persons with Disabilities, Aged Persons, etc.
[205] International Organization for Migration, "Asia and the Pacific". Available at https://www.iom.int/asia-and-pacific.

Migrants are predominantly semi- and low-skilled workers in informal sectors looking for work.

Moreover, the region is home to 3.5 million refugees, 1.9 million internally displaced persons and 1.4 million stateless people. The majority of refugees originate from Afghanistan and Myanmar.[206]

In a crisis, ICTs have helped those displaced to communicate with family and friends, seek assistance during emergencies, and receive money to meet their immediate needs.

Humanitarian aid agencies have been exploring new ways of delivering aid through mobile money and digital vouchers to the affected, and using blockchain to record transactions. ICTs, including biometrics, have been used for identity management and the facilitation of registration. ICTs have also been used in the provision of education and healthcare services to refugees and displaced persons, and in income generation and trading activities (see Case Study 1).

Often, refugees and displaced persons have no or limited access to ICTs such as mobile devices and/or the Internet. Besides the lack of affordability, there may be other barriers such as the need for proof of identity to purchase a SIM card.

For those who do have access, ICTs have been helpful in:[207]

- Staying connected with family and friends;
- Obtaining Information for journeys and settling into new locations;
- Addressing language barriers by using translation apps;
- Maintaining cultural identity through engagement in online communities, often on social media platforms;
- Education by both adults and children;
- Seeking employment opportunities or pursuing self-employment and entrepreneurship;
- Finding a doctor or gaining health information to support self-care;
- Saving, sharing and acquiring documents related to their personal identities and educational or professional qualifications; and
- Receiving and/or sending money.

Research by the United Nations Refugee Agency (UNHCR) reveals that refugees see connectivity as a critical survival tool, often prioritizing it over items such as education,

[206] UNHCR, "Asia and the Pacific". Available at https://www.unhcr.org/en-my/asia-and-the-pacific.html.
[207] Ashwed Patil, "The Role of ICTs in Refugee Lives", Tenth International Conference on Information and Communication Technologies and Development, January 2019. Available at https://dl.acm.org/doi/pdf/10.1145/3287098.3287144?download=true.

clothing and healthcare. For many, it is a lifeline through which they can inform themselves about their new environment, access services and support, and become connected to the national and global communities around them.[208]

For highly-skilled migrants who are moving from one city or country to another, access to and use of ICTs may not be significantly different before and after the move. Many have probably used the Internet for preparation prior to, during and after the journey. ICTs open up doorways to employment, transportation, money transfers and services en route, and reduce the risk of theft or loss of money because migrants no longer need to carry large sums of cash with them. Electronic and mobile payments have reduced the transaction costs of migrant remittances, allowing workers and their families to keep more of their earnings.

According to GSMA, it is now possible to send remittances from one mobile money account to another mobile money account between more than 35 countries worldwide. The cost of international remittances has also reduced significantly using mobile money. In 2017, the average cost of sending USD 200 using mobile money was 1.7 per cent of the transaction.[209]

The ways in which ICTs can promote decent work for migrant workers are summarized in Table 4.

[208] Filippo Grandi, "Internet and Mobile Connectivity for Refugees – Leaving No One Behind", in ITU, *Fast-forward progress: Leveraging tech to achieve the global goals* (Geneva, no date), pp. 84-86. Available at https://www.itu.int/en/sustainable-world/Documents/Fast-forward_progress_report_414709%20FINAL.pdf.
[209] GSMA, "Mobile money: Competing with informal channels to accelerate the digitisation of remittances", May 2018. Available at https://www.gsma.com/mobilefordevelopment/wp-content/uploads/2018/05/Mobile_Money_Competing_with_informal_channels_to_accelerate_the_digitisation_of_remittances.pdf.

Table 4: An overview of ways in which ICTs can promote decent work for migrant workers

Digitalization 	A. Information dissemination, pre-departure orientation, and support services	• Outreach and information dissemination to prospective migrant workers on Facebook, Line, WhatsApp, and other online platforms • Online pre-departure training
	B. Fair recruitment	• Government databases for managing migration procedures • Online recruitment platforms for direct hiring • Platforms for comparing recruitment agencies
	C. Providing decent working conditions	• Organizing, networking, and information dissemination using Facebook, Line, WhatsApp, and other online platforms • Digital aids in labour inspection • Online remittance and payment services, digital wallets • Online skills training
	D. Facilitating access to redress mechanisms and support services	• Helpline apps • Online support services, e.g., through Skype consultations • Databases to manage migrant welfare, including complaints, assistance, and training
	E. Effective return and reintegration strategies	• Online skills assessments and training • Databases to manage migrant welfare, including reintegration services
	F. Public education campaigns	• Social media campaigning on Facebook, YouTube, Twitter, Instagram, etc.
	G. Collecting, sharing, and analysing labour migration data	• Administrative data drawn from management databases

Source: ILO, *Digitalization to promote decent work for migrant workers in ASEAN* (2019). Available at https://www.ilo.org/wcmsp5/groups/public/---asia/---ro-bangkok/---sro-bangkok/documents/publication/wcms_713546.pdf.

Migrants contribute to websites, online discussion forums and social media platforms by sharing information and experiences, providing insider knowledge on migration.

While social media may help migrants, social media plays a role in the recruitment of trafficking victims. Social media allows traffickers to access a greater number of victims and advertise their services over larger spatial distances.

However, law enforcements are making use of big data from social media and other platforms to identify trafficking cases. Also, helplines, crowdsourcing and crowdmapping platforms have emerged for citizens to report and help identify traffickers.[210]

[210] See Child Helpline International. Available at https://www.childhelplineinternational.org; International Association of Internet Hotlines. Available at http://www.inhope.org; Internet Watch Foundation. Available at https://www.iwf.org.uk/; and Timo Luege, "Europol Turns to the Crowd to Identify Locations of Child Abuse", *Social Media for Good*, 2 June 2017. Available at http://sm4good.com/2017/06/02/europol-turns-to-the-crowd-to-identify-locations-of-child-abuse/.

Case Study 33: The Rohingya Project

The Rohingya Project aims to create self-sovereign digital identities for the stateless Rohingya diaspora to facilitate financial inclusion and access to services. The project plans to develop a blockchain-based financial ecosystem tied to digital identity cards with pilots in Bangladesh, Saudi Arabia and Malaysia.

Using a multi-layered verification methodology to confirm Rohingya ancestry through a series of interviews and assessments, this personal information will then be recorded in a blockchain database to provide an authenticatable and legitimate proof of identity.

Initially, the plan was to also record biometric data, such as fingerprints, iris scan and photographs but following a feasibility study, the recommendation is for the project to consider non-biometric methods of identity verification considering the vulnerabilities of the Rohingya diaspora.

This large-scale collection and recording of personal and biometric data can be used to drive repatriation and digitally enable discrimination. If the database of Rohingya people were to be leaked, hacked or shared, it could make it easier to deny Rohingya access to basic services, target them or discriminate against them.

There need to be accountability processes in place in case of errors, and responsible data practices must clearly be followed. According to data minimization principles, only

data that is necessary should be collected, and access to stored personal data should be strictly limited.

To date, the ASEAN member States officially recognize digital identification as a mode of legal recognition. This provides a formal institutional basis to justify blockchain IDs as a viable solution for stateless people in ASEAN.

However, there are a number of issues that need to be resolved. For example, if fraudulent activity is committed using the blockchain authenticated ID, the lack of a centralized authority will cause confusion. Moreover, the question of who holds jurisdiction of processing this type of criminal activity means that the international community will need to find the proper legal framework to indict.

Sources: Rohingya Project. Available at https://rohingyaproject.com/; Henry M. Jackson School of International Studies, University of Washington, "Identities for Opportunities: A Feasibility Study for Overcoming the Rohingya's Statelessness Challenges via Blockchain Digital Solutions", July 2018. Available at https://jsis.washington.edu/wordpress/wp-content/uploads/2018/08/jsis-arp-rohingya-2018.pdf; Skot Thayer and Alex Hern, "Rohingya turn to blockchain to solve identity crisis", *The Guardian*, 21 August 2018. Available at https://www.theguardian.com/world/2018/aug/21/rohingya-turn-to-blockchain-to-solve-identity-crisis; Preeti Jha, "A Digital Nation for the Stateless Rohingya?" *The Diplomat*, 2 July 2019. Available at https://thediplomat.com/2019/07/a-digital-nation-for-the-stateless-rohingya/; and Zara Rahman, "Irresponsible data? The risks of registering the Rohingya", *The New Humanitarian*, 23 October 2017. Available at https://www.thenewhumanitarian.org/opinion/2017/10/23/irresponsible-data-risks-registering-rohingya.

Although ICTs have significant benefits for refugees and aid organizations, increased use of data raises ethical, privacy and security issues (see Case Study 33):[211]

- Frameworks for addressing ICT risks and safeguards against ICT risks are underdeveloped and fragmented across the humanitarian sector;
- Data responsibility issues, including protecting data from misuse and respecting refugees' data-related rights, are growing more urgent and complex as aid operations create and collect increasing amounts of personal data; and
- Bias is introduced or exacerbated by ICT-based humanitarian efforts when they exclude certain groups or perpetuate inequality or discrimination.

Both the opportunities and threats of ICTs must be considered when designing and implementing policies and programmes to reduce inequality.

4.3.5 SDG 11: Make cities and human settlements inclusive, safe, resilient and sustainable

[211] RAND Corporation, *Crossing the Digital Divide: Applying Technology to the Global Refugee Crisis* (Santa Monica, 2019). Available at https://www.rand.org/content/dam/rand/pubs/research_reports/RR4300/RR4322/RAND_RR4322.pdf.

For the first time in history in 2019, over half of Asia-Pacific's population was living in cities—that was 2.3 billion people—and it is estimated that the figure will reach 3.5 billion by 2050. These numbers equate to adding four Tokyo-sized cities every year.[212]

This is both a threat and an opportunity. Overcrowding, poorly-constructed infrastructure and housing, water shortages, easily-transmitted diseases, criminal violence, traffic congestion and pollution, are among the frequently encountered challenges. The Asia-Pacific region is now home to 97 of the 100 most air-polluted cities in the world.[213] To effectively handle these challenges, cities will have to become smarter about how they use existing limited resources.

The opportunities cities offer are many. Cities are highly diverse in human and other resources, which adds to their resilience. Cities offer economies of scale to provide education and healthcare and other social services within financial means. CO_2 emissions per capita are lower in cities with higher urban densities. Cities attract investments and entrepreneurs. Cities are therefore economically and socially dynamic, the very conditions needed to be centres of innovation.

With the spread of broadband Internet, smart devices and IoT, cities can become centres of smart applications. Cities generate huge amounts of data, and big data from multiple sources collected and transferred in real time enables local governments to model and analyse urban issues using AI, and respond more effectively and promptly to them. Mobile web access for services like ride sharing has triggered a lifestyle shift in cities. AI applications such chatbots are performing customer service duties on many service websites. These technological shifts are transforming the way we connect with one another, conduct business, provide services and live our lives in cities. For city leaders, technological advancement offers numerous opportunities to tackle urban challenges in ways never before imagined.

Technology, however, has also aroused intense social discussions due to its offense towards individuals' privacy and security. The lack of data protection laws and regulations is one of the major difficulties in future applications of big data in cities.

There is no single definition of a smart city. In fact, most definitions are no more than descriptions, and often terms like "Intelligent City" and "Knowledge Economy" are used, but all cases involve their own variety of programmes and applications. They include:

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[212] ESCAP and UN-Habitat, *The Future of Asian & Pacific Cities* (Bangkok, 2019). Available at https://www.unescap.org/publications/future-asian-and-pacific-cities-2019-transformative-pathways-towards-sustainable-urban.

[213] ESCAP, *Economic and Social Survey of Asia and the Pacific 2020: Towards Sustainable Economies* (Bangkok, 2020). Available at https://www.unescap.org/publications/economic-and-social-survey-asia-and-pacific-2020.

- Smart street lighting;
- Smart e-government services;
- Digital crowdsourced information and online citizens' participation in decision-making;
- Smart energy-efficient buildings;
- Intelligent transportation systems;
- Smart grids and smart energy consumption;
- Optimized / smart waste collection;
- Smart regeneration of wastelands into green environmentally-friendly areas; and
- Pollution management.

A good definition of smart cities is, "the potential to improve the efficiency and flexibility of public services while increasing the quality of life for the residents".[214] Under the heading of "smart cities", governments in collaboration with private sector and development organizations have been developing innovative approaches for modern urban mobility and living concepts aimed at improving urban quality of life (see Case Study 34).

Case Study 34: Improving the natural environment for a high standard of living in Luang Prabang, Lao PDR

Luang Prabang is situated at the confluence of Mekong and Nam Khan rivers in Lao PDR. Wetlands play an important role in its natural drainage system and for food production, but much of this fragile ecosystem suffers from pollution and illegal encroachment from urban development. Wetland degradation threatens residents' quality of life and puts the city under tremendous risk of flooding.

The city is planning to roll out a rehabilitation plan for its 183 ancient wetlands and small ponds through its membership in the ASEAN Smart Cities Network. In its upcoming Master Plan for Urban Drainage and Sewage System, Luang Prabang plans to collect extensive data through sensors and GIS to closely monitor the condition of its wetland ecology, such as water levels and extent of urban development, in order to inform planning decisions.

Source: Extracted from ESCAP and UN-Habitat, *The Future of Asian & Pacific Cities* (Bangkok, 2019). Available at https://www.unescap.org/publications/future-asian-and-pacific-cities-2019-transformative-pathways-towards-sustainable-urban.

[214] Jonathan Woetzel and others, "Smart cities: Digital solutions for a more livable future", 5 June 2018. Available at https://www.mckinsey.com/industries/capital-projects-and-infrastructure/our-insights/smart-cities-digital-solutions-for-a-more-livable-future.

The smart cities concept has received significant endorsement with the establishment of official structures, such as the ASEAN Smart Cities Network, a collaborative platform where ASEAN cities work towards the common goal of smart and sustainable urban development. National governments have also rolled out smart city blueprints, such as Smart City Blueprint in Hong Kong, China (see Case Study 20), India's Smart Cities Mission and Indonesia's plan to build 100 smart cities.[215]

The SDGs are about inclusiveness, but too often the marginalized are excluded as sources of information. Development is a multidisciplinary issue, and anthropologists and sociologists should be involved along with economists, technologists and engineers if information and context are to add to knowledgeable policymaking. Achieving this is a huge challenge—the idea of a multidisciplinary unit within government ministries is novel but as Case Study 35 illustrates, it is possible.

Case Study 35: Multidisciplinary policymaking in Singapore

Co-Lab is an innovation unit in Singapore's Ministry of Manpower made up of a multidisciplinary team from industrial design and sociology to computer science and statistics.

Co-Lab combines behavioural insights, data analytics and design thinking to improve the way citizens are served. Its mission is to ensure that policies and services are not built on assumptions or beliefs, but on evidence and data from testing and trying. This approach is helping the government redesign interactions with citizens and building a strong culture of data within.

For instance, Co-Lab worked with the Central Provident Fund to improve its retirement planning services with strategies to better engage with soon-to-be pensioners. As a result of this reaching out, the response rate to meet with a fund manager to plan for retirement doubled.

Co-Lab also looked into health and safety issues in the construction industry as it has consistently been the highest contributor to workplace fatal injuries. Co-Lab aimed to help construction companies take greater ownership of their workplace safety, upskill

[215] ESCAP and UN-Habitat, *The Future of Asian & Pacific Cities* (Bangkok, 2019). Available at https://www.unescap.org/publications/future-asian-and-pacific-cities-2019-transformative-pathways-towards-sustainable-urban.

the companies and promote self-regulation. Instead of just telling the company their safety gaps, clear guidelines on what can be done to improve safety were also given. By effectively engaging with company managers to understand their challenges, the needs for enforcement notices were reduced six-folds.

Besides improving service delivery, Co-Lab is building the capacity of civil servants to adopt these methodologies and multidisciplinary approaches. Co-Lab works with government officials to test new ideas, understand user needs and spend time on the ground for user research.

While testing new ideas, officials suspend their regular work targets, so they can spend time experimenting and trying new things without fear of failure. Co-Lab also trains senior and middle management staff on how they can better support their teams in using data, design and behavioural insights.

Source: Medha Basu and Chia Jie Lin, "Exclusive: Using data to redesign retirement", *GovInsider*, 20 July 2018. Available at https://govinsider.asia/innovation/hefen-wong-ministry-of-manpower-data-analytics/.

An ESCAP report makes the case for four priorities to realize a sustainable urban future:[216]

1. **Plan the foundations of a sustainable future** – Integrate sustainability and quality-of-life targets into urban planning to future-proof public and private investment in cities, and co-producing with citizens urban planning solutions that align technological investment with adequate local government capacities;

2. **Guard against future risks** – Adopt resilience strategies that break down governance siloes to improve policy efficacy, provide opportunities to scale up nature-based infrastructure solutions, and engage the creativity of the urban poor as solution providers to guard against potential shocks and stresses, including natural disasters;

3. **Capitalize on frontier technologies to develop people-centred smart cities** – Develop smart cities roadmaps across different urban systems that capture the innovation of technological entrepreneurs, bridge the digital divide, support smart mobility, and include the perspectives of local stakeholders, while ensuring their safety; and

[216] Ibid.

4. **Mobilize financing to invest in sustainable urban solutions** – Adopt innovative investment tools such as land value capture instruments, public-private partnerships (PPPs) and environmental user fee models.

Integrated smart master planning and development

Effective and integrated urban planning and development allow cities to manage the trade-offs and balance the different priorities in the development process, enabling cities to achieve balanced outcomes of economic development, high quality of life and a sustainable environment.

This process requires drawing long-term plans that set out local development goals in various domains to align priorities across stakeholders. Up-to-date and comprehensive data allows authorities to effectively resolve disputes and fraud cases around land and property ownership issues, and protect key infrastructure and resources in times of natural disasters. However, traditional paper-based land surveys and records can be time consuming and labour intensive, and quickly become outdated.

In recent years, cities have adopted GIS to store, manage and visualize geographical information. In addition to visualization, digitized data also supports deepened analytics for more informed and integrated planning decisions.

Singapore has been making significant progress in incorporating GIS for integrated planning. One example is planning for an age-friendly city (Case Study 36).

Case Study 36: Singapore plans for an age-friendly city

Singapore is expected to have one senior (aged 65 and above) for every four Singaporeans by 2030. Planning for ageing is thus a national imperative involving multi-agency efforts, such as the Ministry of Health, Urban Redevelopment Authority, Housing and Development Board, and Land Transport Authority.

To ensure that the city provides sufficient medical and social services to the elderly, planners across agencies built in-house digital geospatial planning tools such as an e-planner and GIS-enabled mapping, modelling and analysis. These tools allow planners across agencies to view digitized planning and demographic data, such as distribution of senior residents across estates, as well as locations of recreational facilities and aged care facilities. By sharing such platforms, planners acquire a consistent understanding of planning issues and can better coordinate planning decisions across departments effectively.

For example, planners can view all existing and upcoming facilities, then prioritize the development and social programmes in areas of high concentration of seniors and

seniors who live alone. They can also make more informed decisions such as co-location of the aged care facilities with aging social support centres to better serve seniors' medical and social needs. Collectively, these GIS platforms have enhanced the planning agencies' capacity to make more coordinated and informed decisions across stakeholders for integrated planning. A long-term and integrated development approach also fosters the discipline to build in flexibility to provide space for new opportunities that may arise.

Source: Ministry of Health, Government of Singapore, "What is the Action Plan About?" Available at https://www.moh.gov.sg/ifeelyoungsg/about/what-is-the-action-plan-about (accessed on 24 June 2020).

In planning for smart systems, it is important that the issue of interoperability is considered as new technologies are being rolled out faster than ever. Often, data produced through sensors, geospatial and other ways are not integrated across disparate urban systems and do not provide an opportunity for integrated, citywide decision-making. Some cities, such as Petaling Jaya in Malaysia,[217] are addressing this issue through citywide big data platforms.

Dynamic and adaptive urban governance

Governance is about engaging diverse and capable stakeholders such as citizens, governments and businesses, including local enterprises and startups, in decision-making and oversight of how the city plans, utilizes and manages its resources. It can take many forms, such as PPPs and joint ventures.

Traditionally, city leaders have convened platforms such as public dialogues, polls and town hall meetings to bring stakeholders together to discuss dedicated issues. With smart technologies, governance in smart cities can take on new forms and innovative channels to meaningfully engage stakeholders.

Cities like Seoul in the Republic of Korea have launched smartphone apps and online portals to encourage participation in policy issues. For example, Seoul's mVoting and "Oasis of 10 Million Imagination" allow people to vote on issues of concern and give ideas to improve the city.[218] These apps have been positively received as a form of meaningful consultation that builds trust between the government and the people.

Besides being consulted on public issues, smart technologies allow residents to be involved as content producers to assist city management. Indonesian cities are

[217] ESCAP and UN-Habitat, *The Future of Asian & Pacific Cities* (Bangkok, 2019). Available at https://www.unescap.org/publications/future-asian-and-pacific-cities-2019-transformative-pathways-towards-sustainable-urban.

[218] Zhou Yimin, Wong May Ee and Koo A Mi, "Smart City, Smart Residents: Seoul's 'Smart' Transformation Accelerates under Mayor Park". Available at https://www.clc.gov.sg/docs/default-source/commentaries/smart-city.pdf.

making bold steps in engaging citizens in various aspects of urban management through social media (Case Study 37).

Case Study 37: PetaJakarta.org, Indonesia

Jakarta is the world's most active Twitter city, posting more tweets than any other city worldwide. At the same time, Jakarta is extremely prone to natural disasters. Every year, the low-lying megacity experiences frequent floods during monsoon seasons. While major drainage improvement work is ongoing, Jakarta needs "quick wins" to better manage its flood risk, reduce damage and provide an alert system.

In 2014, the University of Wollongong, Australia, worked with the Jakarta Emergency Management Agency and Twitter to create PetaJakarta.org, an online platform that gathers real-time flood reports from posts by Jakarta residents on Twitter, and visualize such data in an online map.

During floods, Twitter users in Jakarta are programmatically prompted to tweet and post photographs using the keyword "*banjir*" or "flood".[219] Such flood reports would then be collected in a centralized geospatial database and rendered into an online map showing geo-located flood information in real time across the city.

[219] Tomas Holderness and Etienne Turpin, "PetaJakarta.org: Assessing the Role of Social Media for Civic Co-Management During Monsoon Flooding in Jakarta, Indonesia", White Paper. Available at https://petajakarta.org/banjir/in/research/index.html.

In February 2015, PetaJakarta.org mapped over 1,000 flooding sites across the city and the resulting map has been viewed more than 160,000 times.[220] Besides allowing residents to navigate dangerous flood situations, the crowdsourced data helps the government to perform flood assessment and response actions in real time.

Sources: Semiocast, "Twitter reaches half a billion accounts: More than 140 millions in the U.S.", 30 July 2012. Available at https://semiocast.com/publications/2012_07_30_Twitter_reaches_half_a_billion_accounts_140m_in_the_US; Tomas Holderness and Etienne Turpin, "PetaJakarta.org: Assessing the Role of Social Media for Civic Co-Management During Monsoon Flooding in Jakarta, Indonesia", White Paper. Available at https://petajakarta.org/banjir/in/research/index.html; and Tomas Holderness and Etienne Turpin, "How tweeting about floods became a civic duty in Jakarta", *The Guardian*, 25 January 2016. Available at https://www.theguardian.com/public-leaders-network/2016/jan/25/floods-jakarta-indonesia-twitter-petajakarta-org.

The example of PetaJakarta.org showcases how city leaders can leverage social media and crowdsourcing methods, made possible by wide penetration of smartphones, to meaningfully engage residents and empower residents in urban management issues.

Intelligent transportation systems

As traffic congestion and air pollution are common problems in many cities, intelligent transport systems are being developed, often as part of smart city initiatives. Intelligent transport systems can help to tackle traffic congestions, air pollution and environmental degradation, reduce pedestrian fatalities, enhance transport infrastructure systems, and realize future autonomous driving. Self-driving vehicles are projected to reduce traffic fatalities by 90 per cent, in addition to enhancing travel efficiency and reducing CO_2 emissions.[221]

IoT enables tracking of where people drive their vehicles, allowing AI applications to measure traffic in real time, monitor commuting statistics, and improve traffic planning and management. For example, intelligent traffic signals with dynamic functioning can gauge the actual traffic in real time and adjust traffic lights based on vehicular volume. They are not static but adjust continuously throughout the day as conditions change. By adding the real-time element, they improve the efficiency of traffic flows and, as a result, help reduce congestion and improve air quality.

[220] Tomas Holderness and Etienne Turpin, "How tweeting about floods became a civic duty in Jakarta", *The Guardian*, 25 January 2016. Available at https://www.theguardian.com/public-leaders-network/2016/jan/25/floods-jakarta-indonesia-twitter-petajakarta-org.
[221] Satoshi Oyama, "Intelligent transport systems towards automated vehicles", *ITU News*, 16 August 2019. Available at https://news.itu.int/intelligent-transport-systems-towards-automated-vehicles/.

Real-time traffic data can also save time for commuters and enhance their commuting experience. This data can be provided in mobile apps to help drivers determine the quickest traffic routes. Similar efficiencies have been derived from real-time public transport data. Many transportation authorities have placed their bus, ferry and train schedules online with live updates, which have reduced waiting time and increased usage of public transport services.

In recent years, big data-driven technologies have been directly integrated into the daily lives of city residents. This includes custom-made applications that empower individual citizens to better navigate traffic or their local commute, improve access to city facilities and inform residents about current threats to public safety.

Furthermore, in cities, the emergence of bike and car sharing, and e-hailing services are new business models that have improved urban mobility and decreased greenhouse gas emissions.

In addition, there are mobile apps that help drivers find available parking places in congested urban areas. Sensors attached to individual parking spots can be integrated into GIS and provide maps showing available parking spots. This means drivers do not have to circle the block aimlessly trying to find parking but can go directly to a free spot, thereby reducing traffic congestion, driving time and vehicular pollutants. Combined with smart metering systems, increased revenue can be generated from public parking efficiencies.
Many intelligent transport pilots have been rolled out and there are many options available, as described above, including intelligent traffic signals, real-time road navigation, real-time public transit information, smart parking, bike and car sharing, e-hailing and more.

It is essential to adopt a holistic approach to transport planning and management, and strategically leverage ICTs to improve mobility and equitable access to transport services, towards achieving the SDGs.

Balancing opportunities and risks

While smart solutions have the potential to facilitate improved urban performance, they are no panacea to all the problems that cities face. If not planned or governed well, smart solutions can cause just as many problems as they set out to address. For example, surveillance systems can incorporate advanced facial recognition software and closed-circuit television applications in an attempt to strengthen public security. However, the systems have generated controversy and concerns over citizen privacy.

A study tested smart city technologies from three companies—Battelle (a not-for-profit organization that develops smart technologies), Echelon (an industrial IoT company) and Libelium (a manufacturer of hardware for wireless sensor networks). They

discovered hundreds of devices open to remote access hacking due to the most common security issues in ICT systems, such as default passwords, authentication bypass and SQL injections.[222]

In some instances, researchers were able to locate through standard Internet searches who purchased the devices and what they were being used for—one city was using the devices for traffic monitoring and another for radiation detection. An attacker could potentially control traffic signals causing accidents, or trigger a radiation leak warning without any actual imminent danger, resulting in panic among citizens.[223]

Use of big data and new technologies provide new legal and ethical challenges. This is particularly relevant in countries where citizens may not be comfortable sharing their private data and daily activity patterns, such as location, movement, social encounters and health data with their governments. Nonetheless, during a global pandemic, digital surveillance could save lives and keep economies functioning, so a carefully considered trade-off between the fundamental right to health and our right to privacy needs to be established.

Beyond the technical solutions, the importance of good urban planning and governance is not to be neglected. The “smarter” cities get, the more their planning and governance mechanisms need to adapt to regulate the use of smart systems and their applications in order to safeguard public interest and ensure that the development takes people’s interests at heart. Smart systems are, at their best, a means to an end. When used well, they empower and equip cities with new capabilities and the capacity to achieve sustainable and resilient development for individuals. Success therefore requires a concerted effort from all stakeholders to plan and guide the use of smart systems in cities.

4.3.6 Key Points

Energy access

- ICTs are recognized as both part of the problem and part of the solution when it comes to energy consumption and production, and greenhouse gas emissions.

- ICTs are part of the problem because: the production of digital devices is energy consuming and uses potentially hazardous waste; and computers, devices, data

[222] Martyn Warwick, "Smart cities are only as smart as those that build them", *TelecomTV*, 17 August 2018. Available at https://www.telecomtv.com/content/news/smart-cities-are-only-as-smart-as-those-that-build-them-32037/.
[223] Daniel Crowley, "How to Outsmart the Smart City", *Security Intelligence*, 9 August 2018. Available at https://securityintelligence.com/outsmarting-the-smart-city/.

centres, cryptocurrency mining and blockchain technology consume a lot of electricity.

- ICTs are part of the solution because: they can increase the efficiency of traditional energy production; they enable the spread of renewable energy technologies; through smart metering they can help redistribute consumption from peak to off-peak hours; and across the energy-consuming industrial economy they can make energy usage more efficient.

- Advancements in distributed solar technologies and growing access to mobile networks and mobile money services have led to the emergence of distributed energy services companies that offer pay-as-you-go solar home systems. The solar home systems are effective in connecting off-grid areas and leapfrogging communities to clean energy solutions.

Digital financial inclusion

- ICTs have enabled access to and delivery of financial services. In particular, the rapid growth in mobile phone uptake has resulted in its innovative use to deliver financial services.

- The digital finance ecosystem has allowed new players to enter the financial and banking sector that has evolved from state banks, microfinance institutions and cooperatives to a broader range of providers that now include mobile operators, mobile agent networks, e-commerce platforms and Internet companies.

- These players are increasing access to financial services, but they are also creating risks related to privacy and security, widening the digital divide, the domination of few large players, lack of interoperability of systems, and unclear liability due to multiple providers involved in service delivery.

- Access to financial services is unequal between women and men, and policies promoting financial inclusion must be gender sensitive.

Youth employment and skills training

- Rapid technological progress and policies for i4.0 are reshaping labour markets and impacting workers and households in significant ways.

- Given that the risk of job automation peaks among young workers, an integrated policy framework for supporting young people in securing decent jobs in this context is critical for future socioeconomic progress.

- There needs to be a review of education, training and lifelong learning policies. This is because without effective policies, the gap between skilled and non-skilled workers will increase income inequality, leading to social instability and undermining inclusive growth efforts.

- Social protection systems need to be reviewed to address these impacts, including ways to cover a growing number of people under non-standard working arrangements, such as those working in the gig economy.

Industrialization, infrastructure and innovation

- i4.0 has the potential to improve productivity and competitiveness, increase energy and resource efficiency, and hence protect the environment. It can enable the transition to a circular economy in which end-of-life products are reused, remanufactured and recycled. Taken together, these developments can lead to more sustainable consumption and production patterns.

- With countries implementing i4.0, there is an urgent demand for a robust and resilient broadband infrastructure that can support the application of frontier technologies. ESCAP has been promoting and supporting member States in the co-deployment of the ICT infrastructure with the transportation and energy infrastructures.

- Fibre-optic cable co-deployment along infrastructure such as major roads, railways, power transmission lines and pipelines could save significant costs and resources as it allows one-time investment in land acquisition and construction.

- Innovation activities, including the commercialization and transfer of technologies, and policies promoting the adoption and diffusion of technologies are important. Just as important are activities that empower poor and vulnerable communities to realize their own innovative potential, such as access to finance and credit, and opportunities to acquire skills, including ICT skills.

Reducing inequalities and promoting social protection

- Inequality persists in all forms. The population of persons with disabilities is likely to increase because of the combined effects of population ageing, poverty, the rapid spread of non-communicable diseases, natural disasters and humanitarian crises. Statistics also show that women tend to spend more years with disabilities than men.

- The healthcare sector has started to explore how AI and big data can contribute to long-term care for older persons, from early diagnosis and more effective treatment of diseases, to at-home health monitoring and fall detection.

- For persons with disabilities, applications that assist access to the Internet are increasing and becoming more affordable, and some of these applications are integrated in mobile devices. Unfortunately, many websites and mobile apps are designed in such a way that makes them difficult or impossible for persons with disabilities and older persons to use.

- Incentives, awareness and support are needed to boost the implementation of digital accessibility. All players in the ICT ecosystem must be involved to guarantee accessibility, including government agencies, providers of ICT services, designers and manufacturers of ICT products, and organizations procuring ICT products.

- In support of migrants, refugees and internally displaced persons, humanitarian aid agencies have been exploring new ways of delivering aid through mobile money and digital vouchers, and using blockchain to record transactions. ICTs, including biometrics, have been used for identity management and the facilitation of registration. ICTs have also been used in the provision of education and healthcare services, and in income generation and trading activities.

- Although ICTs have significant benefits for displaced persons and aid organizations, increased use of data raises ethical, privacy and security issues. While social media helps connect with family and friends, and obtain and share information, social media plays a role in the recruitment of trafficking victims. Both the opportunities and threats of ICTs must be considered when designing and implementing policies and programmes to reduce inequality.

- Social protection is an effective measure to tackling inequalities and building resilience against shocks and crises. ICTs can help to manage and monitor the implementation of social protection initiatives, including efficient disbursement to beneficiaries and reduced opportunities for fraud.

Sustainable cities

- To realize a sustainable urban future, it is important to:

    - Integrate sustainability and quality-of-life targets into urban planning;
    - Co-produce urban planning solutions with citizens, including the urban poor and marginalized groups;
    - Adopt resilience strategies that break down governance siloes;
    - Capitalize on frontier technologies to develop people-centred smart cities; and

- Address privacy and security concerns.

- As traffic congestion and air pollution are common problems in many cities, intelligent transport systems are being developed, often as part of smart city initiatives. Many intelligent transport pilots have been rolled out, including intelligent traffic signals, real-time road navigation, real-time public transit information, smart parking, bike and car sharing, e-hailing and more. A holistic and inclusive approach to transport planning and management is essential.

4.4 Peace

ICTs are helping to build inclusive and accountable institutions towards achieving SDG 16 by: improving citizens' access to public information and services through online platforms; enabling engagement through online dialogues; and enhancing the transparency of public institutions' actions through initiatives like open data. This section explores governments' initiatives to provide digital ID and promote e-governance.

The Academy of ICT Essentials for Government Leaders has a module on "ICT for Development Policy, Process and Governance" and another module on "E-Government Applications". It also has a module on "Social Media, Development and Governance" that includes case studies on governments' use of social media to interact with citizens.[224]

Digital ID

As societies move online, and access to online services becomes more than a matter of infrastructure and affordable devices, it starts to involve inclusion or exclusion based on proof of identity.

The World Bank estimates that at least one billion people do not have registered identities and therefore cannot prove who they are. Most are in Africa and Asia, and most are children.[225] Providing populations with national identities is becoming a development tool as societies go digital.

Government-issued digital ID allows a holder to access various public services and government benefits. The system makes it possible to build a digital "government" in

[224] See https://www.unapcict.org/flagship-programmes/academy.
[225] World Bank, *ID4D - Incentives for Improving Birth Registration Coverage: A Review of the Literature* (Washington, DC, 2018). Available at http://documents.worldbank.org/curated/en/928651518545413868/Incentives-for-Improving-Birth-Registration-Coverage-A-Review-of-the-Literature.pdf.

which the provision of public services can become more efficient, effective and inclusive. A summary of the advantages is as follows:[226]

Development Planning

- Provide opportunities for governments to segregate population by geography, income, gender, age, etc., to identify target population for each initiative;
- Help to prioritize programmes through better estimation of impact; and
- Act as an easy-to-monitor mechanism to check the effectiveness of programmes.

Service Delivery and Governance

- Help to build a reliable population register and better performance analytics that can improve efficiencies of the government and public sector entities;
- Help to eliminate duplicate or ghost beneficiaries thereby reducing wastage in government expenditure;
- Aid in checking leakages in benefits delivery system by acting as an apparatus for the direct transfer of welfare benefits; and
- Enable efficient public service delivery.

Social Inclusion

- Lower transaction costs for beneficiaries seeking to enter social security programmes and thus enable equal opportunities;
- Enable governments to create reliable beneficiary databases;
- Provide mobility of identity across geography and service domains; and
- Enable new opportunities for improving delivery in critical sectors such as healthcare.

Financial Inclusion

- Help financial institutions to easily perform know-your-customer checks to establish identity;
- Empower poor and underprivileged residents by enabling access to financial services;
- Aid in servicing residents in remote areas through services such as branchless and card-less banking; and
- Help to reduce cost of transactions through easy resident authentication process.

[226] ADB, *Identity for Development in Asia and the Pacific* (Manila, 2016). Available at https://www.adb.org/publications/identity-development-asia-and-pacific

See Table 5 for an overview of the ten principles on digital ID for sustainable development. These principles have been endorsed by many international agencies.

Table 5: Ten principles on digital ID for sustainable development

Inclusion Universal coverage and accessibility	1. Ensure universal coverage for individuals from birth to death, free from discrimination 2. Remove barriers to access and usage, and disparities in the availability of information and technology
Design Robust, secure, responsive and sustainable	3. Establish a robust—unique, secure and accurate—identity. 4. Create a platform that is interoperable and responsive to the needs of various users 5. Use open standards and ensure vendor and technology neutrality 6. Protect user privacy and control through system design 7. Plan for financial and operational sustainability without compromising accessibility
Governance Building trust by protecting privacy and user rights	8. Safeguard data privacy, security and user rights through a comprehensive legal and regulatory framework 9. Establish clear institutional mandates and accountability 10. Enforce legal and trust frameworks through independent oversight and adjudication of grievances

Source: Principles on Identification for Sustainable Development: Toward the Digital Age. Available at http://documents.worldbank.org/curated/en/213581486378184357/pdf/Principles-on-identification-for-sustainable-development-toward-the-digital-age.pdf.

Something to do

Does your country have a digital ID system? If so, find out if it is in line with the ten principles on digital ID for sustainable development, outlined in Table 5.

The content of national ID cards generally consists of civic registration details such as name, gender, date and place of birth. It also has a unique identifier such as an ID reference number. In the case of smartcards, some biometrics are included such as fingerprints, iris scan and photo.

In some cases, additional cultural information may be registered, such as faith and ethnicity, but the danger of this is that it can be used to discriminate against a person. If such information is required for national planning purposes, it is better to be collected separately through surveys and census. For national analytics, it can be helpful, but

even if used for positive discrimination—such as helping the poor—it needs handling with great sensitivity to avoid communal violence.

The digital IDs can function in multiple ways for authentication to access services and receive benefits, to give digital signatures, for encryption to ensure secure data transfer, as an e-wallet, as an electronic key in access systems, and for e-voting.

The World Bank has developed a guide for rolling out a digital ID system, which consists of four crucial steps: (1) identification; (2) eligibility; (3) enrolment; and (4) transactions.[227]

There are many challenges to these steps, particularly in the collection of data to validate identity and eligibility, especially from persons in remote areas. The use of tablets and mobile phones with installed database software can speed the process and determine locations using GPS.[228]

However, there may be errors in the input of data or deliberate fraud, for example, in allowing someone to claim social benefits in more than one local area or under more than one name. Therefore, the "cleaning" of data is important and computer software can be used to search for duplicates and suspicious entries.[229]

Despite all the safeguards, the threat of ID theft always remains, such as smartcards falling into the wrong hands, interception of passwords, and creation of fake websites that entice people to offer their passwords and account numbers. Measures to address these threats and protect citizens need to be in place.

The experience of implementing Aadhaar, the world's largest biometric ID system, is presented in Case Study 38.

Case Study 38: Aadhaar, India

The Unique Identification Authority of India was set up in 2009 and introduced biometric identification cards (using fingerprints and iris scans) with unique ID numbers, known as the Aadhaar.

Inclusive identification, eligibility and enrolment processes

The Aadhaar system aims for an inclusive approach to enrolment to maximize coverage and utility of the system. Importantly, Aadhaar does not provide legal proof of nationality (no

[227] World Bank, *ID4D Practitioner's Guide* (Washington, DC, 2019). Available at https://id4d.worldbank.org/guide.
[228] ADB, "Improving the Delivery of Social Protection through ICT: Case studies in Mongolia, Nepal, and Viet Nam", ADB Sustainable Development Working Paper Series, No. 50, November 2017. Available at https://www.adb.org/sites/default/files/publication/384386/sdwp-50.pdf.
[229] Ibid.

documentation of nationality is required). In addition, low birth registration rates mean that enrolment agents are allowed to accept any of 32 documents for proof of identity, 45 documents for proof of address and 15 for proof of date of birth.
(See list at https://uidai.gov.in/images/commdoc/valid_documents_list.pdf).

People without any supporting documents can use approved introducers to attest to their identity. This includes people with high credibility, and particularly those who work with vulnerable groups (e.g., social workers, teachers, hospital staff and local government officials).

Mobile centres enrol residents in remote rural areas and those without Internet connectivity, and enrolment is free of charge.

Between 2009 and 2018, over 1.2 billion people (99 per cent of India's population) have been enrolled in Aadhaar.

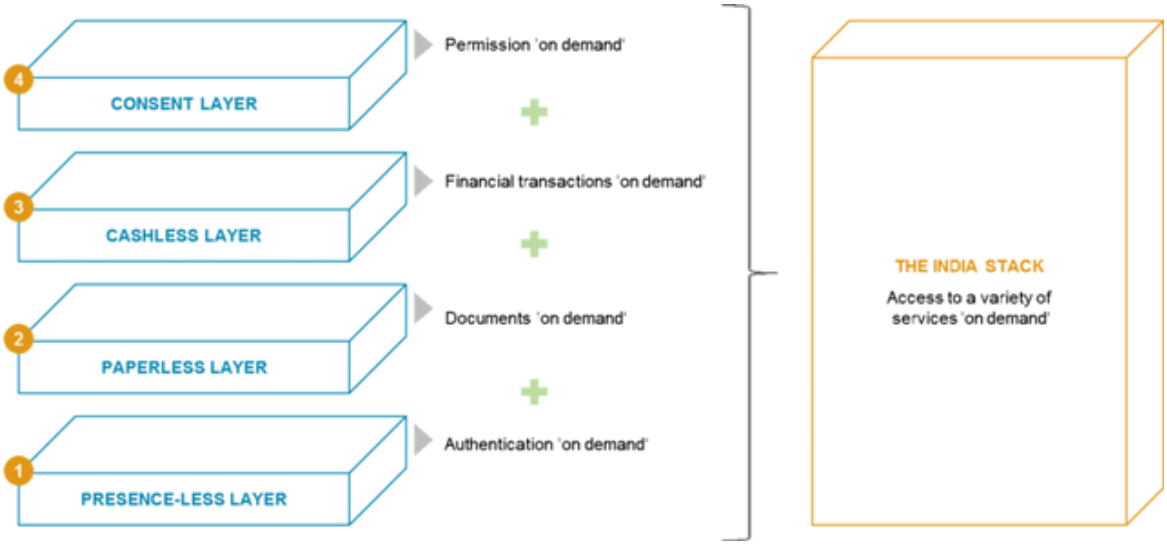
Open platform to enable transactions

Aadhaar is built on an open platform that allows external organizations to re-engineer its API to create new, connected services.

The "layers" of services, known as the "India Stack" are as follows:

- **Presence-less layer** – Leverages Aadhaar's unique identification and authentication system to enable remote and real-time identification and verification of individuals and businesses;
- **Paperless layer** – Comprised of a "Digital Locker" and "Digital Signature", it enables entities to store and share documents, and enter into contracts digitally;
- **Cashless layer** – Based on the Unified Payments Interface, it allows for real-time and interoperable payments across all bank accounts and mobile wallets. Transactions can be stored and transaction histories shared, for example, with credit providers to enable alternative credit-scoring models; and
- **Consent layer** – Enables individuals to share data, or allow time-bound and identity-verified access to their data, but only with their consent.

Figure 15 : Layers in the India Stack



These layers of services have enabled the rapid adoption of Aadhaar, and they have allowed enterprises and startups to create a wide range of services around Aadhaar.

For example, Reliance Jio, a mobile operator, leveraged India Stack's presence-less layer to verify individuals and issue mobile SIM cards more quickly, thus improving customer experience. The entire SIM activation process that previously took 3-5 days now takes only a few minutes.

The Aadhaar ID numbers can be linked to a mobile phone number or a low-cost (Jan Dhan) bank account to facilitate the transfer of benefit schemes, subsidies and salary payments, such as the Mahatma Gandhi National Rural Employment Guarantee Scheme (see Case Study 30).

Another innovation developed is Aadhaar Pay that maps the Aadhaar ID number and payment card / bank account number while using the fingerprint as an authentication mechanism. This allows an individual to pay for goods and services by providing a fingerprint at a participating merchant.

However, this approach faced some challenges such as not being able to identify certain types of fingerprints and requiring multiple attempts to capture the biometric accurately enough to enable validation.

Leadership and collaboration

While the India Stack is itself an innovative platform approach that has expanded access to various services, it is important to note that its achievements have been possible because of various initiatives undertaken by governmental and non-governmental stakeholders, as follows:

- In 2011, the National Payments Corporation of India launched the Aadhaar Payments Bridge and Aadhaar Enabled Payments System that use the Aadhaar ID for electronically channelling government benefits and subsidies;

- In 2013, the Indian Software Product Industry Roundtable was established and has been instrumental in promoting the development of APIs and supporting systems for the India Stack;
- In 2014, the government launched the Pradhan Mantri Jan Dhan Yojana scheme to provide basic bank accounts to all Indians above the age of 10 years;
- In 2015, the Controller of Certifying Authorities launched e-Sign to enable Aadhaar holders to digitally sign a document;
- In 2015, the Reserve Bank of India licensed new categories of financial institution, namely payment banks and small finance banks, to further expand access to transaction accounts;
- In 2016, the National E-governance Commission launched the Digital Locker platform to facilitate digital issuance and verification of documents;
- In 2016, the Ministry of Finance issued a Cabinet Note to provide guidelines for the promotion of card and digital payments, as well as to coordinate various government initiatives aimed at encouraging digital transactions.

This case study illustrates that strong leadership and coordination across various government and non-government entities are crucial in addressing the various issues related to the use of ICTs and providing a favourable regulatory environment for national identification and financial inclusion.

Also, the promotion of interoperable open technology platforms helps stimulate innovation, competition and rapid uptake.

The fast-paced growth of the Aadhaar system, however, has raised privacy and security concerns, particularly given the size and centralization of the biometric database. Systems for grievance redressal are not fully in place to deal with systems failure, such as labourers whose fingerprints have worn out leading to denial of food subsidies. Moreover, the systems' reliance on good quality Internet and electricity (lacking in many rural areas) can lead to the exclusion of marginalized groups from access to services.

Sources: United Nations, *World Social Report 2020* (New York, 2020). Available at https://www.un.org/development/desa/dspd/world-social-report/2020-2.html; World Bank, *ID4D Practitioner's Guide* (Washington, DC, 2019). Available at https://id4d.worldbank.org/guide;
World Bank, *G20 Digital Identity Onboarding* (Washington, DC, 2018). Available at http://www.gpfi.org/sites/gpfi/files/documents/G20_Digital_Identity_Onboarding.pdf;
Global Partnership for Financial Inclusion, "Digital Financial Inclusion: Emerging Policy Approaches". Available at http://www.gpfi.org/sites/gpfi/files/Digital%20Financial%20Inclusion-CompleteReport-Final-A4.pdf; and Prakhar Misra and Meena Bhandari, "All eyes on India's biometric ID experiment", *Pathways for Prosperity Commission*. Available at https://pathwayscommission.bsg.ox.ac.uk/blog/all-eyes-indias-biometric-id-experiment.

Some recommendations to consider when rolling out a digital ID system include the following:[230]

[230] World Bank, *G20 Digital Identity Onboarding* (Washington, DC, 2018). Available at http://www.gpfi.org/sites/gpfi/files/documents/G20_Digital_Identity_Onboarding.pdf.

- Establish a strong legal and regulatory framework for data privacy and security before an ID initiative is rolled out;

- Develop an integrated multi-stakeholder approach to understanding opportunities and risks relevant to digital ID, and develop relevant regulations and guidance to mitigate the risks;

- Assess and leverage existing digital ID assurance frameworks and technical standards related to digital identity, cybersecurity, data protection and privacy;

- Build authentication and service delivery systems that protect user privacy, and provide individuals with the right to access their data and oversight over how their data is shared;

- Establish clear and well-publicized procedures for citizen redress including where the onus of responsibility lies in case of system failure, errors or in the event that the security of a person's identity is compromised;

- Support the development of private sector-led services to leverage the digital ID infrastructure for building out digital layers. In doing so, government should ensure that these services are safe, reliable, efficient and interoperable; and the market is competitive; and

- New approaches to ID are constantly emerging and government should closely monitor these developments with a view to sharing knowledge and establishing common legal frameworks at the national and international levels.

E-governance

Improving the effectiveness and transparency of governments is necessary to uphold justice and peace and reduce bribery and corruption. ICTs have been used by government to promote public participation and co-creation of public services.

E-government refers to the use of ICTs in public administration to efficiently and effectively delivery public services.

E-governance refers to the use of ICTs to improve the process of governing, such as by engaging with multiple stakeholders and being accountable to citizens.

Case Study 39: Crowdsourcing platform for anti-corruption – Lessons from a case in India

Crowdsourcing platforms allow citizens to report corruption incidences and publicly share

individual experiences via the Internet or telephone.

A well-known example is “I Paid A Bribe” that allows users to anonymously share their corruption experience. It was first introduced in India and adopted in more than 10 other countries, including Toidihoilo in Viet Nam. In the Philippines, the Check My School platform allows citizens to monitor and report on the use of public funds by schools.

Crowdsourcing platforms can be used to tackle corruption by tightening oversight and tracking effectiveness of reforms on the basis of crowdsourced information. For example, the Transport Commissioner for the state of Karnataka in India used data collected from “I Paid A Bribe” to push through reforms in the motor vehicle department, including online applications and video monitoring to reduce corruption and increase transparency. Crowdsourcing platforms can also raise awareness, educating the public about their rights and the illegality of corruption.

However, the value of crowdsourcing platforms depends on users’ access to the platform, knowledge of how to use it and motivation to participate. Therefore, important factors contributing to the success of crowdsourcing platforms are access to the ICT infrastructure, digital literacy and a strong civil society.

The risk of security loopholes in the protection of users’ data and gaps in users’ privacy protection can cause their mistrust, put them at risk and compromise their participation.

Another concern is related to the anonymous submission of information. This means information is hard to verify, opening up possibilities for false allegations and complicating follow-up action. Therefore, another critical success factor is the presence of an organization that is willing and able to follow up on crowdsourced information to generate actual results.

Janaagraha Centre, the NGO responsible for the “I Paid A Bribe” platform, has been instrumental in channelling crowdsourced information into constructive policy, raising awareness and engaging with the public, and playing a mediating role between platform users and the government.

While the platform was initially designed for anonymous reporting only, the option to provide one’s name was added later to enable follow-up actions for possible prosecution. Officials called “Janayuktas” mediate between users and the government, following up on reports by initiating prosecution of corrupt officials while protecting users’ identities, and analysing anonymous reports to identify and advocate for future reform.

Source: Isabelle Adam and Mihály Fazekas, “Are emerging technologies helping win the fight against corruption in developing countries?” Pathways for Prosperity Commission Background Paper Series, no. 21. Available at http://www.govtransparency.eu/wp-content/uploads/2019/02/ICT-corruption-24Feb19_FINAL.pdf.

Good governance entails meaningful and inclusive political participation—basically, people having more say in the decisions that shape their lives. It also entails openness and transparency where data, budgets and reports on actions taken are shared with citizens.

E-governance has been used as a tool to tackle corruption. ICTs have:

- Made it easier to provide access to information;
- Reduced the cost of two-way communication between government and citizens; and
- Enabled anonymous corruption reporting (see Case Study 39).

A study shows evidence that e-governance do not always reduce corruption. In some cases, it could provide new corruption opportunities.[231] For example, digitalization and centralization of databases could mean easier and broader access to their hacking and manipulation.

Another example is the development of government e-procurement systems, which has helped improve governance when it provides an audit trail for transactions made, allowing citizen and peer oversight over public projects and overall bureaucratic processes. However, the e-procurement system could facilitate corruption when it enables bidders to identify the relevant officials to bribe.

Generally, to be effective in reducing corruption, e-governance needs to be embedded in broader administrative reform.

ICTs widen the options for public engagement with government. Government websites and portals can include citizen charters that show the quality of service citizens can expect, including the time period for provision of various services. Government websites can host online discussions and online voting on specific issues, making decision-making participatory. Websites and apps can also help concerned agencies track public grievances and complaints more effectively.

Citizens, in turn, can interact with government officials, draw attention to public issues, receive quick responses and action for their requests for information or for redress of grievances, and even develop citizen report cards and other measures of social audit on how efficiently and effectively government is functioning. All of these can be done at a lower cost and with greater efficiency using ICTs. Through appropriate access to infrastructure at affordable prices (e.g., community telecentres), governments can ensure that even the poor can reap these benefits of e-governance.
Social media has emerged as a set of additional tools that governments can use as they engage with citizens. Social media can serve as an additional information channel, a mechanism for feedback and consultation, and enhanced citizen participation, and a platform for increased interagency collaboration.

[231] Isabelle Adam and Mihály Fazekas, “Are emerging technologies helping win the fight against corruption in developing countries?” Pathways for Prosperity Commission Background Paper Series, no. 21. Available at http://www.govtransparency.eu/wp-content/uploads/2019/02/ICT-corruption-24Feb19_FINAL.pdf.

Since 2001, the United Nations Department of Economic and Social Affairs has published the "United Nations E-Government Survey". The methodological framework for the collection and assessment of the Survey's data on e-government development is based on a holistic view of e-government that incorporates four dimensions:

1. Adequacy of telecommunication infrastructure;
2. Ability of human resources to promote and use ICTs;
3. Availability of online services and content; and
4. Level of e-participation

The fourth dimension, e-participation, is defined as "the process of engaging citizens through ICTs in policy, decision-making, and service design and delivery so as to make it participatory, inclusive and deliberative".[232] Results from the latest E-Government Survey in 2018 show that there has been a marked improvement in engagement with citizens.

The E-Government Survey measures e-participation through the E-Participation Index (EPI) based on: (1) e-information – availability of online information; (2) e-consultation – online public consultations; and (3) e-decision-making – directly involving citizens in decision processes.

Between 2016 and 2018, the number of countries with very high EPI doubled from 31 to 62.

The typical stages through which e-government websites progress are as follows:

1. Static webpages, often just scanned copies of documents
2. Digital content that can be downloaded
3. Digital content that is interactive for users and mobile-friendly
4. Navigation that links or clusters different e-government services
5. Website platforms that link all government agencies according to standards, protocols and formats
6. Responsive websites that store and retrieve user information
7. Intelligent websites (using machine learning or AI) that recognize different users and their needs

Countries with low EPI are often stuck on stage 1 and most have not gone beyond stage 2. Middle EPI countries are between stages 3 and 5. Stage 5 is an important step forward as it makes e-government more genuinely useful to citizens who have lifestyle issues that cut across government agencies, such as starting a business or enrolling a child in a school (see Case Study 40).

[232] United Nations, *United Nations E-Government Survey 2018* (New York, 2018). Available at https://publicadministration.un.org/egovkb/Portals/egovkb/Documents/un/2018-Survey/E-Government%20Survey%202018_FINAL%20for%20web.pdf/.

Case Study 40: OneService app and portal, Singapore

In 2015, Singapore's Municipal Services Office coordinated with other government offices to create a OneService app and portal—a one-stop service to resolve municipal matters, without citizens having to find out which agency is in charge. From the app, users can tag the location of the feedback, upload photos, and receive case status and updates.

The functioning of the app and portal was made possible only after the digitalization of government offices, and cooperation of 11 government agencies and 16 town councils to re-engineer the municipal service workflow, and develop and adopt an integrated case management system—the backend system behind the OneService app and portal.

Usage of the OneService app increased by almost threefold from about 4,000 cases per month in 2016 to close to 12,000 cases per month in 2018.

The Municipal Services Office use the data gathered from the app and portal to further improve public service delivery. For example, data analysis identified a strong correlation between stray dog-related feedback and construction sites. The analysis suggested that the clearance of forested land before construction drove dogs out of their habitat, while food waste from construction sites might be a source of food for the dogs. Based on these findings, the Agri-Food and Veterinary Authority established an arrangement with the Housing and Development Board to trap stray dogs before and after infrastructure works, and ensure proper food waste disposal at the canteen areas in construction sites. The Agri-Food and Veterinary Authority also partnered with animal welfare groups to rehome these dogs.

Beyond data and systems, the Municipal Services Office recognizes that the most important factor for service delivery is how well the frontline officers work together. Thus, the Municipal Services Office brought operations officers from various government agencies together to discuss multi-agency cases and understand other agencies' roles through the Regional Operations Network sessions. These sessions help officers develop closer partnerships to improve municipal services delivery.

The Municipal Service Office also engages with citizens to identify ways to improve service delivery. In 2018, a nationwide OneService Innovation Challenge was organized to submit ideas on how the OneService app and portal can be improved.

Sources: Municipal Services Office, "OneService: Who We Are". Available at https://www.oneservice.sg/aboutus; Centre for Liveable Cities, Government of Singapore, "Case Study: Joining Forces for Better Municipal Services", *Urban Solutions*, Issue 13, July 2018. Available at https://www.clc.gov.sg/docs/default-source/urban-solutions/urb-sol-iss-13-pdfs/13_case_study-singapore-oneservice@sg.pdf; OneService Innovation Challenge 2018, "Winners". Available at https://oneservicechallenge.sg/winners; and ESCAP and UN-Habitat, *The Future of Asian & Pacific Cities* (Bangkok, 2019). Available at https://www.unescap.org/publications/future-asian-and-pacific-cities-2019-transformative-pathways-towards-sustainable-urban.

Open government data

Open government data contributes to the achievement of the SDGs by generating better data for tracking SDG progress. It is also supporting the attainment of SDG 16—to build effective, accountable and inclusive institutions at all levels.

Open government data can increase transparency and lead to increased accountability and trust in governments and public institutions. Publicly available and reusable open data related to population, public budgets, education, public health, weather, trade, etc. is also fuelling participation and collaboration among actors in the public, private and civil society sectors to improve service delivery.

The number of countries with open government data portals has reached 139, comprising 72 per cent of the United Nations member States.[233] Often, the datasets released on the portal are in non-machine-readable formats, for example, in PDF. However, making data both human- and machine-readable is an important step towards greater utilization of open government data. For example, enterprises and startups have used open government data to create useful apps.

About 74 per cent of countries that have open government data portals are providing guidance on using and navigating the complex datasets, encouraging users to request new datasets, initiating hackathons and promoting use of public open data in creating online apps. This trend is significant and encouraging, given that in 2016 only 24-50 per cent of countries did the same.[234]

However, a regional assessment by the World Wide Web Foundation reveals that:[235]

- Readiness of the private sector to take advantage of open data remains stagnant even though government support for innovation is increasing;
- While budget data is accessible in most countries, contracting and spending data remains closed; and
- Open data is improving government efficiency, but open data impact has not yet translated into concrete improvements in people's lives.

The World Wide Web Foundation outlines the following recommendations for government:[236]

Put "open by default" into action – Develop clear plans, guidelines and procedures to disclose data proactively. This includes listening to people's demands, facilitating data sharing, and investing in the financial and human resources needed for better

[233] Ibid.
[234] Ibid.
[235] World Wide Web Foundation, "Open Data Barometer: East Asia and the Pacific", 2016. Available at https://opendatabarometer.org/4thedition/regional-snapshot/east-asia-pacific.
[236] World Wide Web Foundation, "Open Data Barometer: Leaders Edition", September 2018. Available at https://opendatabarometer.org/leadersedition/report/.

open data governance;

Build and consolidate open data infrastructure – Improve data quality and interoperability through effective data management practices and data management systems that are built to manage open data. Invest in building capacity and data skills; and

Publish data with purpose – Work closely with civic groups and multi-stakeholder advisory groups to identify pressing challenges that open data can help solve. Publish the relevant datasets and analyse the impact achieved.

Questions to think about

- Is there a well-defined open data policy and/or strategy in your country?
- To what extent are private sector and civil society organizations engaging with the government regarding open data?
- Is government directly supporting a culture of innovation with open data through competitions, grants or other support actions?
- Is training on open data available for individuals or businesses who want to increase their technical skills or develop businesses to use open data?
- Is there evidence of open data making any impact on increasing transparency and accountability in your country?
- Is there evidence of open data making any impact on increasing the inclusion of marginalized groups in policymaking and accessing government services?

4.4.1 Key Points

- ICTs are helping to build inclusive and accountable institutions by: improving citizens' access to public information and services through online platforms; promoting public participation and co-creation of public services; and enhancing the transparency of public institutions' actions through initiatives like open data.

- Without proof of identity, people may be denied access to rights and services. Government-issued digital ID allows the provision of public services to become more efficient, effective and inclusive.

- However, it is important to remove barriers to ICT access and usage, and safeguard data privacy, security and user rights through systems design and a comprehensive legal and regulatory framework.

- It is also important to support the development of private sector-led services to leverage the digital ID infrastructure through interoperable open technology

platforms that stimulate innovation, competition and rapid uptake.

- Open government data can increase transparency and lead to increased accountability and trust in governments and public institutions. But generally, e-governance needs to be embedded in broader administrative reform in order to be effective in reducing corruption.

4.5 Partnership

SDG 17 focuses on the means of implementation. This is an important goal as it has a significant impact on the achievement of the SDGs.

National governments have been tasked with the primary responsibility to integrate the SDGs in national planning, and shape institutional arrangements for implementation and review of progress (this is detailed in Section 5).

Partnerships are critical in the successful implementation of the SDGs because it is clear that no one sector or group or country can deliver the complexities of sustainable development alone.

Partnership was a key element of the MDGs (Goal 8), and is again emphasized in the SDGs, reflecting the recognition that these goals cannot be achieved without a sustained collaborative effort among all stakeholders—government, the private sector and civil society.

Partnerships between countries are also important. The SDGs emphasize that partnerships need to focus on mobilizing and sharing knowledge, expertise, technology and financial resources. For low-income countries, one of the barriers is gaining access to advanced ICTs and having the technical knowledge and skills to use them. Global partnerships are a vital means to overcome these barriers, involving technology transfers.

The first issue is the capacity of the recipient country to absorb the technologies and use them in productive ways. Aid and trade that bring ICTs into low-income country are of limited value if they are not operated and maintained by local persons with digital skills. Nor are they of much use if a supporting infrastructure of electric power is missing.[237]

One positive aspect of ICT transformation is that very often the complexity of operating digital devices is reduced over time as more intuitive and user-friendly adaptations are

[237] A website that offers practical suggestions is: Geneva Initiative on Capacity Development in Digital Policy. Available at https://www.giplatform.org/genevainitiative/.

developed. For example, software programs to help write and develop applications are becoming widespread, de-skilling the tasks in many ways. The downside is that cybercrimes become easier to learn as well.

The Technology Bank is an initiative that aims to strengthen national technology capabilities and provide expertise to the world's least developed countries.[238]

Partnership models

One of the partnership models is PPP. PPPs can be of many types—from simple participation in the development of ICT applications as part of corporate social responsibility, to a complete project taken on a turnkey basis, built, owned and operated by the private sector.

The benefits of such PPPs include increased efficiency in the execution of projects, reduced risk for the public sector and the stimulation of innovation in the provision of public services. The partnerships' greater efficiency allows government funds to be redirected to other important socioeconomic areas.

PPPs, however, should not simply be viewed as a convenient way to outsource. Instead, it should be seen as an opportunity to gain ICT project management know-how, system operations and digital skills.[239]

The Academy of ICT Essentials for Government Leaders has a module on "Options for Funding ICT for Development" that examines the pros and cons of PPP models, principles for implementation, criteria for success of PPP projects, and managing risks in PPP projects.[240]

Another set of models is based on multi-stakeholder approaches. There is no single model of the multi-stakeholder process. Instead, it is a set of tools or practices that allows individuals and organizations from different sectors participating together to share ideas and develop consensus-based policies and strategies.[241]

ICTs play an important role in bringing people together, providing a platform for sharing ideas and developing consensus, and raising awareness about the

[238] United Nations, "Technology Bank for Least Developed Countries". Available at https://www.un.org/technologybank/.
[239] ESCAP, "Country Guidance: Public-Private Partnerships for Sustainable Development in Asia and the Pacific", version 1.0. Available at https://www.unescap.org/sites/default/files/PPP%20and%20SDGs%20Draft%2020%20December.pdf .
[240] See https://www.unapcict.org/flagship-programmes/academy.
[241] Internet Society, "Internet Governance – Why the Multistakeholder Approach Works", 26 April 2016. Available at https://www.internetsociety.org/resources/doc/2016/internet-governance-why-the-multistakeholder-approach-works/.

partnerships. Collaborative software informed by machine learning can make decision-making within and between institutions more efficient.

The United Nations Secretary-General's High-level Panel on Digital Cooperation calls for multi-stakeholder collaboration that involves a more diverse spectrum of stakeholders and more diverse voices, "particularly from developing countries and traditionally marginalized groups such as women, youth, indigenous people, rural populations and older people".[242]

These are people who are more likely to not have access to ICTs. Therefore, alternative ways to ensure their participation in decision-making are needed. Moreover, even if they are invited to the table, such groups may lack the capacity to participate effectively and meaningfully.

This means, wider issues related to: (1) generating the political will to engage with all stakeholders; (2) developing the capacity of marginalized groups; and (3) reducing barriers and providing safe spaces to participate, need to be addressed. At the same time, it is necessary to accelerate efforts to increase access to affordable ICTs and their use for the SDGs.

Types of partnerships and their impacts

The **Partnerships for SDGs** online platform[243] collates the voluntary commitments and multi-stakeholder partnerships related to the SDGs. There are over 5,000 partnerships registered on the platform. The types of partnerships are diverse—from global level down to local communities, and from multi-sector, multi-issue platforms, to single-sector, single-issue interest groups.

Ensuring that these partnerships are sustainable and make an impact towards achieving the SDGs is a challenge. Partnerships registered on the platform are expected to submit annual progress reports. Yet, less than 200 of 5,000 partnerships have submitted their reports on time.

Despite claims about the need for multi-stakeholder partnerships, we are still not seeing sufficient impact coming out of partnerships as an essential mechanism for sustainable development.[244]

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[242] United Nations Secretary-General's High-level Panel on Digital Cooperation, "The Age of Digital Interdependence", June 2019. Available at https://www.un.org/en/pdfs/HLP%20on%20Digital%20Cooperation%20Report%20Executive%20Summary%20-%20ENG.pdf.

[243] United Nations, "SDG Partnerships Platform". Available at https://sustainabledevelopment.un.org/partnerships/.

[244] The Partnering Initiative and United Nations Department of Economic and Social Affairs, *Maximising the Impact of Partnerships for the SDGs* (2019). Available at

Successful partnerships require a combination of leadership, commitment, resources, and good planning and management practices to succeed.

Given the significant investments in resources and time for partnerships, the United Nations advises that partnerships should only be initiated when they have the genuine potential to create value well in excess of their inputs.[245] Before initiating a partnership, we must ask:

- What added-value does the partnership bring towards delivering on the SDGs?
- How will each individual partner gain net value from its participation (e.g., capacity, funding and positioning)?

A United Nations guide highlights 11 major ways through which partnering may bring a collaborative advantage to maximize impact towards the SDGs:[246]

1. **Connection** – Networking, connecting and building relationships;
2. **Complementarity** – Bringing together essential complementary resources;
3. **System transformation** – Harmonizing / coordinating key system actors' resources, e.g., for digital financial inclusion;
4. **Standards** – Creating collective legitimacy and knowledge, important for ensuring interoperability of systems;
5. **Innovation** – Combining diverse resources, thinking and approaches;
6. **Holism** – Convening a holistic range of actors across traditional silos, e.g., to address unemployment, skills mismatch and digital literacy;
7. **Shared learning** – Creating a mechanism for collective learning and capability building;
8. **Shared risk** – Collectively sharing risk of major investments / implementation;
9. **Synergy** – Aligning programmes / resources and cooperating to exploit synergies;
10. **Scale** – Combining delivery capacity across geographies, e.g., for cross-border child protection; and
11. **Critical mass** – Collectively providing sufficient weight of action.

When an organization decides to work in partnership, it must be clear about the value it hopes to gain. The value may be of two types:[247]

- **Mission value** – The organization is able to deliver greater strategic impact through the partnership; and/or

https://sustainabledevelopment.un.org/content/documents/2564Partnerships_for_the_SDGs_Maximising_Value_Guidebook_Final.pdf.

[245] Ibid.

[246] Ibid.

[247] Ibid.

- **Organizational value** – The organization itself gains in some way, improving its ability to deliver its mission, now and in the future.

There is no one model of partnership but there are good planning and management practices that contribute to their success (see Section 5). Each partnership will face its own specific challenges and participating organizations will need to be creative and flexible in addressing them.

The development of a system for monitoring and reviewing partnerships is essential to ensure that the partnerships are making an impact on the SDGs and are benefiting participating organizations.

The **Asia-Pacific Forum on Sustainable Development (APFSD)**[248] is an example of a platform for coordinating the review of progress towards achieving the SDGs. APFSD is an annual and inclusive intergovernmental forum and a regional partnership platform organized by ESCAP to support countries, in particular those with special needs, in the implementation and progress review of the SDGs.

To promote inclusion, ESCAP also organizes the Asia-Pacific People's Forum on Sustainable Development[249] in partnership with civil society as a preparatory meeting for the APFSD to consolidate civil society's positions and recommendations for a regional sustainable development agenda.

Governments and institutions are increasingly aware of the importance of harnessing data to better inform decision-making. Lack of reliable data on even the most basic indicators of development can lead to misguided policies and misallocation of resources.

An example of a partnership that focus on improving the quality of data is the **Strengthening Data Partnerships for Oceans in Asia and the Pacific**. This is another initiative of ESCAP that is starting out as a pilot in five countries—China, Malaysia, Samoa, Thailand and Viet Nam—to develop ocean accounting for sustainable development.

Ocean accounts organize data to allow complex environmental and economic systems present in our oceans to be described and inform decision-making. Through this partnership, a technical guidance on ocean accounts for sustainable development has

[248] ESCAP, "Asia-Pacific Forum on Sustainable Development". Available at https://www.unescap.org/apfsd/7/.
[249] ESCAP, "The Asia-Pacific People's Forum on Sustainable Development". Available at https://www.unescap.org/events/apcsfsd6.

been drafted and the five pilot countries have established national inter-agency working groups to integrate ocean accounting in policymaking.[250]

A subregional example of partnership that promotes collaborative actions is the **ASEAN Smart Cities Network** established in 2018.[251] It is a collaborative platform where cities from the ten ASEAN member States work towards the common goal of smart and sustainable urban development.

Various partnerships have been established through the network connecting ASEAN cities with private sector solution providers and dialogue partners who are ready to invest and support. By November 2018, the platform had facilitated 33 memorandums of understanding or letters of intent among the cities, private companies and external partners. The ASEAN Smart Cities Network has proven to be an effective platform to foster effective business matching.

An example of partnership at the national level is the **Local Governments Actions for SDGs in the Republic of Korea**, coordinated by Local Governments for Sustainability, an international organization. It is a partnership between local governments, civil society and research institutes to achieve the targets of SDG 11 on Sustainable Cities and Communities, in line with the Republic of Korea's National SDGs.[252]

Something to do

Describe one multi-stakeholder partnership working towards implementation of the SDGs in your country?

Key lessons learned from an extensive survey of ICTD partnerships include the importance of having the following:[253]

- Clear focus in terms of shared goals and alignment of objectives;
- Formal structure of partnership agreements and clearly defined roles and responsibilities;

[250] United Nations Ocean Conference, "Strengthening data partnerships for Oceans in Asia and the Pacific", 16 December 2019. Available at https://oceanconference.un.org/commitments/?id=16118.
[251] ASEAN, "ASEAN Smart Cities Network". Available at https://asean.org/asean/asean-smart-cities-network/; and ESCAP and UN-Habitat, *The Future of Asian & Pacific Cities* (Bangkok, 2019). Available at https://www.unescap.org/publications/future-asian-and-pacific-cities-2019-transformative-pathways-towards-sustainable-urban.
[252] United Nations SDG Partnerships Platform, "Local Governments Actions for SDGs in the Republic of Korea", 13 January 2020. Available at https://sustainabledevelopment.un.org/partnership/?p=26794.
[253] Marije Geldof and others, "What are the key lessons of ICT4D partnerships for poverty reduction? Systematic Review Report", February 2011. Available at http://www.gg.rhul.ac.uk/ict4d/workingpapers/DFID_ICT_SR_Final_Report.pdf.

- Accountability;
- Ownership;
- Ethical frameworks;
- Willingness to adapt to changing conditions;
- Leadership;
- Team building;
- Mutual understanding and respect; and
- Deep understanding of the project conditions and local contexts—political, social and technological.

4.5.1 Key Points

- Partnerships such as PPPs and multi-stakeholder approaches, can mobilize human and financial resources, expertise, and technology and knowledge transfer.

- ICTs play an important role in bringing people together, providing a platform for sharing ideas and developing consensus, and raising awareness about the partnerships. Collaborative software informed by machine learning can make decision-making within and between institutions more efficient.

- The United Nations Secretary-General's High-level Panel on Digital Cooperation calls for multi-stakeholder collaboration that involves a more diverse spectrum of stakeholders and more diverse voices, particularly from developing countries and traditionally marginalized groups.

- These are people who are more likely to not have access to ICTs. Therefore, alternative ways to ensure their participation in decision-making are needed. Moreover, even if they are invited to the table, such groups may lack the capacity to participate effectively and meaningfully.

- This means, wider issues related to: (1) generating the political will to engage with all stakeholders; (2) developing the capacity of marginalized groups; and (3) reducing barriers and providing safe spaces to participate, need to be addressed. At the same time, it is necessary to accelerate efforts to increase access to affordable ICTs and their use for the SDGs.

5. ICTS, SUSTAINABLE DEVELOPMENT AND NATIONAL DEVELOPMENT POLICY AND PLANNING

This section aims to:

- Explain how ICTs are integrated into national development policies and plans to achieve the SDGs;
- Explore the main factors that determine the failure and success of using ICTs to achieve the SDGs; and
- Pinpoint issues to consider when planning ICT interventions to achieve the SDGs.

National governments have been tasked with the primary responsibility to integrate the SDGs in national policy planning, and shape institutional arrangements for implementation and review of progress.

Countries need to:

- Develop national-level targets and implementation plans that take into account national priorities;
- Establish funding and delivery models, since resource mobilization to achieve the SDGs is seen largely as a national obligation. Every country must identify sources of financing;
- Identify and scale up innovations and new practices for greater effectiveness and maximum impact;
- Build effective partnerships between different stakeholders, including government, private sector and civil society organizations, to support large-scale programmes; and
- Set up a monitoring and evaluation system. Getting the right interventions to the right people at the right time is important. A dedicated well-funded, high-quality monitoring and evaluation system can enable transformations.

This section discusses the intersection between ICTs, SDGs and national policy and planning.

The Academy of ICT Essentials for Government Leaders modules on “ICT for Development Policy, Process and Governance”, “ICT Project Management in Theory and Practice” and “Realizing Data-Driven Governance” are relevant to this section.[254]

[254] See https://www.unapcict.org/flagship-programmes/academy.

5.1 National Policy and Planning

Most countries in the Asia-Pacific region have a national development policy or plan in place—one that lays out the roadmap for achieving sustainable development. Most countries also have an ICT policy or plan, and the necessary legislation in place that regards ICTs as the “critical infrastructure” enabling sustainable development.

In most countries, the ICT policy or plan is developed by the ICT ministry or department. The ICT ministry or department tends to focus more on business and technology issues, and is less development-oriented. For example, the emphasis is on connectivity and infrastructure, e-government, e-delivery and growth, rather than on needs-based and people-centric improvement of quality of life.

The development-related departments (e.g., education and health), on the other hand, often do not have good ICT orientation, and even if they do, they are often not able to significantly influence ICT policy.

While the situation is gradually changing, what needs to be understood is that policies that focus on ICTs for sustainable development, involving both the ICT and the development-related ministries and departments, must be developed if countries wish to leverage ICTs to achieve the SDGs.

An ICTs for sustainable development policy is very different from an ICT policy. The former requires the fusion of disciplines and sectors. In fact, the use of ICTs for sustainable development is a multidisciplinary undertaking, requiring team effort.

Partnerships and collaboration between various stakeholders, i.e., government, private sector and civil society, are essential in ICTs for sustainable development policymaking, planning and implementation.

5.1.1 Vision, Mission and Means of Implementation

A national policy or plan normally includes three elements—vision, mission and means of implementation.

For a policy or plan that addresses the SDGs, the vision is set towards developing a more equitable, resilient, inclusive and sustainable economy and society.

The mission specifies the goals to be achieved and the government agencies set to achieve them.

The means of implementation focuses on how to achieve the goals, the resources available and the ways in which the resources are to be used.

There is usually a longer-term 10-15 year national policy or strategy that guides the development of shorter-term five-year plans. This makes sense because the parameters of planning will change over time due to possible changes in: (1) governments and/or their priorities; (2) technologies and the costs involved; and (3) global markets that affect the demand for exports and therefore foreign currency earnings, as well as the flow of foreign investments.

At the agency level, from line ministries down to regional and local authorities, the task is to align plans with the national goals and identify the means to implement them.

An inclusive plan involves the participation of local communities, including marginalized groups, in its formulation, so the vision is a shared one. The local communities will become equal partners in the mission of the plans, and a combination of central and local financial and human resources can provide the means to implement the plans.

Many countries in Asia and the Pacific have integrated the SDGs into their national development plans and public budgeting. Institutions and mechanisms such as committees, task forces and/or SDG focal points in ministries have been established to promote SDG integration and monitor progress, and in some cases, to strengthen engagements with the private sector and civil society. In some countries, the SDGs have been integrated in sectoral and local plans as well.[255]

Today, the development and use of ICTs are also often integrated in national development plans. Some countries have developed national ICT strategy, policy or plan.

In Japan, an SDG Model was developed that incorporates the promotion of Society 5.0 (described in Section 4.3.3). It sets out strategies for including science, technology and innovation for achieving the SDGs. The Expanded SDG Action Plan 2019 is based on the SDG Model.[256]

See Case Study 41 for a look at Thailand's long- and short-term plans for achieving the SDGs using ICTs.

[255] ESCAP, Seventh Asia-Pacific Forum on Sustainable Development: Updates on the implementation of the 2030 Agenda for Sustainable Development at the subregional level, ESCAP/RFSD/2020/INF/1, 6 February 2020. Available at https://www.unescap.org/apfsd/7/document/APFSD7_INF_1E.pdf. See also: ESCAP, "SDG Help Desk: SDG Coordination Mechanism – Fact Sheets: Institutional Mechanisms", March 2019. Available at http://sdghelpdesk.unescap.org/sites/default/files/2019-03/Institutional%20mechanisms.pdf.

[256] ESCAP, Seventh Asia-Pacific Forum on Sustainable Development: Updates on the implementation of the 2030 Agenda for Sustainable Development at the subregional level, ESCAP/RFSD/2020/INF/1, 6 February 2020. Available at https://www.unescap.org/apfsd/7/document/APFSD7_INF_1E.pdf.

Case Study 41: Thailand's digital strategies for achieving the SDGs

Thailand has a Twenty-Year National Strategy (2017-2036) that is Thailand's development master plan for steering the country towards security, prosperity and sustainability.

In line with this long-term strategy, the 12th Five-Year National Economic and Social Development Plan (2017-2021) has been developed. Both the strategy and plan have integrated the SDGs, and have prioritized the development of the country's digital economy and society.

The Thailand Digital Economy and Society Development Plan was developed in line with the Twenty-Year National Strategy to serve as a framework for the implementation of government policies on digital economy and society towards the country's sustainable development.

A committee was established to develop the plan together with a group of advisors. They include personnel from the then Ministry of ICT (now Ministry of Digital Economy and Society), National Science and Technology Development Agency and the Federation of Thai Industries. Three public hearings were held in October 2015 on the draft plan for: (1) the government sector; (2) private sector; and (3) civil society, academia and the general public.

Its **vision** is to drive transformation towards Digital Thailand.

Digital Thailand refers to a Thailand that can create and take full advantage of ICTs and all its potential to harness infrastructure, innovation, data, human capital and other resources to drive national socioeconomic development.

Its **missions** are to:

- Enhance Thailand's competitiveness in the global arena by harnessing ICTs as tools to create innovations in production and services;
- Create equal opportunities in society by upgrading people's quality of life through ICTs;
- Reform the paradigm of operations and services of the public sector through ICTs and data utilization to ensure transparency, efficiency and effectiveness; and
- Develop human capital by equipping every group of workers with appropriate knowledge and skills in preparation for a life and career in the digital age.

The following **six strategies** have been formed to achieve the vision and missions of socioeconomic development through ICTs:

1. Develop countrywide high-efficiency digital infrastructure;
2. Drive the economy with digital technology;
3. Build an equitable and inclusive society through digital technology;
4. Transform the public sector into a digital government;
5. Develop workforce for the age of digital economy and society; and
6. Build trust and confidence in the use of digital technology.

In the plan, each strategy consists of goals with targets, and an implementation plan with indication of key executing agencies.

For example, for Strategy 3 to build an equitable and inclusive society, one of the goals is: People of all groups, especially those living in remote areas, the elderly and the disabled, will be able to access and make use of digital technology.

One of the targets for this goal is: By the year 2020, at least 25 per cent of people aged 50 years and over will become Internet users.

The plan lacks the environment dimension although it does touch upon the development of environmentally-friendly ICTs, and the use of ICTs for environmental monitoring and surveillance, and conservation.

Following the launch of the Thailand Digital Economy and Society Development Plan, line ministries are expected to develop **sectoral digital plans**.

For example, the Ministry of Agriculture and Cooperatives developed the Digital Agriculture Strategic Plan (2017-2021). This strategic plan comprises three missions: (1) develop agricultural information system for proactive management; (2) apply appropriate digital technology in the agriculture sector; and (3) support sustainable agriculture.

The following five strategies aim to achieve its missions:

1. Escalate digital literacy and digitalize existing know-how for farmers;
2. Emphasize digital technology for supply chain management such as the use of precision farming, automation and big data analytics;
3. Integrate data and information for farmers' well-being and sustainable agriculture, e.g., developing single window for agriculture database, and enhancing public services for farmers via digital platforms;
4. Add value to agricultural products by increasing accessibility to markets; and
5. Transform the public sector for promoting digital agriculture.

Sources: Ministry of Digital Economy and Society, Government of Thailand, *Thailand Digital Economy and Society Development Plan* (2016). Available at https://www.onde.go.th/assets/portals/1/files/DE-EN%20BOOK%20FINAL.pdf; and Apichart Pongsrihadulchai, "Thailand Agricultural Policies and Development Strategies", FFTC Agricultural Policy Articles, 18 June 2019. Available at http://ap.fftc.agnet.org/ap_db.php?id=980&print=1.

Something to do

Review the ICT plan of a country and assess its vision, missions and means of implementation? Are they in line with achieving the SDGs?

As highlighted in Case Study 41, to fully harness ICTs for sustainable development, it is necessary to **first build-up foundational infrastructure** (Strategy 1), like high-speed broadband Internet, robust cloud computing capabilities, a wide-array of data functionality, as well as cybersecurity defenses as the deployment of digital solutions creates new threats.

Next is to foster cultures and strengthen capacities to support operational and service delivery changes. Technology will advance and change rapidly. Ideally, systems will be designed to be as future-proof as possible by leveraging open standards and open source that allows the easy integration of new and updated solutions as they develop.

Relevant ICT training for all public officials and service providers on a regular and continuous basis to orient and update knowledge and applications will be essential. At the same time, a **transformation of the culture and institutional structures** will be necessary. This could involve:

- Breaking down silos between agencies;
- Establishing interoperability;
- Forming partnerships;
- Developing a culture of innovation; and
- Engaging with multiple stakeholder and ensuring inclusion.

Countries have no shortage of issues and projects demanding time, money and other vital resources. New ideas can be difficult to prioritize and move forward, and immediate need for critical services during crisis and emergencies can compete with future demands.

Prioritization of projects to undertake is important. This should be **supported by the use of data, data analytics and data visualization** to help diagnose problems, make decisions, and monitor and measure performance.

Generally, ICTs for sustainable development require the reform of systems for planning, management and project implementation, characterized by the engagement and active participation of different sectors of the economy and society.

This means a merging of many disciplines, in particular the engineering sciences and the social and behavioural sciences. It also means multi-stakeholder partnerships where government can implement favourable policy, regulation, funding and capacity building; the private sector can build infrastructure and invest in services; civil society can work with communities; and communities can own and drive initiatives.

Maximizing the use of ICTs requires an understanding of both its potentials and limitations. The next section explores why projects succeed or fail.

Something to do

Identify the department tasked with ICT policymaking in your country. Does the department have an inter-ministerial or inter-agency consulting or advisory group where both provider and user ministries are included? If yes, review its composition and decide whether all who should be included, are included.

If there is no such consulting or advisory group and you were to draft a proposal for its constitution, what argument would you use to justify its creation and composition (specify which agencies should be represented in the group)?

5.2 Why ICTD Projects Fail?

One of the most damaging statistics in public sector ICT is the number of failed ICT projects. According to the World Bank:[257]

- About 30 per cent of e-government projects are total failures, with the projects abandoned before completion.

- Another 50 to 60 per cent are partial failures, with significant budget and time overruns and only a limited number of the project objectives achieved.

- Fewer than 20 per cent are successfully implemented. However, these projects could be worsening outcomes as, without proper regulatory safeguards in place, automation makes it easier to perpetrate fraud and corrupt practices, and erase records or avoid capturing them altogether, thereby eroding transparency mechanisms.

Why do projects succeed or fail? There seems to be a clear consensus among experts that factors determining the success or failure of projects are often not technology-related but are people-related.

[257] World Bank, *World Development Report 2016: Digital Dividends* (Washington, DC, 2016. Available at https://www.worldbank.org/en/publication/wdr2016.

These factors include:[258]

- Lack of vision and strategy;
- Lack of participation and representation;
- Results not directly tied to improving economic condition of end user;
- Not relevant to local contexts, strengths or needs;
- Not understanding infrastructure capacity;
- Lack of trust among stakeholders;
- Poor project management;
- Siloed sectors;
- Poor change management (i.e., the redesigning of work processes);
- Inflexible funding and design;
- Projects supported only by short-term grants;
- Underestimating maintenance costs and issues;
- Dominance of politics and self-interest; and
- Lack of requisite competencies of organizations or individuals implementing and maintaining the project.

We can learn from the successes and failures from other countries. For example, the Republic of Korea is a recognized leader in e-government, but it was not a straightforward success as it took time to learn by trial and error. A report shared the following setbacks they experienced:[259]

- An inability to identify and capitalize on emerging global market trends due to concentrating too heavily upon domestic technological development and standards;
- Suffered from redundancies and instances of over-investment in e-governance infrastructure;
- Hasty inclusion of premature technologies in pilot projects that ultimately did not materialize; and
- Lack of methodical and systematic follow-up evaluation of many ICT investments, which could have prevented downstream mistakes and restrained the mainstreaming and scaling up of underperforming projects.

[258] Richard Heeks, “eGovernment for Development: Success and Failure in eGovernment Projects”, Institute for Development Policy and Management, University of Manchester, 19 October 2008. Available at http://www.egov4dev.org/success/evaluation/factormodel.shtml; and Wayan Vota, "Top 7 Reasons Why Most ICT4D Projects Fail", ICT Works, 5 January 2011. Available at https://www.ictworks.org/top-7-reasons-why-most-ict4d-projects-fail/#.XstBvMBS_IU.
[259] World Bank, *Bringing Government into the 21st Century: The Korean Digital Governance Experience* (Washington, DC, 2016). Available at http://documents.worldbank.org/curated/en/934391468011726182/pdf/106581-REVISED.pdf.

5.3 Planning ICTD Interventions

Careful project planning is essential to avoid gaps between design and reality—in contexts, in approaches to planning and implementation, and in perceptions and philosophies between the different stakeholders. Without planning, the consequence is often a mismatch between priorities, investments, deliverables and outcomes.

The Australian Agency for International Development developed a framework and checklist for the design of ICTD projects that bring clarity to the planning process, as follows:[260]

- Why? – Is the ICTD project aimed clearly at achieving a specific development goal?
- Who? – Is there a clearly specified target audience that the project is aimed at?
- How? – Is the form of ICTs to be deployed appropriate in terms of cost, support, maintenance and compatibility with existing information flows?
- How? – Is the form of ICTs to be deployed scalable to enable it to be replicated and expanded?
- How? – Are appropriate intermediaries being used?
- How? – What scope is there for PPPs?
- What? – Is the content transmitted by the ICTs relevant to the target audience and is it in a language easily understood by the audience?
- How long? – Is the project self-sustaining and over what period?
- How well? – What performance measurement, monitoring and evaluation processes are in place?
- What risks? – What unexpected events or situations might arise? What should be done to manage these?

Addressing the questions above in consultation with all partners and stakeholders should help project managers avoid the pitfalls that have led to the failure of many ICTD projects.

ICTD projects should be explicit about their development goals and expected outcomes, with clear links to the SDGs. The value of creating clear links is that it makes it possible to exclude interventions that do not contribute to the goals.

ICTD initiatives should be demand driven rather than supply driven, and the demand should come from the community itself. This implies the need to build partnerships

[260] Richard Curtain, *Information and Communications Technologies and Development: Help or Hindrance?* (Canberra, Australian Agency for International Development, 2004), p. 29.

with the community and to foster a sense of ownership by the community. Building such partnerships and working with the community are long, slow and demanding processes but they are potentially effective in delivering project objectives. A large number of projects fail because they follow a top-down approach to development without adequate attention to local contexts and needs.

ICTD initiatives should be sensitive to local conditions and limitations, including those related to infrastructure, access, relevance and language, and they should be designed to last and be sustainable. The choice of access technologies to provide connectivity, the computer hardware and software elements, and the security systems are critical and should depend on local conditions, rather than what is available in technology-rich cities and locations.

Most development projects, especially if they are donor-funded, operate with fixed targets and fixed time frames. While these are planning constraints, it has to be recognized that using ICTs effectively as development tools requires their long-term and sustained use.

This is because the use of ICTs requires both attitudinal and systemic changes in organizations and communities, and it is necessary to provide a sufficient lead time for ICTs to be embedded in the social fabric of the community. There are also time lags associated with the decision to use, the deployment of appropriate technologies, capacity building and use.

These processes, although ideally parallel, are often done in a sequential and linear manner, necessitating more time than originally planned. This often means that by the time the project starts to show dividends, the fixed time frame is over, donor support is withdrawn and the project is seen to have failed because it did not meet the target objectives.

5.3.1 Principles for Digital Development[261]

The Principles for Digital Development is a community-created resource involving the consultation and contributions of hundreds of development practitioners over the course of a decade. The nine principles aim to guide the design of technology-enabled programmes to improve overall outcomes.

[261] This subsection is extracted from Principles for Digital Development, “Advocacy Toolkit”. Available at https://digitalprinciples.org/advocacy-toolkit/.

1. Design with the User[262]

- Incorporate the voices of multiple user types and stakeholders;
- Develop context-appropriate tools informed by users' priorities and needs;
- Consider sensitivities and needs of the traditionally underserved;
- Incorporate feedback frequently and iterate as needed; and
- Allow users to opt out of participation.

2. Understand the Existing Ecosystem[263]

- Coordinate with other implementing organizations, civil society and government;
- Align with existing technological, legal and regulatory policies;
- Involve community members, local governments and other implementers; and
- Monitor the ecosystem for any changes you need to adapt to.

3. Design for Scale[264]

- Keep your design simple, flexible and modular;
- Identify partners early who can help to scale your tool or approach;
- Consider your funding model, including revenue-generation options, social business models and cost per user; and
- Fully validate that your initiative is appropriate for scale.

[262] Often, technology tools are created without sufficient input from stakeholders whose engagement and ownership are critical to long-term success. User-centered design starts with getting to know the people you are designing for through conversation, observation and co-creation. By designing with the users, and not for them, you can build digital tools to better address the specific context, culture, behaviours and expectations of the people who will directly interact with the technology.

[263] Dedicating time and resources to analyse the ecosystem or context helps to ensure that selected technology tools will be relevant and sustainable, and will not duplicate existing efforts. Ecosystems are defined by the culture, gender norms, political environment, economy, technology infrastructure and other factors that can affect an individual's ability to access and use a technology or to participate in an initiative.

[264] Often, projects fail to move beyond the pilot stage, or to reach anticipated scale. Achieving scale can mean different things in different contexts, but it requires adoption beyond a pilot population and often necessitates securing funding or partners that take the initiative to new communities or regions. Designing for scale means thinking beyond the pilot and making choices that will enable widespread adoption later, as well as determining what will be affordable and usable by a whole country or region, rather than by a few pilot communities. By designing for scale from the beginning, your initiative can be expanded more easily to new users, markets, regions or countries if the initiative meets user needs and has local impact.

4. Build for Sustainability[265]

- Identify and implement a sustainable business model;
- Use and invest in local technology service providers;
- Engage local governments and integrate national strategies;
- Collaborate instead of compete; and
- Build a project that can be adapted.

5. Be Data Driven[266]

- Identify and use open data and interoperability standards;
- Collect and use data responsibly according to international norms and standards;
- Design projects so that impact can be measured;
- Make use of existing data;
- Close knowledge gaps by contributing data to the development community;
- Use quality real-time or timely data to support rapid decision-making;
- Present data in formats that are easy to interpret and act on;
- Prioritize capacity building and data use efforts with stakeholders; and
- Be holistic about data collection and analysis.

6. Use Open Standards, Open Data, Open Source and Open Innovation[267]

- Context is essential—do what is right for your users;
- Adopt and expand on existing open standards;
- Share non-sensitive data after ensuring that data privacy needs are addressed;
- Use existing open platforms where possible;
- Invest in software as a public good; and
- Enable innovation by sharing freely without restrictions.

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[265] Often, projects fail to factor in the physical, human and financial resources that will be necessary for long-term sustainability. Building sustainable projects, platforms and digital tools is essential to maintain user and stakeholder support, as well as maximize long-term impact. For many digital initiatives, institutionalization by an NGO, private company or local government is the ultimate goal in achieving long-term, positive impact. For others, institutionalization is achieved by developing a business model that has sustainable revenue generation.

[266] Often, projects fail to fully leverage data to support project planning and decision-making. When an initiative is data driven, quality information is available to the right people when they need it, and they are using those data to take action.

[267] Often, scarce public and international development resources are spent investing in new software code, tools, data collection, content and innovations for sector-specific solutions that are locked away behind licensing fees, with data only used by and available to specific initiatives. An open approach to digital development can help to increase collaboration in the digital development community and avoid duplicating work that has already been done. What being “open” means for your initiative will depend on practical and technical constraints, privacy and security concerns, and the dynamics of the people and networks in your space.

7. Reuse and Improve[268]

- Identify the existing technology tools (local and global), data and frameworks being used by your target population, in your geography or in your sector;
- Develop modular, interoperable approaches instead of those that stand alone; and
- Collaborate with other digital development practitioners.

8. Address Privacy and Security[269]

- Define data ownership, sovereignty and access before any data is collected or captured;
- Perform a risk-benefit analysis of the data being processed;
- Minimize the collection of personal identifiable information;
- Create a plan for mid- and post-project destruction or secure offline storage of sensitive data;
- Explain to end users how you will use and store their data;
- Obtain informed consent prior to data collection; and
- Protect data by adopting best practices for securing and restricting access to data.

9. Be Collaborative[270]

- Understand how your work fits into the global development landscape;
- Engage diverse experts and partners across disciplines, countries and industries;
- Build collaborative activities into proposals, work plans, budgets and job descriptions; and
- Document work, results, processes, lessons learned and best practices, and share them.

[268] Instead of starting from scratch, projects that "reuse and improve" look for ways to adapt and enhance existing products, resources and approaches. Reuse means assessing what resources are currently available and using them as they are to meet project goals. Improve means modifying existing tools, products and resources to improve their overall quality, applicability and impact.
[269] Addressing privacy and security involves careful consideration of how data is collected and how data is acquired, used, stored and shared.
[270] Being collaborative means sharing information, insights, strategies and resources across projects, organizations and sectors, leading to increased efficiency and impact.

Something to do

SDGs and Principles for Digital Development Card Game

This exercise allows participants to draw connections between the SDGs and the Principles for Digital Development through a team-based card game.

In preparation for the exercise, print and cut out two sets of cards per group. There are 12 SDG scenario cards and 9 digital principle cards per set that are downloadable from:

https://digitalprinciples.org/wp-content/uploads/SDG_Scenario_Cards_cutout_v4.pdf
https://digitalprinciples.org/wp-content/uploads/DIAL_Card_Game_cutout.pdf

Divide the participants into groups of 4-6 people, and further divide the group into two teams of 2-3 people: a project design team and a donor team.

This means if there are 30 participants, 5 sets of scenario cards and digital principle cards will need to be produced for 5 groups of 6 participants. In each group, 3 participants will be in the project design team and the other 3 in the donor team.

Exercise:

The exercise begins by placing the two sets of cards facing down.

The project design team draws a SDG scenario card and the donor team draws a digital principle card.

Both cards are placed in the centre facing up for everyone to see.

Once the cards are drawn, five minutes are given for discussion among the team members:

- For the project design team, the scenario is the project that you want to propose to the donor team. You must consider how the Digital Principle might apply to the proposed project and anticipate what questions the donor team might have.
- For the donor team, you want to ensure that the project design team is applying the principles early and often in their design process. Your goal is to come up with two questions related to the Digital Principle card drawn.

After five minutes of discussion among the teams, the question and answer round begins. The donor team asks two questions and the project design team responds.

After the exchange, the teams switch roles and draw another set of cards.

This exercise is developed by TechChange and the Digital Impact Alliance.

5.3.2 Planning for Monitoring and Evaluation

An often neglected part of planning ICTD interventions is designing the mechanisms for monitoring and evaluating the ICTD interventions. This involves conducting needs assessment and baseline studies, and creating a monitoring and evaluation plan with resources allocated for its execution.

For more details refer to the Academy of ICT Essentials for Government Leaders Monitoring and Evaluation Toolkit.[271]

The monitoring and evaluation of ICTD projects are important and are conducted for the following reasons:

- To know if an ICTD solution succeeds or fails to achieve its objectives;
- As a planning tool, to determine whether the ICTD solution is likely to meet the needs of all stakeholders, the donors and funding agencies, the implementing agencies, and the beneficiaries;
- To assess whether an ICTD solution is financially and socially sustainable in the long run;
- To establish whether investment in an ICTD solution is worth the expenditure; and
- To examine the intended and unintended impacts of the ICTD solution.

There are various stages in an evaluation of projects. Broadly, these fall into three categories—formative, process and summative:

- **Formative evaluation or baseline** is conducted before or at the beginning of a project. Data collection at this stage helps to formulate general and specific objectives and strategies, develop protocol materials, and improve upon the project design. Pilot or prototype testing and resource mapping are some of the elements of formative evaluation.

- **Process evaluation or monitoring** is the ongoing and frequent assessment of ongoing activities in the project. Process evaluation aims to assess the performance of a project, check that the project is on track, and ensure that intended changes are taking place. If they are not, corrective measures may be necessary.

- **Summative evaluation** is carried out after a project is completed, and is defined as a more thorough examination than monitoring, usually with an emphasis on impact on the beneficiaries, and on the relevance, effectiveness, efficiency, sustainability and replicability of the project.

[271] See https://www.unapcict.org/flagship-programmes/academy.

Following a summative evaluation, it should be possible to analyse causes of success and failure, identify strengths and weaknesses, and make definite recommendations for the future, both for individual programmes and for the system as a whole. For this reason, summative evaluation studies impact, and addresses issues such as financial and social sustainability, scaling up or closing down.

Needs assessment and baseline studies

Often, beneficiary groups and their needs are determined from outside the community, and ICT platform decisions are made without taking into account ground realities. As a result, such needs identification tends to be at a very general level and in terms of broad objectives. Project managers, however, require much more detailed information about the characteristics of the beneficiary groups and their specific needs to translate broad objectives into implementation.

Needs assessment is a critical input into ICTD project planning. The various needs that should be assessed include the following:

- Felt or manifested needs that are directly perceived and expressed by the beneficiary group;
- Unfelt or latent needs that are important and require attention, but unexpressed because the beneficiary group does not understand them or does not perceive them as important (e.g., safe water, soil pathogens, telecommunications and connectivity);
- Real needs or constraints to development that the beneficiary group is aware of and understands as important, but are unexpressed due to various constraints (e.g., inadequate infrastructure, lack of facilities and poor political priorities);
- Social and cultural needs, values and norms of the beneficiary group that would support or inhibit the introduction of the initiative; and
- Communication needs of the beneficiary group, including the types of information that the group seeks, the media platforms that the group uses, and the extent to which the group trusts the different media platforms.

The purpose of baseline studies is to establish benchmarks against which to monitor and assess progress and effectiveness during and after various interventions to achieve the SDGs. Baseline data needs to be carefully collected and should include profiles of the beneficiary group, with indicators closely related to the planned intervention.

For instance, knowing the income level of the beneficiary group can help project managers determine if a service is to be provided free or charged, or knowing the literacy levels and the number of people with feature phones versus smartphones can

help determine if delivery should be through SMS, an IVR system, a mobile app, or a combination of traditional and social media.

Needs assessment should also include financial needs and costs and how these would be mobilized. In estimating financial needs, it is necessary to ensure that capital and recurring costs are included. One way of doing this would be to earmark or set aside a given percentage of the national budget exclusively to address cross-sectoral goals.

Needs assessments and baseline data can help determine technology choices. The following factors should be considered:

- **Reach vs. access** – The reach of any technology is not the same as its access. More than half of the world's mobile phones are in the Asia-Pacific region. However, when multiple connections for the same individual are factored in, the penetration rate of mobile phones is less. Then, when the type of device and the speed of connectivity are also considered, the number of subscriptions and connections for those with smartphones and broadband are even lower.

- **Ownership and control** – Access is determined by patterns of ownership and control. If there is one phone in the family, the question is who can access it? When the beneficiaries of an ICTD project are women, it would be important to know if they own and control the chosen technology, and in what ways they have access to it.

- **Technology driven vs. people driven** – Choosing a technology because it is the latest available in the world is often the wrong choice.

- **Cost** – This includes the cost of technology development, deployment, delivery and receipt by the beneficiary. Different technologies have different development and deployment costs. A mobile app may be cheaper than a website or an IVR system to develop, yet, all three may be necessary for optimum success. In any ICTD project, it is important to examine the relative costs of the technology, because it is often necessary to deliver messages through multiple channels for maximum success. Cost also has to be considered in the context of constant technology evolution and improvement, including the need for re-engineering and regular upgrades.

The SDGs call for reversing growing digital inequality and all ICTD projects should be working towards closing the gender digital divide. To ensure that ICTD projects are promoting gender equality, the integration of gender perspectives in monitoring and evaluation is crucial. Box 6 describes the tools available to integrate gender perspectives in monitoring and evaluation.

Box 6: Tools for integrating gender perspectives in ICTD monitoring and evaluation

The **Gender Evaluation Methodology** (GEM) is a guide to integrating a gender analysis into evaluations of initiatives that use ICTs for social change. Pioneered by APC and used extensively all over the world, GEM provides a sound methodology framework not just for integrating gender analysis into evaluation of ICTD initiatives, but also a framework that can be used in ICTD projects that target marginalized and poor communities.

For example, in Bangladesh, a country where one in every two males accesses information online yet only three in a hundred women do, GEM found that access for schoolgirls is not just about the availability of computers and classes. For girls, it requires the support of the entire community and flexible school schedules.

The **Digital Gender Gap Audit Scorecard Toolkit** is developed by the World Wide Web Foundation with support from UN Women. This scorecard aims to fill the evidence gap in assessing the gender digital divide by bringing together 14 simple indicators for which reliable empirical evidence exists to measure progress towards closing the digital gender divide.

Sources: APC, "Gender Evaluation Methodology for Internet and ICTs". Available at https://www.apc.org/en/projects/gender-evaluation-methodology-internet-and-icts-ge/; and World Wide Web Foundation, "Digital Gender Gap Audit Scorecard Toolkit". Available at http://webfoundation.org/docs/2016/12/WRO-Digital-Gender-Gap-Audit_Toolkit.pdf.

5.4 Key Points

Policies that focus on ICTs for sustainable development, involving both the ICT and the development-related ministries and departments, must be developed if countries wish to leverage ICTs to achieve the SDGs.

Moreover, planning for sustainable development has often involved a piecemeal approach, treating the elements separately as the needs arise. However, to achieve impact, a holistic approach is required.

For example, to ensure that farmers and rural workers and their families have access to agricultural and industry support, training and education and healthcare services, line ministries of agriculture, education and health need to plan together, and plan with the full participation of the local communities involved, so the **vision** of the plans can be co-created. The local communities will become equal partners in the **mission** of the plans, and a combination of central and local financial and human resources can be melded together to provide the **means** to achieve the plans.

To fully harness ICTs for sustainable development, it is necessary to first build-up foundational infrastructure.

Relevant ICT training for all public officials and service providers on a regular and continuous basis to orient and update knowledge and applications will be essential.

At the same time, a transformation of the culture and institutional structures will be necessary. This could involve:

- Breaking down silos between agencies;
- Establishing interoperability;
- Forming partnerships;
- Developing a culture of innovation; and
- Engaging with multiple stakeholder and ensuring inclusion.

Prioritization of projects to undertake is important. This should be supported by the use of data, data analytics and data visualization to help diagnose problems, make decisions, and monitor and measure performance.

There seems to be a clear consensus among experts that factors determining the success or failure of projects are often not technology-related but are people-related. Therefore, a people-centric rather than ICT-centric approach is critical for ICTD projects to succeed.

Careful project planning is essential to avoid gaps between design and reality—in contexts, in approaches to planning and implementation, and in perceptions and philosophies between the different stakeholders. Without planning, the consequence is often a mismatch between priorities, investments, deliverables and outcomes.

The Principles for Digital Development aim to guide the design of technology-enabled projects to improve overall outcomes. The principles are:

1. Design with the user;
2. Understand the existing ecosystem;
3. Design for scale;
4. Build for sustainability;
5. Be data driven;
6. Use open standards, open data, open source and open innovation;
7. Reuse and improve;
8. Address privacy and security; and
9. Be collaborative.

Studies have found that a sound monitoring and evaluation system is critical for preventing setbacks, and promoting the mainstreaming and upscaling of ICTD interventions.

Needs assessments and baseline studies help to establish benchmarks against which to monitor and assess progress and effectiveness during and after various interventions to achieve the SDGs. Needs assessments and baseline data can also help determine technology choices.

A gender perspective must be integrated in monitoring and evaluation systems to promote gender equality and ensure that ICTD interventions do not widen the gender digital divide.

6. SUMMARY

The development challenges that the Asia-Pacific region faces are massive. The “Asia and the Pacific SDG Progress Report 2020” published by ESCAP highlights that the Asia-Pacific region cannot be expected to achieve the SDGs by 2030 without accelerated actions. Analysis for this report was conducted before the global outbreak of COVID-19, which has severe implications for global sustainable development.

The SDGs offer a roadmap to tackle this global crisis, ensuring that COVID-19 recovery leads to more equal, inclusive and sustainable economies and societies that are more resilient to pandemics, climate change and other global challenges.

The Interlinkages between Sustainable Development, the SDGs and ICTs

Sustainable development was defined in 1987 by the Brundtland Commission Report as “development that meets the needs of the present without compromising the ability of future generations to meet their own needs.”

In September 2015, member States of the United Nations adopted the 2030 Agenda for Sustainable Development with 17 SDGs at its core. It is a comprehensive global blueprint for social, economic and environmental development that is sustainable and inclusive.

Although ICTs are explicitly mentioned in only four of the goals (in six targets and seven indicators), they are transformative tools that can potentially improve development programme impacts, empower communities and accelerate the achievement of the SDGs.

ICTs play a vital role in the collection and analysis of data for evidence-based policymaking which, combined with the direct involvement of communities to give bottom-up data sources and local co-creation of relevant policies, are good principles for policymakers to follow.

ICTs also provide new, more automated means to monitor and evaluate progress towards the SDGs, improving data collection, analysis, visualization and dissemination capabilities. Online platforms and open data standards can facilitate sharing, and foster transparency and accountability.

ICT Trends and the Digital Divide

The combination of AI, blockchain, big data analytics, cloud computing, IoT and broadband technologies is bringing about synergistic and transformative impacts, creating new business models, as well as regulations.

These frontier technologies bring enormous opportunities but also significant challenges, especially related to privacy, security and trust. As more people and devices are connected, the risk and impact of data breaches are much higher with implications on people's safety and well-being. Frontier technologies also present ethical, legal and accountability challenges that can potentially perpetuate existing inequalities.

The challenges may hinder ICT adoption and undermine efforts towards meeting SDG targets. We need to collaboratively ensure that the benefits of ICTs outweigh the risks, and take steps to minimize risks.

Moreover, the widening digital divide in the Asia-Pacific region means that countries without a robust and resilient broadband infrastructure risk being left behind, unable to reap the benefits of frontier technologies to achieve the SDGs.

The COVID-19 pandemic is a powerful reminder of the impact of the digital divide, particularly when crucial government and community services, knowledge resources for education and learning, and labour market functions have moved online, further excluding those who are not able to access the Internet.

The pandemic has clearly exposed the inequalities in ICT access and skills across the region. Most of those not using ICTs live in low- and middle-income countries. Women, older persons, persons with disabilities, ethnic minorities, indigenous groups, migrants, refugees, internally displaced persons, and people living in rural and remote areas are disproportionately without ICT access and skills.

Government regulations need to be focused on encouraging investments to develop the broadband infrastructure, particularly in unserved and underserved areas that are not commercially viable—where most marginalized communities live.

However, statistics show that 54 per cent of Asia-Pacific's population that has mobile broadband network coverage (3G and above) are not using mobile Internet services. This is because of a combination of the lack of affordability of devices and data, the lack of relevant content, and lack of skills to not only use ICTs but also create relevant applications. More women than men are not using ICTs.

Governments must therefore also address the affordability of broadband, as well as enable the production of locally-driven and gender-specific online content and applications in local languages to encourage the use of ICTs.

A holistic and gender-sensitive approach to the development of ICT skills and digital literacy is needed. This requires a concerted effort by all stakeholders, ranging from policymakers across different sectors to private companies, academic and educational

institutions, as well as community-based organizations, committed to building capacities in the use of ICTs for sustainable development.

Five Elements of the SDGs and the Application of ICTs to Accelerate their Achievements

People

Poverty is often defined by one-dimensional measures—usually based on income. But poverty is multidimensional. Poor people experience various deprivations in their daily lives, including poor health, lack of education, disempowerment, poor quality of work, the threat of violence, and living in areas that are environmentally hazardous, among others.

We need to approach the multidimensional aspects of poverty through multi-stakeholder, cross-sectoral partnerships in order to accelerate the implementation of the SDGs. It will require a whole-of-government approach as well as engagement with the private sector and civil society.

Through whole-of-government approaches and partnerships, governments have used ICTs to address issues relating to poverty eradication, including its multidimensional nature. The initiatives often focus on rural development to bridge the rural-urban digital divide.

Besides a top-down model initiated by national government, bottom-up interventions from civil society and community-based organizations have emerged to complement government efforts in reducing rural poverty using ICTs. It is important that governments enable such bottom-up initiatives.

Moreover, the SDGs cannot be achieved unless gender disparities and discriminations are addressed, and women and girls are empowered and provided with equal opportunities. However, many development policies and programmes remain gender blind, including ICT policies and programmes.

ICTs hold enormous potential for the empowerment of women and girls, by enabling access to online and mobile learning, as well as increased employment opportunities and engagement in e-commerce. ICTs have also enabled women to organize advocacy campaigns for women’s rights, and participate in online forums to voice their views and concerns.

For ICTs to fully benefit women, the gender digital divide must be bridged. This includes not only ensuring that women have access to a device and broadband Internet, but are also equipped with the skills to use ICTs to improve their livelihood and social status.

Yet, social media is a double-edged sword. Women and girls can learn about their rights and find their voice. But social media platforms are also frequently used to monitor, harass, threaten, intimidate, impersonate and stalk victims.

Technology-facilitated gender-based violence that disproportionately impacts women and girls must be addressed in a holistic manner. This involves a combination of legislative reforms, capacity building of law enforcement agencies and the judiciary, and coordinated online safety programmes in schools and for the public.

Agriculture

Two-thirds of the extremely poor earn their livelihood in farming, and productivity growth in agriculture has the largest impact of any sector on poverty reduction. ICTs can help farmers optimize their farming operations and increase revenues.

Precision farming is making use of satellite technology, sensors, drones, cloud computing and mobile apps to ensure farming profitability, sustainability and protection of the environment.

Besides boosting agricultural productivity, ICTs have facilitated farmers' linkages to markets, including removal of intermediaries, which have helped to reduce transaction costs and improve agricultural value-chain processes.

Although farmers with even very small holdings can potentially benefit from these frontier technologies, poor farmers in more remote areas without the expertise, digital skills or resources to invest in these technologies are mostly excluded.

Policymakers can help poor farmers adopt smarter methods of farming through a combination of funding, education and skills training, and possibly through some variant of contract farming as an incentive for them to adopt smart techniques.

In addition to promoting the use of ICTs, policymakers need to make available complementary resources to bring about changes in the institutions and structures of the wider livelihood system. Examples include policies that encourage the expansion of power and telecommunications infrastructure, education, and availability of finance in rural areas. Such policies are important when introducing more complex applications of ICTs that can potentially bring about greater impact to the farming communities and the agricultural sector.

These policies need to be jointly planned through involvement of other institutions, such as educational institutions, private sector providers, NGOs, developmental agencies and the rural communities and farmers. This is to ensure their effectiveness, sustainability and inclusiveness.

The existence of an e-agriculture strategy and its alignment with other government plans will prevent e-agriculture initiatives from being implemented in isolation, and increase the sustainability and scalability of the initiatives.

Health

Digital health is the umbrella term that includes all aspects of ICT use in healthcare. Telemedicine and m-health applications increase access to healthcare services, particularly for rural and remote communities, and island countries. Digital data collection and health management information systems have enabled more efficient recording, monitoring and reporting of patient data, and supported decision-making. ICTs have provided access to the latest findings from medical research, and enabled continuing education for healthcare professionals.

ICTs have supported public health emergencies by predicting, preventing, monitoring and tracking disease outbreaks. The COVID-19 pandemic has brought to the fore, on the one hand, many innovative ICT solutions and their effectiveness in supporting health crisis management. On the other hand, it has revealed the inadequacies of both the ICT and health systems in terms of the infrastructure requirements and capacity needed to implement some of these ICT solutions. The COVID-19 pandemic has also brought attention to the importance of addressing privacy and security risks of these ICT solutions.

Despite there being many digital health projects, the majority remain pilots, few are evaluated and even fewer are designed or assessed for scalability. National digital health policies and strategies play an important role in addressing the fragmentation of the digital health ecosystem and the lack of engagement and cross-sector collaborations. They are also essential for facilitating standards for interoperability, regulations and policies to support digital health solutions.

Education

The use of ICTs for education is both extensive and diverse. There are interventions that focus on providing ICT hardware and software to schools, teachers and students, but on their own, they have often not worked well.

This is because many rural and remote regions do not have the basic infrastructure to support the use of ICTs due to irregular supply of electricity and lack of access to the Internet; the cost of deploying and maintaining the ICTs is a huge barrier; teachers are not trained on the use of ICTs in the classroom; and there is a lack of culturally-and-linguistically appropriate and curriculum-relevant digital educational resources.

ICT use in education needs to be introduced in the context of system-wide reform in educational policies and practices that increases access to ICTs alongside teacher training on how to use the technology and curriculum reforms.

OERs and MOOCs have contributed to self-learning and lifelong learning. Language remains a significant barrier as most of the OERs and MOOCs are currently in English, although there have been efforts to localize them. The official recognition of the certifications issued by these education providers for employment, and the ability to accumulate and transfer academic credits across educational systems are challenges that need to be addressed.

Education management information systems can provide quality data that facilitate evidence-based education system planning and policy dialogue. The development of national ICT in education plans in a holistic and collaborative manner that aim to use ICTs to remove barriers to education and enhance the quality of education is encouraged.

Planet

SDGs 6 and 12 to 15 draw attention to the dangerous consequences that inequitable distribution of resources and overexploitation of natural resources have created for the survival of the Earth. The global community is charged with reversing the damage of global climate changes and there are numerous ways in which ICTs can be used to protect our ecosystems.

The Asia-Pacific region has regressed the most on SDG 12 on sustainable consumption and production along with SDG 13 on climate action. There is therefore an urgent need to shift to more resource-efficient systems of consumption and production in order to accelerate economic progress in a sustainable manner.

ICTs have contributed to SDGs 6 and 12 to 15 in the following ways:

- Collect, manage, analyse and visualize data on greenhouse gas emissions and climate-related risks;
- Create platforms to facilitate multi-sector and multi-stakeholder engagements for dialogue, collaboration, technical support and financing (e.g., crowdfunding) at local, national, regional and global levels;
- Promote awareness, knowledge exchange, technical cooperation, capacity building and incentives for action;
- Improve early warning systems and disaster risk management, including the provision of timely information for quick rescue and response;

- Improve energy efficiency in cities, buildings, transportation, and the production of goods and services through smart applications (thus, reducing energy consumption and material waste);
- Enable farmers, fishers and foresters to access information and choose among diverse methods of achieving sustainable production;
- Dematerialize or substitute high-carbon products and activities with low-carbon alternatives, e.g., remote working, online learning, e-payment and sharing economy; and
- Enhance transparency and traceability of transactions along supply chains to verify that products are produced sustainably (e.g., using blockchain).

However, technologies alone cannot solve the climate crisis. Policies are needed to change behaviour of markets and people, such as the elimination of fossil fuel subsidies, adoption of carbon pricing approaches, development of emission standards, improving access to finance for renewables, and incentivizing innovation, use and scaling of sustainable solutions.

With climate change giving rise to more frequent extreme weather events and natural disasters, and as the COVID-19 pandemic shows, the ICT infrastructure is a lifeline, essential for effective and quick response and recovery. E-resilience, or the ability of ICT systems to withstand and recover from external disturbances such as a natural disaster, is important.

To address the scarcity, quality and distribution of water supplies in ways that support SDG 6, ICTs can reduce the duration and costs of monitoring and inventory activities; improve efficiency gains of water service providers throughout the supply chain; improve collection rates of water service providers through ICT-based payment systems; ensure better services to the poor; and strengthen citizen voice and accountability framework.

Like other sectors, water management and governance must adopt a holistic and cross-sectoral approach in working with multiple stakeholders to achieve the SDGs. For example, improving the efficiency of the agriculture sector will play a major role in the sustainability of the world’s water resources.

It is important to recognize that the ICT industry in the region is a major contributor to unsustainable consumption and production through e-waste.

The illegal dumping and informal recycling of e-waste are not only hazardous for the recyclers, their communities and the environment, but they are also inefficient, as they are unable to extract the full value of the processed products.

For low-income countries, rather than becoming dumping grounds for the toxic waste coming from more developed countries, there are opportunities to pioneer new methods of recycling and new materials that are either biodegradable, re-usable or simply long-lasting.

Governments can foster a circular economy that replenishes the resources used in consumption and production. For example, prioritizing the safe and efficient recovery of metals from e-waste using bioleaching, formalizing the e-waste sector, and supporting its development while improving labour conditions, extraction techniques and resource management.

Prosperity

Energy access

ICTs are recognized as both part of the problem and part of the solution when it comes to energy consumption and production, and greenhouse gas emissions.

ICTs are part of the problem because: the production of digital devices is energy consuming and uses potentially hazardous waste; and computers, devices, data centres, cryptocurrency mining and blockchain technology consume a lot of electricity.

ICTs are part of the solution because: they can increase the efficiency of traditional energy production; they enable the spread of renewable energy technologies; through smart metering they can help redistribute consumption from peak to off-peak hours; and across the energy-consuming industrial economy they can make energy usage more efficient.

Advancements in distributed solar technologies and growing access to mobile networks and mobile money services have led to the emergence of distributed energy services companies that offer pay-as-you-go solar home systems. The solar home systems are effective in connecting off-grid areas and leapfrogging communities to clean energy solutions.

Digital financial inclusion

ICTs have enabled access to and delivery of financial services. In particular, the rapid growth in mobile phone uptake has resulted in its innovative use to deliver financial services.

The digital finance ecosystem has allowed new players to enter the financial and banking sector that has evolved from state banks, microfinance institutions and cooperatives to a broader range of providers that now include mobile operators, mobile agent networks, e-commerce platforms and Internet companies.

These players are increasing access to financial services, but they are also creating risks related to privacy and security, widening the digital divide, the domination of few large players, lack of interoperability of systems, and unclear liability due to multiple providers involved in service delivery.

Access to financial services is unequal between women and men, and policies promoting financial inclusion must be gender sensitive.

Youth employment and skills training

Rapid technological progress and policies for i4.0 are reshaping labour markets and impacting workers and households in significant ways.

Given that the risk of job automation peaks among young workers, an integrated policy framework for supporting young people in securing decent jobs in this context is critical for future socioeconomic progress.

There needs to be a review of education, training and lifelong learning policies. This is because without effective policies, the gap between skilled and non-skilled workers will increase income inequality, leading to social instability and undermining inclusive growth efforts.

Social protection systems need to be reviewed to address these impacts, including ways to cover a growing number of people under non-standard working arrangements, such as those working in the gig economy.

Industrialization, infrastructure and innovation

i4.0 has the potential to improve productivity and competitiveness, increase energy and resource efficiency, and hence protect the environment. It can enable the transition to a circular economy in which end-of-life products are reused, remanufactured and recycled. Taken together, these developments can lead to more sustainable consumption and production patterns.

With countries implementing i4.0, there is an urgent demand for a robust and resilient broadband infrastructure that can support the application of frontier technologies. ESCAP has been promoting and supporting member States in the co-deployment of the ICT infrastructure with the transportation and energy infrastructures. Fibre-optic cable co-deployment along infrastructure such as major roads, railways, power transmission lines and pipelines could save significant costs and resources as it allows one-time investment in land acquisition and construction.

Innovation activities, including the commercialization and transfer of technologies, and policies promoting the adoption and diffusion of technologies are important. Just as

important are activities that empower poor and vulnerable communities to realize their own innovative potential, such as access to finance and credit, and opportunities to acquire skills, including ICT skills.

Reducing inequalities and promoting social protection

Inequality persists in all forms. The population of persons with disabilities is likely to increase because of the combined effects of population ageing, poverty, the rapid spread of non-communicable diseases, natural disasters and humanitarian crises. Statistics also show that women tend to spend more years with disabilities than men.

The healthcare sector has started to explore how AI and big data can contribute to long-term care for older persons, from early diagnosis and more effective treatment of diseases, to at-home health monitoring and fall detection.

For persons with disabilities, applications that assist access to the Internet are increasing and becoming more affordable, and some of these applications are integrated in mobile devices. Unfortunately, many websites and mobile apps are designed in such a way that makes them difficult or impossible for persons with disabilities and older persons to use.

Incentives, awareness and support are needed to boost the implementation of digital accessibility. All players in the ICT ecosystem must be involved to guarantee accessibility, including government agencies, providers of ICT services, designers and manufacturers of ICT products, and organizations procuring ICT products.

In support of migrants, refugees and internally displaced persons, humanitarian aid agencies have been exploring new ways of delivering aid through mobile money and digital vouchers, and using blockchain to record transactions. ICTs, including biometrics, have been used for identity management and the facilitation of registration. ICTs have also been used in the provision of education and healthcare services, and in income generation and trading activities.

Although ICTs have significant benefits for displaced persons and aid organizations, increased use of data raises ethical, privacy and security issues. While social media helps connect with family and friends, and obtain and share information, social media plays a role in the recruitment of trafficking victims. Both the opportunities and threats of ICTs must be considered when designing and implementing policies and programmes to reduce inequality.

Social protection is an effective measure to tackling inequalities and building resilience against shocks and crises. ICTs can help to manage and monitor the implementation of social protection initiatives, including efficient disbursement to beneficiaries and reduced opportunities for fraud.

Sustainable cities

To realize a sustainable urban future, it is important to:

- Integrate sustainability and quality-of-life targets into urban planning;
- Co-produce urban planning solutions with citizens, including the urban poor and marginalized groups;
- Adopt resilience strategies that break down governance siloes;
- Capitalize on frontier technologies to develop people-centred smart cities; and
- Address privacy and security concerns.

As traffic congestion and air pollution are common problems in many cities, intelligent transport systems are being developed, often as part of smart city initiatives. Many intelligent transport pilots have been rolled out, including intelligent traffic signals, real-time road navigation, real-time public transit information, smart parking, bike and car sharing, e-hailing and more. A holistic and inclusive approach to transport planning and management is essential.

Peace

ICTs are helping to build inclusive and accountable institutions by: improving citizens' access to public information and services through online platforms; promoting public participation and co-creation of public services; and enhancing the transparency of public institutions' actions through initiatives like open data.

Without proof of identity, people may be denied access to rights and services. Government-issued digital ID allows the provision of public services to become more efficient, effective and inclusive.

However, it is important to remove barriers to ICT access and usage, and safeguard data privacy, security and user rights through systems design and a comprehensive legal and regulatory framework.

It is also important to support the development of private sector-led services to leverage the digital ID infrastructure through interoperable open technology platforms that stimulate innovation, competition and rapid uptake.

Open government data can increase transparency and lead to increased accountability and trust in governments and public institutions. But generally, e-governance needs to be embedded in broader administrative reform in order to be effective in reducing corruption.

Partnership

Partnerships such as PPPs and multi-stakeholder approaches, can mobilize human and financial resources, expertise, and technology and knowledge transfer.

ICTs play an important role in bringing people together, providing a platform for sharing ideas and developing consensus, and raising awareness about the partnerships. Collaborative software informed by machine learning can make decision-making within and between institutions more efficient.

The United Nations Secretary-General's High-level Panel on Digital Cooperation calls for multi-stakeholder collaboration that involves a more diverse spectrum of stakeholders and more diverse voices, particularly from developing countries and traditionally marginalized groups.

These are people who are more likely to not have access to ICTs. Therefore, alternative ways to ensure their participation in decision-making are needed. Moreover, even if they are invited to the table, such groups may lack the capacity to participate effectively and meaningfully.

This means, wider issues related to: (1) generating the political will to engage with all stakeholders; (2) developing the capacity of marginalized groups; and (3) reducing barriers and providing safe spaces to participate, need to be addressed. At the same time, it is necessary to accelerate efforts to increase access to affordable ICTs and their use for the SDGs.

ICTs, Sustainable Development and National Development Policy and Planning

Policies that focus on ICTs for sustainable development, involving both the ICT and the development-related ministries and departments, must be developed if countries wish to leverage ICTs to achieve the SDGs.

Moreover, planning for sustainable development has often involved a piecemeal approach, treating the elements separately as the needs arise. But to achieve impact, a holistic approach is required.

For example, to ensure that farmers and rural workers and their families have access to agricultural and industry support, training and education and healthcare services, line ministries of agriculture, education and health need to plan together, and plan with the full participation of the local communities involved, so the **vision** of the plans can be co-created. The local communities will become equal partners in the **mission** of the plans, and a combination of central and local financial and human resources can be melded together to provide the **means** to achieve the plans.

To fully harness ICTs for sustainable development, it is necessary to build up the ICT infrastructure.

Relevant ICT training for all public officials and service providers on a regular and continuous basis to orient and update knowledge and applications will be essential.

At the same time, a transformation of the culture and institutional structures will be necessary. This could involve:

- Breaking down silos between agencies;
- Establishing interoperability;
- Forming partnerships;
- Developing a culture of innovation; and
- Engaging with multiple stakeholder and ensuring inclusion.

Prioritization of projects to undertake is important. This should be supported by the use of data, data analytics and data visualization to help diagnose problems, make decisions, and monitor and measure performance.

There seems to be a clear consensus among experts that factors determining the success or failure of projects are often not technology-related but are people-related. Therefore, a people-centric rather than ICT-centric approach is critical for ICTD projects to succeed.

Careful project planning is essential to avoid gaps between design and reality—in contexts, in approaches to planning and implementation, and in perceptions and philosophies between the different stakeholders. Without planning, the consequence is often a mismatch between priorities, investments, deliverables and outcomes.

The Principles for Digital Development aim to guide the design of technology-enabled projects to improve overall outcomes. The principles are:

1. Design with the user;
2. Understand the existing ecosystem;
3. Design for scale;
4. Build for sustainability;
5. Be data driven;
6. Use open standards, open data, open source and open innovation;
7. Reuse and improve;
8. Address privacy and security; and
9. Be collaborative.

Studies have found that a sound monitoring and evaluation system is critical for preventing setbacks and promoting the mainstreaming and upscaling of ICTD interventions.

Needs assessments and baseline studies help to establish benchmarks against which to monitor and assess progress and effectiveness during and after various interventions to achieve the SDGs. Needs assessments and baseline data can also help determine technology choices.

Frontier technologies must be explored for their true potential and managed to ensure that their risks are mitigated and the safety of people receiving assistance is protected.

Connectivity is a key feature of the digital revolution. Given that those likely to remain unconnected are the poor and marginalized, “leaving no one behind” means that we should be mindful of the risks posed by a fully digital approach and thus make sure that our efforts do not exacerbate inequality. This requires, among others, giving special attention to digital gender divides and to online and offline barriers to digital inclusion that women and girls face.

Across countries, women and girls experience multiple inequalities and intersecting forms of discrimination based on their sex, age, class, ability, race, ethnicity and migration status. Therefore, efforts to leave no one behind must incorporate these multiple dimensions of inequalities in policy, planning, monitoring and evaluation systems.

Let’s join hands in strengthening our capacity to harness the transformative potential of ICTs to create more sustainable, inclusive and resilient economies and societies.

NOTES FOR TRAINERS

The purpose of these “Notes for Trainers” is to align the authors’ perceptions of the module content with those of national and regional training institutions and individuals who will take the modules forward in their own individual settings.

As noted in the section entitled “About the Module Series”, this module is designed to have value for different sets of audiences and in varied and changing national conditions. The module can also be presented, in whole or in part, in different modes, face-to-face or online.

Case studies may change from region to region and from country to country and therefore, the module may require customization to suit local settings. What will be presented and how it will be presented should depend on the situation at hand. The module may be studied by individuals and by groups in training institutions as well as within government offices. The duration of the training sessions will determine the extent of details in the presentation of content.

These “Notes” offer trainers some ideas and suggestions for presenting the module content more effectively. Trainers may adopt, adapt or create afresh the training plans presented here.

General Notes on Effective Training Techniques

The module is designed for self-study as well as for “classroom” delivery. Thus, each section of the module begins with a statement of learning objectives and ends with a summary of key points. Readers may use the objectives and summary of key points as a basis for assessing their progress through the module. Each section also contains discussion questions and practical exercises that may be accomplished by individual readers or used by trainers.

Case studies form a significant part of the module content. These are intended for discussion and analysis, particularly in terms of the extent to which the key concepts and principles presented in the module work in real-world programmes and projects. It is important for readers to appreciate the need to adapt ICT-based and ICT-supported approaches and models to suit local conditions.

The module is written according to the principles of adult learning. For example, it is recognized that adults learn best when they are free from stress and information overload, and they are able to decide for themselves what is important to be learned.

The self-study questions and practical exercises are designed to enable readers to draw on their own experience to benchmark the content and think reflectively on the

issues presented. The aim is to make the content as closely relevant to their work experience as possible, and enable them to link the knowledge gained to their own experience in order to solve problems.

It is recognized that the readers of this module could themselves serve as knowledgeable resource persons. Trainers should keep this in mind when using the module as a training resource in different settings and with different groups of audiences. For example, trainers may encourage participants to cite other cases and examples from their own experience to substantiate the content of the module.

Structuring the Sessions

Depending on the audience, time available, and local settings and conditions, the content of the module could be presented in different structured time capsules. What could be covered in sessions of different durations is outlined below. Trainers are invited to modify the session structure based on their own intimate understanding of the country and audience.

For a 90-minute session

For senior policymakers: A broad summary of Sections 2 and 3 for a general understanding of the SDGs and ICT applications in development, including a detailed explanation of a relevant case study.

For policymakers working in a particular development sector: An overview of Section 2 and the relevant SDGs from Section 4, including a detailed explanation of a case study from the relevant sector.

For project management staff: Section 5 that looks into the challenges of using ICTs in development policy and planning, along with a detailed explanation of a case study from Section 4.

For a three-hour session

For policymakers: A broad summary of Sections 2 to 4, and a detailed explanation of a relevant case study followed by a practical group exercise of 1.5 hours on policy analysis or design.

For project management staff: A broad summary of relevant development sectors from Section 4 and a detailed presentation of Section 5, followed by a practical group exercise on project design and implementation planning.

Generally, a three-hour session could be divided into two 1.5-hour sessions containing a summary of a relevant section and a case study followed by a practical group exercise.

For a full-day session (6 hours)

Design the content progressively starting with Section 1 and progressing to Section 5. Use the same pedagogical approach described above.

Consider spending one hour each for Sections 2, 3 and 5.

Section 4 will take more time. Depending on the interest of the participants, select the relevant SDGs to cover, and allocate three hours for this section incorporating relevant case studies and practical group exercises.

For a three-day session

About half a day could be spent on Sections 2 and 3.

A day and a half could be spent on Section 4, with a field visit on the second day to a nearby ICTD application.

Lessons learned from the field visit could be used to bolster the discussion of Section 5 on the third day.

Participants could be invited to link the different challenges to the use of ICTs with the case study / field visit and to the content of the module being presented, so that they take away from the three-day programme a sound understanding of the critical importance of proper planning, design and implementation.

For a five-day session

A five-day session would be ideal for people involved in programme and project implementation. The emphasis should be on Section 5, and the in-class sessions should be interspersed with field visits to case study locations nearby.

Day 1 could consist of an extensive exploration of Sections 2 and 3. Half a day could be spent on exploring progress on the SDGs, and on establishing the intersectoral linkages.

For instance, a poverty alleviation initiative is likely to have spin-offs in healthcare and in education. Such linkages should be explored as they are vital to programme design and implementation.

The second half of Day 1 could be spent on exploring the different ICTs, with a focus on looking at convergence and digital divide issues. A visit to a nearby telecentre, if possible, could round off the day's activities.

Days 2 and 3 could focus on the applications of ICTs for meeting different SDGs covered in Section 4, with at least half a day devoted to a field visit. Case studies can be explored in detail. The field visit should be followed by an exercise applying to a planned intervention, the key principles and design features observed during the field visit.

Days 4 and 5 could continue with the exercise. The materials in Section 5 could be presented in an instructor-led session in the morning, followed by extensive practical work by individuals and groups in the afternoon. The fifth day would close with presentations of the exercise followed by peer review.

Trainers are encouraged to structure each session to include a combination of lecture, discussion and individual or group exercises.

Ideally, there should be no more than 25 participants in a training session.

Trainers should use the references listed in the Further Reading section, and look up the original documents and websites cited. Trainers may also use other relevant case studies. However, remember to cite all references and sources in the presentation.

FURTHER READING

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APCICT

The Asian and Pacific Training Centre for Information and Communication Technology for Development (APCICT) was inaugurated on 16 June 2006 as a regional institute of Economic and Social Commission for Asia and the Pacific (ESCAP), and is located in Incheon, Republic of Korea. Guided by the 2030 Agenda for Sustainable Development and other internationally agreed development goals, the Centre's objective is to build and strengthen the capacity of members and associate members of ESCAP to leverage information and communication (ICT) for the purpose of socio-economic development. APCICT's work is focused on training, knowledge sharing, and multi-stakeholder dialogue and partnership.

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The Economic and Social Commission for Asia and the Pacific (ESCAP) is the most inclusive intergovernmental platform in the Asia-Pacific region. The Commission promotes cooperation among its 53 member States and 9 associate members in pursuit of solutions to sustainable development challenges. ESCAP is one of the five regional commissions of the United Nations.

The ESCAP secretariat supports inclusive, resilient and sustainable development in the region by generating action-oriented knowledge, and by providing technical assistance and capacity-building services in support of national development objectives, regional agreements and the implementation of the 2030 Agenda for Sustainable Development.

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