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Session



# Seizing the Opportunity

DIGITAL INNOVATION FOR  
A SUSTAINABLE FUTURE



**ESCAP**  
Economic and Social Commission  
for Asia and the Pacific



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# Seizing the Opportunity

## DIGITAL INNOVATION FOR A SUSTAINABLE FUTURE

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# Foreword



**A**sia and the Pacific is at the forefront of a global digital transformation. Innovations in cognitive digital technologies, digital finance, government technology and the Internet of things are reshaping the way we do business, deliver public services and protect people and our planet. Intelligently deployed and properly governed, digital innovations could turbocharge sustainable development efforts. They could enable the extraordinary collective push that is required to achieve the 2030 Agenda for Sustainable Development at a time when progress is alarmingly slow. Yet, for this to happen, common understanding and shared approaches are needed across the region.

With these objectives in mind, we have scrutinized ground-breaking digital innovations and explored how further ingenuity might be identified and deployed at scale. We have proposed a framework to create the enabling conditions needed for digital innovations to support the Sustainable Development Goals. The framework provides a method to foster innovation by proposing benchmarks to measure the impacts of initiatives on sustainable development outcomes and identifying enabling actions designed with relevant stakeholders. Furthermore, the framework is practical and has already been deployed, for example, to frame the use of cognitive digital technology for cancer treatment decisions.

We have gathered case studies from across the region. They paint an uplifting picture. Smart grid technologies and transport solutions are contributing to climate action. Artificial intelligence is improving early warning systems for disasters and saving lives and livelihoods. Better access to quality health care and education services is being delivered in the most remote of areas. The speed and responsiveness of tax collection are being upgraded, and financial inclusion is being expanded. Our objective now must be to use this empirical evidence to shape a regional collective effort so that no one is left on the wrong side of the digital divide.

To this end, we present tangible enabling measures. Expanding affordable Internet coverage, including among marginalized and underserved communities, is a prerequisite. Furthermore, the short development cycles of new digital technologies require a measured combination of predictable policy environments and agile regulatory instruments that operate in specific contexts. This is crucial to attract investment and unleash innovation, underpin patent growth, support innovative micro, small and medium-sized enterprises and improve the delivery of essential services. To give scale to innovation, structures are needed to coordinate the efforts of multiple stakeholders and build capacity for the public sector to harness digital innovation for the greater good.

Finally, this report makes concrete proposals to leverage the link between digital innovation and sustainable development, proposals that are grounded in regional cooperation. They focus on recommendations to support the development of digital innovation platforms, enhance sociotechnical competencies to scale up innovation and promote policy convergence for an enabling ecosystem with requisite financing. Together, these measures could ensure that digital innovations become the game changer we need to achieve the Sustainable Development Goals. Our ambition is commensurate with the opportunity. Our hope is that our analysis and proposals are just the first step towards the actions needed in every corner of Asia and the Pacific. Let us together seize the opportunity.

A handwritten signature in black ink, appearing to read 'A. Salsiah'.

**Armida Salsiah Alisjahbana**

Under-Secretary-General of the United Nations and Executive Secretary of ESCAP

# Acknowledgements

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## Acronyms

<b>ADM</b>	Algorithmic Decision-Making
<b>AI</b>	artificial intelligence
<b>AMI</b>	Advanced Metering Infrastructure
<b>APCICT</b>	Asian and Pacific Training Centre for Information and Communication Technology for Development
<b>APIS</b>	Asia-Pacific Information Superhighway
<b>ASEAN</b>	Association of Southeast Asian Nations
<b>ASGARD</b>	AIoT-Enabled Smart Grid Application for Sustainable and Resilient Digital Ports
<b>CAV</b>	Connected Autonomous Vehicle
<b>CBDC</b>	central bank digital currency
<b>C-ITS</b>	Cooperative Intelligent Transport Systems
<b>CPTA</b>	Cross-border Paperless Trade in Asia
<b>DER</b>	Distributed Energy Response
<b>DESI</b>	Digital Economy and Society Index
<b>DR</b>	demand response
<b>ECC</b>	United Nations Convention on Electronic Communications in International Contracts
<b>EGDI</b>	UN E-government Development Index
<b>EIT</b>	Energy Innovation Tool-Kit
<b>ENEA</b>	East and North-East Asia
<b>ESCAP</b>	Economic and Social Commission for Asia and the Pacific
<b>FDI</b>	foreign direct investment
<b>FiT</b>	feed-in-tariff
<b>GaaP</b>	Government-as-a-Platform
<b>GenAI</b>	generative artificial intelligence
<b>GNI</b>	gross national income
<b>GovTech</b>	government technology
<b>GST</b>	Goods and Services Tax
<b>GW</b>	gigawatt
<b>ICT</b>	information and communications technology
<b>ILO</b>	International Labour Organization
<b>IoT</b>	Internet of things
<b>IRAS</b>	Inland Revenue Authority of Singapore
<b>IT</b>	information technology
<b>ITA</b>	Information Technology Agreement
<b>ITU</b>	International Telecommunication Union
<b>LCRs</b>	Local Content Requirements

<b>LNOB</b>	Leaving No One Behind
<b>MaaS</b>	Mobility-as-a-Service
<b>MHEWS</b>	multi-hazard early warning systems
<b>MLETR</b>	Model Law on Electronic Transferable Records
<b>MSMEs</b>	micro, small, and medium enterprises
<b>NCBM</b>	National Council for the Blind, Malaysia
<b>NGO</b>	non-governmental organization
<b>NTMs</b>	non-tariff measures
<b>NWP</b>	Numerical Weather Prediction
<b>OECD</b>	Organisation for Economic Co-operation and Development
<b>P2P</b>	peer-to-peer
<b>PES</b>	public employment services
<b>R&amp;D</b>	research and development
<b>SAARC</b>	South Asian Association for Regional Cooperation
<b>SDGs</b>	Sustainable Development Goals
<b>SEA</b>	South-East Asia
<b>SIDS</b>	small island developing States
<b>STEM</b>	science, technology, engineering, and mathematics
<b>TRIMs</b>	Trade-Related Investment Measures
<b>TVET</b>	Technical and Vocational Education and Training
<b>UNDRR</b>	United Nations Office for Disaster Risk Reduction
<b>UNFCCC</b>	United Nations Framework Convention on Climate Change
<b>UNICEF</b>	United Nations Children’s Fund
<b>UNU</b>	United Nations University
<b>USF</b>	Universal Service Funds
<b>VICS</b>	Vehicle Information and Communication System
<b>VRU</b>	Vulnerable Road User
<b>VSAT</b>	Very Small Aperture Terminal
<b>WTO</b>	World Trade Organization



# Executive Summary

## Digital innovation landscape and sustainable development

**Accelerating progress towards the full implementation of the 2030 Agenda for Sustainable Development is a priority in Asia and the Pacific.** Progress on many of the 17 Sustainable Development Goals has been alarmingly slow at both the global and regional levels. If it remains on its current trajectory, the region will achieve less than half of the necessary progress by 2030. Population groups in vulnerable situations remain exposed; the gap between countries in special situations and the rest of the region shows no sign of narrowing; and climate action urgently needs to be strengthened. With the support of enabling policy and regulatory regimes, digital innovations could play a decisive role in the extraordinary collective effort needed to make a meaningful course correction.

Asia and the Pacific is a hub for digitally-driven innovations that have the potential to accelerate sustainable development. The region's sociodemographic profile, digitally literate youth, ability to leverage economies of scale and rapidly expanding access to digital infrastructure all provide fertile ground for the further development of digital innovations. Innovations in cognitive digital technologies, digital finance, government technology and the Internet of things carry great potential to accelerate the region's progress towards the 2030 Agenda for Sustainable Development (Mäkitie and others, 2023).

To tap into this potential, in the present report, the secretariat examines how Governments can encourage and support the development, replication and scaling up of digital innovations. First, it provides a framework that sets out the synergistic linkages between digital innovations and sustainable development. Second, through the prism of this framework, it identifies five enabling actions while advocating for strengthened stakeholder engagement and durable partnerships. Third, the secretariat recommends that existing regional cooperation mechanisms be leveraged along three pathways with a view to consolidating the contribution of digital innovations to the accelerated implementation of the Sustainable Development Goals. Throughout the report, illustrative case studies from across the Asia-Pacific region are drawn upon. The focus is not on digital technologies themselves, but on how they can be enabled and leveraged for the benefit of the environment and to improve people's lives.

## Cognitive digital technologies

**Cognitive digital technologies, which use advanced analytics, machine learning and generative artificial intelligence<sup>1</sup> to develop insight, have become drivers of transformational change (ESCAP, 2022a).** There are few technologies that have swept through systems with such speed and impact. Hardly a day passed in 2023 without generative artificial intelligence developments making it into the headlines. While still mired in caveats, unknowns and consequently widely divergent views on their benefits and threats, cognitive digital technologies could have a profound impact on the Sustainable Development Goals in at least the following ways:

- A Cognitive digital technologies are improving diagnostic capabilities and enabling the discovery and development of new drugs, supporting good health and well-being (Goal 3). They are being used in a wide range of applications, from clinical trials for cancer therapies to telemedicine, which are improving access to health care in rural areas across the Asia-Pacific region (Lorenz, Perset and Berryhill, 2023);
- B Cognitive digital technologies are also mitigating the impact of natural disasters and environmental hazards by facilitating the rapid analysis and integration of a wealth of data derived from satellite, meteorological and ground sources. This can provide location-precise, time-sensitive, impact-based

<sup>1</sup> The creation of various forms of digital content using natural language prompts.

and life-saving early warnings, contributing to a number of the Goals, including, notably, the Goal on climate action (Goal 13). Furthermore, cognitive digital technologies are increasingly being used to forecast changes in air quality, thus allowing action to be taken ahead of heavy pollution, which is critical to achieving good health and well-being (Goal 3) and sustainable cities and communities (Goal 11) (Zhang and others, 2022);

- c Generative artificial intelligence is offering personalized educational content that could make a qualitative contribution to bridging regional educational gaps and achieving quality education (Goal 4) while enhancing teacher productivity and improving students' learning experiences, if supported by the right digital infrastructure, as well as the right policy and regulatory frameworks.

## Digital finance

**Digital finance has made it easier to gain access to financial services and enabled swift responses to crises.** The finance sector in the Asia-Pacific region has embraced digital tools, and the value of digital transactions is projected to reach US\$ 6.7 trillion by 2026 (ESCAP, 2022b). Countries that had invested in digital payment mechanisms were able to respond to the coronavirus disease (COVID-19) pandemic better, in part because they could swiftly make social assistance payments to stop people falling into poverty (Goal 1). Digital finance has also improved access to essential services such as banking and insurance, notably for women, for micro-, small and medium-sized enterprises and for remote and marginalized communities, thereby contributing to lower gender and income inequalities (Goals 5 and 10).

## Government technology

**Government technology has improved the efficiency, effectiveness, accessibility, reach and transparency of public services, supporting progress towards several Sustainable Development Goals.** Government digital platforms, if they are user-friendly and have a low-bandwidth intensity, are already helping to reach areas and groups traditionally excluded from the benefits of digitalized public services.

## Internet of things

**Technologies linked to the Internet of things have the potential to optimize resource management, support responsible consumption and production (Goal 12) and strengthen the circular economy through informatization and dematerialization.** They enable intelligent infrastructures that are equipped with sensors for data collection and monitoring, which in turn allow for a more efficient distribution and disposal and a lower consumption of scarce resources.

## Digital innovations: Looking ahead

**Yet, for all these positive impacts on the Sustainable Development Goals, many challenges remain.** For example, because cognitive digital technologies often depend on algorithms that draw on data that may be biased towards wealthier countries, their use can deepen inequalities. Furthermore, concerns about possible privacy violations, intellectual property infringements, the spread of misinformation and disinformation and security breaches, to mention but a few, have all rung the alarm and led to calls for regulatory regimes that mitigate possible harm.

Nevertheless, it is equally important to consider how known – or pilot tested – digital innovation successes can be replicated and scaled up, without fear of unknown repercussions. In other words, can technology-driven solutions be used in combination to generate even greater added value,

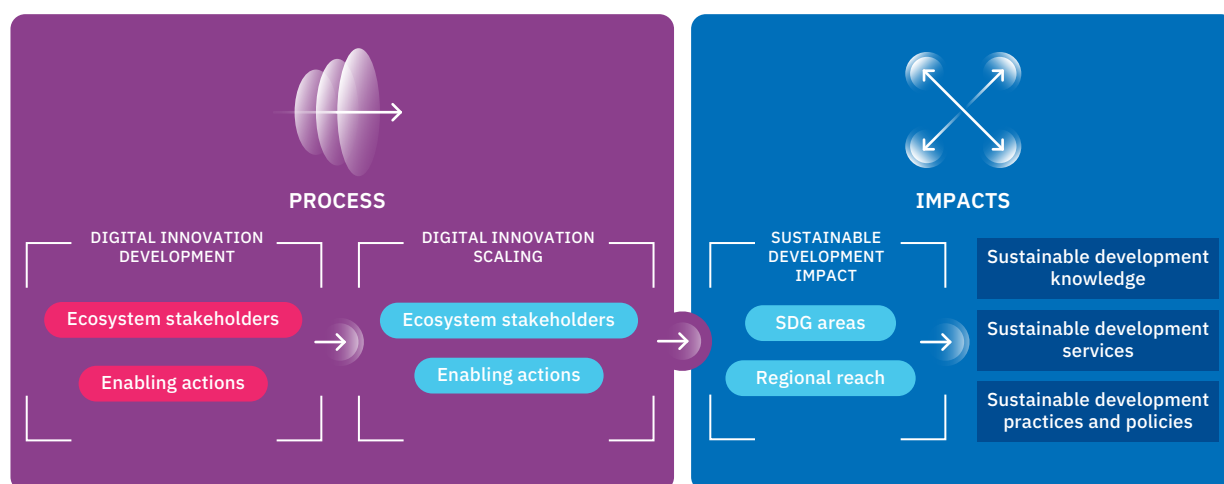
more quickly, than before? It has been said that innovators dominate headlines but that those who are able to scale up innovations dominate markets. An enabling policy and regulatory environment can help to encourage the scaling up of innovations for sustainable development.

What might the elements of such an enabling environment be and what role can regional cooperation play in scaling up innovations? These questions are considered in the sections that follow. The rest of the summary contains a framework for harnessing digital innovation to accelerate progress towards the Sustainable Development Goals, and case studies.

## Harnessing digital innovation: A framework

**To accelerate the implementation of the Sustainable Development Goals, Governments need to be able to identify and foster digital innovations that connect technology to social, economic and environmental outcomes.** This requires a structured approach to creating enabling conditions, engaging the stakeholders and ensuring the availability of metrics to measure the impact of the interlinkages between digital advancements and the Goals. For this purpose, the secretariat proposes a framework that supports two process-related actions with two resulting impacts (figure 1).

FIGURE 1 Framework for linking digital innovation and sustainable development



Source: ESCAP.

In the process phase, government initiatives to foster digital innovation should be clearly distinguished as being either aimed at the development of digital technologies or at scaling them up. To support development, Governments should encourage businesses, the public sector and citizens to collaboratively experiment with digital technologies to create new products or services. Only after these new products or services have been tested and have received financial investment, in an appropriate intellectual property and institutional infrastructure, can they lead to sustainable outcomes. Deliberate policy efforts that have been developed with and are therefore attuned to specific scientific and technological enterprises are needed to identify mature digital technologies that can be deployed on a larger scale. Such efforts include assessing the objectives of the innovation and the degree to which stakeholders and the policy environment can support the innovation so as to expand its reach to marginalized areas and population groups.

As digital innovations are scaled up, their contribution to achieving the Sustainable Development Goals can be viewed in three areas: knowledge; services; and practices and policies. Developing metrics for each area could improve understanding of how digital innovations are reshaping the landscape of sustainable development. A range of services – from education, finance and infrastructure development to policymaking – could become more inclusive and sustainable. Practical considerations are further discussed in the following section.

Despite the linear visual representation in figure I, the relationship between process and impacts is not unidirectional and impacts feed back into the process of developing and scaling up digital innovations. Cases where digital innovations have had a positive impact often lend support to the kind of policy environment that enables technological development and stimulate further investments into the process. Assessing the impacts of innovations is critical for deepening understanding and guiding the frequent iterations between process and impacts.

## Digital innovation: Case studies for the future

**In the power sector, smart grid technologies enabled through the Internet of things are facilitating the development of renewable energy and enhancing the resilience, inclusivity and affordability of energy resources.** Smart meters provide consumers with real-time signals and pricing information, allowing them to adjust their energy use. In the Philippines, a decentralized smart grid controlled by a cloud-based, mobile-enabled application using Internet of things connectivity has optimized power distribution across properties within a village (IEA, 2023). The application of blockchain technology in peer-to-peer energy trading platforms is another significant development. The value of blockchain technology has been demonstrated in a development project in Bangkok known as T77, where it minimizes information asymmetry between producers and consumers and supports efficient energy trading (Petrichenko and Schletz, 2020). The integration of rooftop solar panels, battery energy storage and network-enabled appliances is reshaping power systems, particularly in small island developing States.

**In the transport sector, the focus is shifting from easing the flow of traffic to meeting people's needs.** Smart mobility, mobility as a service and connected vehicles combined with big data applications that help understand trends have enhanced predictive capabilities, enabling more reliable, efficient and evidence-driven policymaking in support of road safety and the decarbonization of the sector. Emerging innovations in the region include research into autonomous vehicles in Singapore<sup>2</sup> and the development of real-time and reliable road and traffic information systems in Japan (Yamamoto, Onosato and Ogiso, 1996). Kazakhstan and Uzbekistan have introduced several digital features into their national rail networks, including electronic payment systems, digital client interfaces and links to other parts of the logistics system (ESCAP, 2019).

**Cognitive digital technologies could contribute to ensuring that every person on Earth is protected by early warning systems by 2027.** Increasingly, artificial intelligence applications are delivering early warnings for floods, earthquakes and landslides. A flood early warning service that started in Bangladesh and India four years ago has since been scaled up to cover more than 90 countries (Zafrin, 2023). Another digital early warning system, which uses android smartphones as mini seismometers to detect earthquakes, has detected hundreds of quakes without false positives, although many of them have not required further human response action (Berman, 2023). Similarly, scientific monitoring and reliable telecommunications cable systems, through which ocean bed fibre-optic cables are equipped with sensors, can generate a wealth of data, including on sub-seafloor seismic activity, thus expanding the range of tsunami early warning systems. Such a system, which is relatively cost-effective, is being piloted along a cable route between Vanuatu and New Caledonia.<sup>3</sup> These technological breakthroughs enhance the capacity to predict disasters and expand the reach of early warnings, enabling all who have reliable digital connectivity to take and benefit from risk reduction actions.

<sup>2</sup> See, for example, Centre of Excellence for Testing and Research of Autonomous Vehicles – NTU (CETRAN), n.d. Available at <https://cetran.sg>.

<sup>3</sup> See, SMART Cables for Ocean Observing, “Vanuatu – New Caledonia”, 2024. Available at [www.smartcables.org/systems/vanuatu-newcaledonia](http://www.smartcables.org/systems/vanuatu-newcaledonia).

**Digital solutions are improving the speed, rate of compliance, accuracy and responsiveness of tax collection processes, thus lowering administrative costs and discouraging tax evasion.** Most countries in the region have e-filing systems and the COVID-19 pandemic accelerated this shift (OECD, 2021). The adoption of electronic tax identification numbers in countries such as the Republic of Korea (Lee, 2016) and Singapore has simplified taxpayer registration procedures and broadened the tax base. Since its implementation in 2021, the track and trace system in Pakistan has led to increases in transparency and tax compliance and reductions in the prevalence of counterfeit goods (FBR Pakistan, 2024). Uzbekistan has introduced e-invoicing options to improve compliance and to make it easier for businesses to gain access to and manage their invoicing records (VAT Update, 2023). Digital innovations can help to overcome the unequal access to health-care services in the region by addressing the challenges of geographical distance and resource constraints. In Bangladesh, the success of telemedicine depends on several enabling factors, including Internet connectivity, supportive government policies, a regulatory framework for telehealth services, partnerships with health-care providers and public awareness campaigns. In 2020, during the COVID-19 pandemic, the Government's Shasthyo Batayon telemedicine hotline handled approximately 80,000 calls per day, or 10 million calls over a six-month period (Ahmed and others, 2021). The Digital Family Card in Kazakhstan enables the Government to more effectively identify families from vulnerable groups, assess their needs and provide support in areas such as education, social protection, finance, justice and health. Nearly 6 million families benefited during the first phase alone (UNDP Kazakhstan, 2023).

**A number of countries are considering issuing central bank digital currencies to facilitate payment processes, lower transfer costs and increase the transparency of both national and international payment systems.** In so doing, they would be expanding the global research pool and contributing to the development of regulations that safeguard the stability and security of monetary and financial systems. Gaining a deeper understanding of the risks related to implementing central bank digital currencies is important (BIS, 2023). As these currencies are at an early stage of development and because there is insufficient evidence of their net benefits compared to other technologies, regulations should facilitate competition between emerging digital payment solutions offering similar advantages. Encouraging diversity is essential for the development of more sustainable and inclusive financial systems (Gross and Letizia, 2023).

Maldives is taking an iterative approach to considering the introduction of a central bank digital currency by initially working on developing a regulatory sandbox framework. Extensive staff training, as well as testing of a central bank digital currency and financial technology in a controlled setting, is planned within an overall policy objective of ultimately improving efficiency, equipping the economy with financial inclusion systems and supporting a payment system for the tourism sector (Hrnjic and Clarke, 2022).

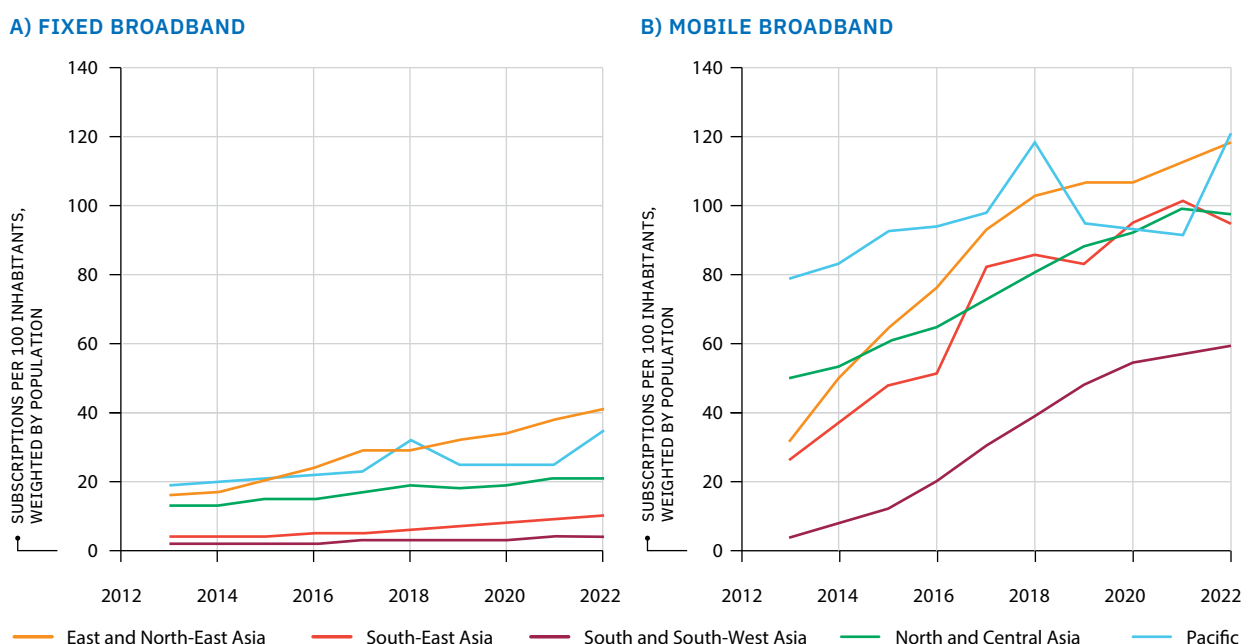
## **Building an enabling environment**

**The essential, albeit insufficient, condition for digital innovation to accelerate implementation of the Sustainable Development Goals is universal access to digital infrastructure.** Through the prism of the framework presented above, in the present section the secretariat first discusses ways of strengthening digital connectivity and then presents five enabling policy actions to augment the positive impacts on sustainable development of universal digital connectivity.

## Strengthening infrastructure and connectivity

In recent years, infrastructure development has greatly expanded Internet coverage. In 2022, 96 per cent of the population of Asia and the Pacific was covered by a fourth generation (4G) mobile network (ITU, 2024). While all of the subregions of the Economic and Social Commission for Asia and the Pacific (ESCAP) experienced improvements, South-East Asia and East and North-East Asia have made progress faster over the past five years, a trend driven by the continued strong growth in terms of access in the Republic of Korea and Singapore (figure II). Notably, South and South-West Asia has lagged behind in terms of fixed broadband Internet access. Notwithstanding the incompleteness of statistical data, which weakens understanding of the extent and nature of connectivity gaps, it is known that Pacific small island developing States are among the most disconnected countries. The data on broadband Internet access in figure II is primarily for Australia and New Zealand.

FIGURE II Broadband Internet access in ESCAP subregions



Source: Produced by ESCAP based on statistics from International Telecommunication Union (ITU), "World Telecommunication/ICT Indicators Database 2023, (27th edition/July 2023)", 2024. Available at <https://www.itu.int/en/ITU-D/Statistics/Pages/publications/wtid.aspx> (accessed on 8 January 2024).

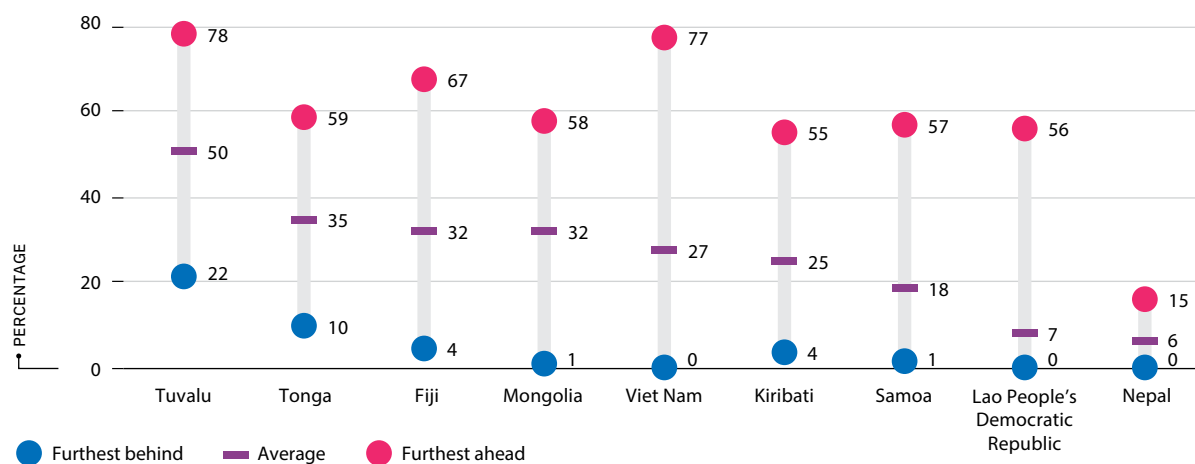
Within countries, significant accessibility gaps remain. These gaps exist especially between women and men, young people and older persons, persons with and without disabilities, people living in urban and rural areas, and people with different income levels and educational backgrounds. Many who are covered do not have the skills necessary to make use of digital innovations. Consequently, 37 per cent of the population that has access to broadband connectivity does not use the Internet (ITU, 2022).

The scaling up of digital innovations in an inclusive way is critically dependent on overcoming disparities in skills. According to available data, only 40 per cent of the region's population has basic digital skills (ESCAP, 2023). In this regard, programmes are needed at different levels: to offer foundational skills and digital literacy for all; to improve the digital skills of workers, including retraining for lifelong learning as the pace of digital innovation accelerates; and to hone the advanced skills held by specialists working in the information and communications technology sector.

In most countries, marginalized groups are particularly ill equipped, which prevents them from using digital technologies effectively (ESCAP, 2023). Women are less likely than men to be able to use technology for basic activities, such as creating simple formulas in spreadsheets, and women in manufacturing face a higher risk of being replaced by automation than their male counterparts

(ESCAP, 2022a). An estimated 86 million people, equal to 14 per cent of the workforce, in Australia, India, Indonesia, Japan, New Zealand, Republic of Korea and Singapore need to receive training to keep pace with technological developments and gain new digital skills to succeed in their careers (AlphaBeta, 2022). More broadly, the lack of skills is a barrier to digital innovation ecosystems, which benefit from population-wide interlinkages. Available data illustrate the chasm that exists between the information and communications technology skills of those furthest behind and those furthest ahead in several countries (see figure III).<sup>4</sup> Investment in the inclusive expansion of digital skills training is critical.

**FIGURE III Share of the population with basic information and communications technology skills, by furthest behind and furthest ahead groups (men and women aged 15–49 years)**



Source: ESCAP elaborations based on Demographic and Health Surveys (DHS) and Multiple Indicator Cluster Surveys (MICS) (2017–2021). ESCAP, “Leaving No One Behind”, online platform, n.d. Available at <https://lnob.unescap.org/> (accessed on 15 September 2023).

## Five enabling actions

**Predictable policy environments:** A careful combination of a predictable policy environment and regulatory reforms is necessary for the development and scaling up of digital innovations. Clear, coherent and increasingly harmonized regulations among countries need to be established to attract investment, which is in turn essential for achieving the economies of scale and network effects necessary for success. In the power sector, the harmonization of regulatory standards for smart grid interoperability under the United States of America-Association of Southeast Asian Nations (ASEAN) Smart Cities Partnership is supporting the creation of the ASEAN Power Grid, an initiative that is aimed at achieving the seamless interaction of different technologies, thereby reducing costs and carbon emissions (United States of America, Department of Commerce, International Trade Administration and EPRI, 2019). To support the expansion of digitalization initiatives by tax administrations, it is critical for countries to implement a consistent and comprehensive framework of data security and privacy to protect taxpayer information. To strengthen digital trade, Malaysia and the Philippines have aligned compliance costs associated with non-tariff measures with international standards (ESCAP, ECA and ECLAC, 2023). The role of regional blocs in enabling such harmonization is important given their digital integration initiatives. For example, in the ASEAN region there is the Bandar Seri Begawan road map for digital transformation and the Digital Economy Framework Agreement. In addition, partnership agreements are being signed between countries. All these efforts help to promote the harmonization of regulations.

4 Multiple Indicator Cluster Surveys are nationally representative household surveys carried out by national statistical offices in partnership with the United Nations Children’s Fund (UNICEF). Over 15 countries in Asia and the Pacific have collected data by carrying out Multiple Indicator Cluster Surveys for over two decades. Some of the data, which are comparable across countries and over time, are relevant for assessing progress made in respect of several Sustainable Development Goal indicators. Additional information on the surveys is available from <https://mics.unicef.org/surveys>.

**Regulatory reform:** Just as stability and clarity are key enablers for investment, more flexible and iterative regulatory environments are crucial for promoting innovation. Flexible regulatory environments are positively correlated with innovation and have been linked to patent growth. The power sector in the region exemplifies the degree to which regulatory reforms can have a positive impact. Digitalizing grids improves efficiency and operations, strengthening the stability, security and reliability of the transmission and distribution network. Government interventions, such as incentives for smart grid investments and innovative taxes can shift consumer and business behaviour towards cleaner energy. As many of the power utilities in the region operate as State-owned utility companies, frequent updates to the policies that govern them are needed to catch up with societal sustainable development needs. Innovative tax reforms can encourage consumers and businesses to favour digitally-driven sustainable development, as demonstrated by the feed-in tariff scheme implemented in Japan, which helped to increase the use of clean energy in that country (Japan, METI, Agency for Energy and Natural Resources and Energy, 2012). Singapore has accelerated the uptake of artificial intelligence and the Internet of things in smart grids by incentivizing private-sector engagement in research and development, using the Pasir Panjang Terminal at the Port of Singapore as a living lab (Energy Innovation, 2022).

Regulatory sandboxes can help to shape regulations that are supportive of digital innovation. Bangladesh has used this approach to develop regulations more favourable to cottage, micro-, small and medium-sized enterprises and to enhance their access to finance. To improve their operational efficiency, it has created a smart business profile platform, through which selected participants, adhering to robust data protection policies, are invited to test their software's effectiveness, streamline their processes and improve data accessibility. The pilot platform has benefited all those involved and is contributing to reducing lending costs for smallholder businesses.

**Skills and capacity-building initiatives:** Capacity-building is vital for leveraging the opportunities emerging from digital innovation. Governments, academic institutions and enterprises need to collaborate to develop comprehensive and agile curricula that build the skills in demand. Countries that have undergone a successful digital transition have adopted policies and strategies that help to facilitate the smooth integration of digital tools into the public sphere in an inclusive way. Connectivity-focused capacity-building programmes for regulators are needed to support the development of seamless regional infrastructures and digital ecosystems. In Indonesia, Kartu Prakerja is an online platform-based program that is boosting job skills development and entrepreneurial capabilities. Developed by the Government of Indonesia in partnership with the Asian and Pacific Training Centre for Information and Communication Technology for Development, Kartu Prakerja caters to diverse groups, including jobseekers, micro-sized and small business owners, women, persons with disabilities and individuals from disadvantaged communities, through training sessions held in person, online and using hybrid modalities (ILO, 2023). Beyond having a direct impact on Indonesian entrepreneurs, the collaboration between the Centre and the Government on Kartu Prakerja can yield significant spin-off benefits for various sectors. As digital skills become easier to acquire by more people, the overall workforce's capacity to adapt to and thrive in a rapidly evolving digital landscape is being strengthened. This can increase productivity and competitiveness, improve services through digitalization and create a more versatile and adaptable labour force capable of driving innovation and economic growth.

**Active stakeholder engagement:** Effective stakeholder engagement underpins the successful initiation and functionality of digital innovation platforms (see figure I). Maintaining a continuous dialogue among Governments, start-ups, information technology developers and civil society representatives is a prerequisite for success. Involving users in the development stages and establishing iterative feedback mechanisms ensures user-centric platforms that are responsive to evolving needs. Using cognitive digital technologies for feedback analysis can further enhance the user experience. Campaigns to demystify platforms, highlighting their efficiency and convenience, can also be helpful. The secretariat's project entitled "Catalysing women's entrepreneurship" demonstrates the transformative impact of a holistic and multistakeholder approach to supporting women-owned micro-, small and medium-sized enterprises in Bangladesh, Cambodia, Fiji, Nepal, Samoa and Viet Nam in the digital age.<sup>5</sup>

<sup>5</sup> See, United Nations Economic and Social Commission for Asia and the Pacific (ESCAP), "Catalysing Women's Entrepreneurship", n.d. Available at [www.unescap.org/projects/cwe](http://www.unescap.org/projects/cwe).

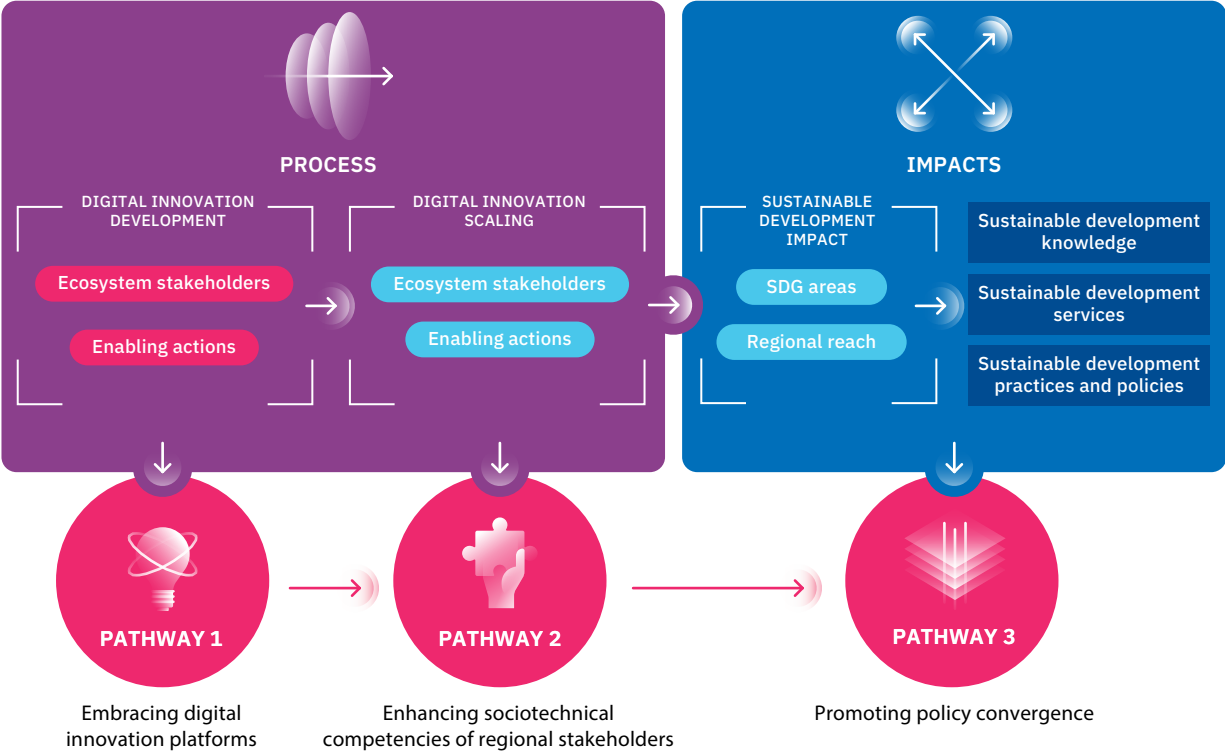


**Digital inclusion:** Upholding the rights of people in vulnerable situations in digital contexts requires a comprehensive understanding of the barriers encountered by diverse groups. For many marginalized groups, affordability is often a more significant barrier than the lack of Internet availability. Universal service funds, generally collected through levies on telecommunications operators, if well targeted, can support marginalized groups in gaining access to digital technologies (ESCAP, 2017). For example, the Government of Malaysia has partnered with mobile network operators to provide a partial subsidy through a universal service fund for entry-level smartphone purchases by young people in rural areas (ESCAP, 2017). That said, digital products and services need to be of good quality and easy to use, not only available. “Jan Dhan-Aadhaar-Mobile” is an initiative that has given 500 million people in India access to direct benefit transfers by leveraging public digital infrastructure connectivity, digital identification tools and financial technologies to promote financial inclusion. China has formulated guiding standards and encouraged information technology companies to develop accessible products for persons with disabilities. Accordingly, some companies have set up independent full-time teams to support the accessibility of their applications for e-commerce and digital payments (ITU, 2021). Enhancing digital skills, particularly among marginalized groups, and promoting participation in science, technology, engineering and mathematics education and careers are vital, as is increasing marginalized groups’ ability to protect themselves from the risks associated with using digital platforms.

**Regional cooperation for digital innovation and sustainable development**

**Regional cooperation can strengthen the link between digital innovation and sustainable development and promote the replication and scaling up of digital innovations across Asia and the Pacific.** Drawing on the framework presented above and building on existing cooperation, the secretariat has identified three pathways to accelerate progress towards the Sustainable Development Goals (see figure IV).

**FIGURE IV Three cooperative pathways of digital innovation**



Source: ESCAP.

## Pathway 1: Embracing digital innovation platforms

**Governments should continue to facilitate the development of digital innovation platforms that allow users to easily gain access to a combination of tools and resources that can, in turn, spur the development of new applications.** Digital innovation platforms can help Governments to manage interactions within and across national borders and leverage this expanded network to improve services while reducing risk and improving scalability and inclusiveness. Digital innovation platforms that combine flexibility, scalability, inclusivity and a decentralized governance approach have an impact on sustainable development that is demonstrably superior to top-down innovation efforts. Yet, even those digital innovations most relevant for sustainable development can only be as good as the data upon which they draw. The platform model therefore needs to be underpinned by principles of data sovereignty and shared ownership and by safeguards for protecting the data privacy of individuals.

Through its analytical work and collaborative platforms, the secretariat can help ESCAP members and associate members to exchange solutions and strategies. It can also help them to identify scalable solutions and promote their adoption and adaptation to accelerate the implementation of the Sustainable Development Goals. In this regard, the secretariat's capacity-building programmes can further strengthen the institutional and operational capabilities necessary for implementing clear governance principles, measuring the impact of digital innovations on the Goals, supporting the creation of enabling environments and replicating success at scale.

The secretariat is using the platform model to lower the entry barriers to adopting geospatial information-based digital innovations through a South-South cooperation initiative. Under the Asia-Pacific Plan of Action on Space Applications for Sustainable Development (2018–2030), ESCAP and the Aerospace Information Research Institute of the Chinese Academy of Sciences are working together to lower the cost of using cloud computing, machine learning and big Earth data for automated crop monitoring and more climate resilient agriculture in the countries of the lower Mekong region. The objective is to significantly increase access to new technologies, thus augmenting capacities to effectively process satellite and ground data. More needs to be done to understand better how such data can be used to strengthen efforts to measure the impacts of such innovations on the Sustainable Development Goals.

## Pathway 2: Enhancing sociotechnical competencies of regional stakeholders

**Digital innovations are inherently sociotechnical, which emphasizes the need for stakeholders to cultivate competencies that extend beyond technical skills.** This ensures that digital innovation complements effective governance rather than replacing it. Key measures include investing in training programmes for government officials and establishing regional knowledge hubs for businesses and non-governmental organizations engaged in digital innovation for sustainability.

Educational and training programmes such as the ones offered by the Asian and Pacific Training Centre for Information and Communication Technology for Development prioritize competencies that enable the seamless integration of digital innovations across all policy domains. Furthermore, as digitalization became the default mode during the COVID-19 pandemic, it assumed strategic significance in government policymaking agencies. There is a need, therefore, to support the development of strategic digital skills tailored to regional sustainable development needs. This includes fostering regional forums and digital diplomacy to facilitate negotiations at the regional level.

### Pathway 3: Promoting policy convergence

**Increasingly harmonized policy frameworks across the Asia-Pacific region could create supportive environments that nurture the growth of digital innovations and their alignment with the 2030 Agenda for Sustainable Development.** The development of common regional metrics could support this endeavour by building a shared understanding of how digital innovations are supporting accelerated progress towards the Sustainable Development Goals. The convergence of definitions and policies related to trade, financing and investment in digital technologies is particularly important. Ensuring that investments are directed towards innovations that can be scaled up, have a significant impact on sustainable development and benefit marginalized groups requires collaboration among Governments and financial institutions. By aligning their policies and financial strategies, Governments in Asia and the Pacific can collectively enhance the scalability, accessibility and impact of digitally-driven sustainable development.

ESCAP supports several cross-cutting initiatives to promote the three pathways:

- A The Asia-Pacific Information Superhighway initiative is enhancing the availability and affordability of broadband Internet access across the region. The Action Plan for Implementing the Asia-Pacific Information Superhighway Initiative, 2022–2026, promotes research and partnerships among multiple stakeholders, especially civil society and government entities, to address the digital divide across countries and between rural and urban communities within countries, build capacity and facilitate information-sharing. It also promotes regional policy dialogues with the aim of building a seamless information and communication space accessible to all. This initiative exemplifies how ESCAP can support the platform model of digital innovation discussed above;
- B ESCAP is leading initiatives supporting the harmonization and interoperability of transport digitalization. This includes developing a regional road map and policy and regulatory frameworks for smart transport systems, as well as guidelines on smart mobility and transport-related Big Data. It also involves digitalizing the Asian Highway Network, the Trans-Asian Railway Network, dry ports, multimodal transport corridors and seaports, among others. The regional road map outlines major strategies and corresponding policy plans that countries can refer to when devising or updating their smart transport-related policies, plans and strategies. Establishing a dedicated cooperation mechanism for smart transport systems in Asia and the Pacific is one of the proposed policy plans. The Regional Action Programme for Sustainable Transport Development in Asia and the Pacific (2022–2026) aims to deploy smart transport systems, to increase awareness of innovative technologies and the use of big data, to interconnect maritime and port systems and to shift to smart regional transport networks;
- c The Framework Agreement on Facilitation of Cross-border Paperless Trade in Asia and the Pacific is accessible to countries at all levels of development wishing to develop or strengthen their capacity to engage in cross-border paperless trade and accelerate the implementation of digital trade facilitation measures. It is expected to reduce existing transaction costs by up to 30 per cent once it is fully implemented.

Building on all these initiatives along the three pathways identified above can accelerate the contribution of digital innovations to sustainable development. In a region that has emerged as an innovation hub, supporting this process requires collaborative governance and effective policy frameworks. While leveraging artificial intelligence, digital finance, government technology and the Internet of things comes with multiple challenges, it also offers an unparalleled opportunity for making progress. If it is to achieve the 2030 Agenda for Sustainable Development, it is an opportunity that the Asia-Pacific region must seize.

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CHAPTER 1

# Digital innovation landscape in Asia and the Pacific

**The Asia-Pacific region is rapidly becoming a hub for digitally-driven innovation, supported by increasing numbers of cutting-edge digital technologies.** This transformation has the potential to turbocharge sustainable development, and could support the huge collective effort required to accelerate progress towards all the Sustainable Development Goals (SDGs) of the 2030 Agenda for Sustainable Development (Mäkitie and others, 2023). Innovations in cognitive digital technologies, digital finance, government technology (GovTech), and the Internet of things (IoT), are reshaping value creation and service delivery in both the public and private sectors. To tap this potential, this report examines how digitalization has spurred groundbreaking innovations, and explores how further ingenuity might be encouraged and deployed at scale to support sustainable development. Its focus is not digital technologies per se, but rather how they can be enabled and leveraged to improve people's lives and the environment.

This report considers digitally-driven innovation to be the development of new products, services or processes that bring added value to economies and societies, in the Asia-Pacific region, using new digital technologies. Such innovation is already facilitating broader access to information, education, employment, business opportunities, social protection, health, and financial services. Yet, without careful planning, it could also deepen existing inequalities and inhibit the engagement of marginalized communities in socioeconomic, political, and cultural spheres. Digital inclusion, aimed at ensuring "equitable, meaningful, and safe access to use, lead, and design of digital technologies, services, and associated opportunities for everyone, everywhere" is vital to fulfil the commitment to leave no one behind in the digital era. The COVID-19 pandemic led to the adoption of digital technology to support public health measures, and accelerated the process of digital access to public resources. Yet, it also created barriers for those without access or the necessary skills.



*The urgency of harnessing the power of technology and innovation to improve the lives and well-being of marginalized groups is underscored by international and regional normative frameworks.*

The widening digital divide makes leveraging digital innovation for inclusive and sustainable development all the more essential. The urgency of harnessing the power of technology and innovation to improve the lives and well-being of marginalized groups is underscored by international and regional normative frameworks.<sup>1</sup> People experience exclusion from the digital space due to various factors including gender, age, disability, geographic location, ethnicity, migration status, education and socioeconomic status (United Nations Office of the Secretary-General's Envoy on Technology, n.d.; Pérez-Escobar and Canet, 2023). Upholding the rights of people in vulnerable situations, in accessing services, processes or products, through digital technologies requires a comprehensive understanding of the barriers they encounter. Equally critical is recognizing the overlap of identities, which results in multiple and intersectional discrimination and inequalities. A whole-of-government and whole-of-society approach is required to overcome the structural obstacles to connectivity and ensure that marginalized population groups are engaged and contribute to digital transformation.

This first chapter introduces the main technological developments which are already contributing to regional sustainable development, and highlights the regional networks they are transforming. Chapter 2 proposes a framework that can support all relevant stakeholders in the Asia-Pacific region, including governments, businesses, and citizens, to leverage digital innovation for sustainable development. The framework establishes the positive association between digital innovation and

<sup>1</sup> These include, among others, the 2030 Agenda for Sustainable Development; Asian and Pacific Ministerial Declaration on Population and Development; Beijing Declaration and Platform for Action; Asia-Pacific Declaration on Advancing Gender Equality and Women's Empowerment: Beijing+25 Review; Madrid International Plan of Action on Ageing; Accelerating Implementation of the Madrid International Plan of Action on Ageing, 2002, to Build a Sustainable Society for All Ages in Asia and the Pacific; Convention on the Rights of Persons with Disabilities; Jakarta Declaration on the Asian and Pacific Decade of Persons with Disabilities, 2023–2032; and Global Compact for Migration.



sustainable development. Chapter 3 provides examples of emerging best practices at different levels, illustrating how digital innovation can promote inclusive and sustainable development. Chapter 4 discusses how the Asia-Pacific region can create an enabling environment to support digitally-driven sustainable development at scale. Chapter 5 provides recommendations on how regional cooperation can help better leverage digital innovation for sustainable development across Asia and the Pacific.

It should be noted that while the report identifies noteworthy developments, not all potentially relevant technologies in the region can be covered. The proposed framework, set out in Chapter 2, is a blueprint to understanding the link between digital innovation and sustainable development. As such, the framework's chosen level of abstraction is a necessary trade-off between the generalizability of its application, and its analytical capability. The choice of the empirical case studies analysed throughout the report is not meant to be representative of all cases of digital innovation in the Asia-Pacific region, but rather to illustrate the use of the framework. While the report touches on the need for regulatory reform and governance of new technologies, it is not comprehensive or prescriptive. Chapter 4 considers the protection of marginalized groups from online violence and how their rights can be upheld. Yet, many of the risks inherent to universal digital connectivity, and the governance of artificial intelligence (AI) and related ethical questions are not considered in this report, their importance notwithstanding.

## Asia and the Pacific in a unique position

Accelerating progress towards the Sustainable Development Goals (SDGs) is a priority in Asia and the Pacific. For many of the 17 SDGs, progress is alarmingly slow in the region, with not a single Goal on track to be achieved by 2030. However, intelligently deployed and properly governed, digital innovation could support the extraordinary collective effort needed for a meaningful course correction, given that the region is uniquely positioned to do so. Its sociodemographic characteristics, including a rapidly growing urban middle-class, make the region ripe for the diffusion and adoption of digital technologies. Many smart phone and digital technologies have already been adopted by the public and private sectors. The region's large population and its growing digital footprint lie at the source of streams of valuable big data that can stimulate the creation of new digital products and services. They provide the economies of scale necessary for investments in large digital infrastructures. A growing user base ensures strong network effects, meaning the value of the services offered increases in proportion to the total number of their users (Mäkitie and others, 2023).

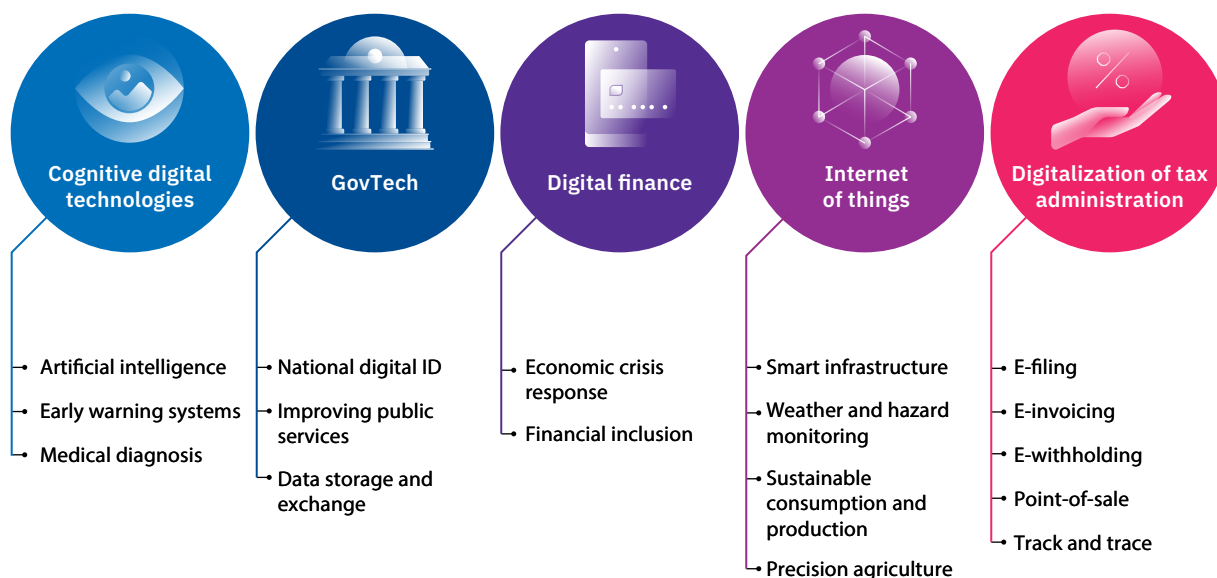
Furthermore, the emergence of smart city technologies and urban digital transformations are key factors in the region's unique position. These are reshaping how urban areas are developing, and how public and private services are being offered, particularly by expanding digital access to communities through online platforms. Integrated into urban planning, smart city applications support businesses, mobility, utilities, community and social engagement, and urban safety, while improving the sustainability of the built environment. They offer solutions to many of the challenges associated with urban growth by improving access to city information, facilitating online permit applications, and providing convenient payment systems. Smart city technologies allow the crowdsourcing of information on negative urban hotspots so that challenges can be swiftly resolved. Digital services reduce resource consumption and improve the quality of life for residents, through responsive urban planning, user-centric transport solutions, sustainable energy use, and efficient waste reduction and management.

By providing an environment where investment is more readily available, smart cities can foster advancements in technology and innovation and create a thriving local ecosystem for startups and tech companies. As cities in the region have a pivotal role to play in the reduction of greenhouse gas emissions, efficient urban planning and the promotion of sustainable practices, such as the integration of renewable energy sources, smart grid systems, and climate-resilient infrastructure, can contribute to climate action. Crucially, smart cities offer a path to urban development that is both environmentally sustainable and economically prosperous.

Network effects are central to the way digital platforms are able to provide high value-added services. For example, they underpin the successes of DiDi, the Chinese transportation digital platform, and Gojek, the Indonesian digital multi-service platform. Similar network effects could potentially be applied to digital services promoting sustainable development, backed by a growing middle-class and rising school enrolment rates, in the region, which could underpin increased access to digital infrastructure. While the Asia-Pacific region still exhibits the highest level of digital divide globally (ESCAP, 2022a), the ‘demographic dividend’ currently experienced by countries with young populations and declining fertility could provide a boost to the development of a digital economy. This has the potential to grow the number of employable people in the workforce relative to the number of dependants.

In this context, the Asia-Pacific region has been impacted by digital innovations supported by cognitive digital technology, digital finance, GovTech, and the Internet of things. In light of the sociodemographic characteristics mentioned above, such digital innovations stand out for the potential impact they may bring. They are particularly relevant in the region because they can provide effective pathways for linking digital innovation with the Sustainable Development Goals.

**FIGURE 1.1 Main digital innovations supporting Sustainable Development Goals in the Asia-Pacific region**



Source: ESCAP.

### Cognitive digital technologies: Boosting decision-making capacity

Cognitive digital technologies, which apply advanced analytics, machine learning and artificial intelligence (AI) approaches to develop insight, have become a driver of transformational change (ESCAP, 2022a). They are able to identify patterns and make forecasts which support decision-making, enabling institutions to better serve the needs of populations. The economic growth of the Asia-Pacific region, in the past few decades, has provided the financial resources and infrastructure necessary for AI research and development. Countries, such as China, Japan, the Republic of Korea, and Singapore, have invested heavily, fostering a fertile ground for innovation (ESCAP, 2022a). Yet for all its potential, current AI and Algorithmic Decision-Making (ADM) processes can often embed systemic and intersectional bias and discrimination against marginalized groups, such as women, persons with disabilities and older persons (Misuraca, 2021). Consequently, the approach to the development, use and adoption of AI should be human centric, grounded in inclusion and diversity (UNESCO, 2022).

Areas of application of cognitive digital technologies for sustainable development are rapidly increasing. The region has made significant strides towards improving health-care outcomes (Goal 3). AI-powered diagnostic tools have been developed to detect diseases like cancer and COVID-19. In India, cognitive digital technologies are being used to bridge the gap in access to health-care services, especially in rural areas, through telemedicine and remote monitoring of aspects of patients' health (Nair and Sethumadhavan, 2022). AI-powered early warning systems are enhancing the ability to pinpoint potential hazards, deliver alerts promptly contributing to climate action (Goal 13) in the world's most disaster-prone region. Machine learning algorithms can assess information derived from diverse sources, such as satellite images, meteorological data, and social media, enhancing our understanding of short- and long-term risks. An adaptive machine learning algorithm has been employed in a city in the Beijing-Tianjin-Hebei region in China to forecast air quality and provide automatic forewarning of heavy pollution, which is critical to achieving the Sustainable Development Goals related to good health and well-being (Goal 3), and sustainable cities and communities (Goal 11) (Zhang and others, 2022; Zhang and Yu, 2022).

The rise of new applications has demonstrated how generative AI (GenAI) can create content based on natural language prompts, which carries great potential for improving essential public services. Although there are legitimate concerns about the carbon footprint of a technology with intense computing requirements (Kumar and Davenport, 2023), GenAI offers exciting new opportunities. It is contributing to the bridging of regional educational gaps (Goal 4) by delivering scalable offerings of personalized interactive learning, improving the effectiveness of educators by supporting the creation of educational material and the design of course syllabuses (Pettinato Oltz, 2023). It supports students by generating prompts for formative assessments and ongoing feedback (Baidoo-Anu and Ansah, 2023). The scalability of these benefits could help overcome societal divides and reach underserved parts of the population. In the health-care sector, generative AI is beginning to be applied for the discovery and development of new drugs (Goal 3). A biotechnology company based in Hong Kong, China is currently undertaking clinical trials for cancer therapies developed using expansive generative and predictive engines drawing on biological, chemical, and textual data (Lorenz, Perset and Berryhill, 2023).

### **Digital finance: Lowering entry barriers to financial services**

Digital finance is lowering entry barriers to financial services and is supporting the delivery of social protection in Asia and the Pacific. Digital finance refers to all electronic offerings and solutions within the financial industry. These include credit and chip cards, electronic trading platforms, online banking, digital payment and trading services, and mobile applications and services (Gomber, Koch and Siering, 2017). The widespread adoption of digital payments is well underway in the Asia-Pacific region, with an annual transaction value of digital payments projected to reach US\$6.7 trillion by 2026 (ESCAP, 2022a). Digital finance has enabled the region to expand social assistance payments rapidly and securely, and improve access to essential services, such as banking and insurance, which contributes to lower inequalities (Goal 10).

Countries in the Asia-Pacific region that invested in digital payments to expand financial inclusion were able to more swiftly distribute social assistance payments to citizens in response to the COVID-19 pandemic, and stop people from falling into poverty (Goal 1) (World Bank, 2022). The Government of Pakistan was able to start payments to beneficiaries of the Ehsaas Emergency Cash programme 19 days after the nationwide lockdown, drawing on its existing payment system based on a biometric verification system via two commercial banks (Beazley, Bischler and Doyle, 2021). Promoting the adoption of digital payments by governmental agencies can contribute to reducing societal divides. It frees up scarce human resources and redirects it to support those who would otherwise face exclusion due to their lack of digital connectivity. The promotion of digital payments should nonetheless include a mix of alternative offline payment methods to ensure inclusivity for groups impacted by various digital divides, including those based on gender, age, disability, and geographic location.

## GovTech: Collaborating digitally for sustainable public services

GovTech is improving public services across Asia and the Pacific. GovTech refers to the use of technology by government entities and private sector collaborations to transform government operations and make public services more accessible and citizen centric. GovTech applications span the gamut of public services, with a strong potential to foster Sustainable Development Goals (Medaglia, Misuraca and Aquaro, 2021). They have the potential to significantly enhance the efficiency of government expenditures, and improve the quality, design, and delivery of services including health care, education and public welfare, safety and security, and transportation as well as improve waste management, urban planning, energy efficiency, and resource management. Involving private sector stakeholders and the users of these essential services in this transformation plays a significant role in making the solutions financially and organizationally sustainable (ESCAP, 2022b).

Examples of promising initiatives include Singapore's LifeSG application and Cambodia's Data eXchange platform. LifeSG allows citizens to access a comprehensive range of services designed to address their requirements according to relevant life events. It has transformed the way Singaporean citizens access government services, consolidating more than 70 services into a single digital portal (LifeSG, n.d.).<sup>2</sup> It has reduced the time for childbirth registration, shrinking it to just 15 minutes, with the added convenience of instant digital birth certificate downloads and the possibility to apply for child benefits. Seven out of every ten births in Singapore are now registered using this app.

The Cambodia Data eXchange interoperability platform provides a decentralized data exchange layer between public agencies and private businesses to improve service delivery. The platform integrates government ministries and places a strong emphasis on interoperability between services that connect citizens, businesses, and government entities. It adheres to a Once-Only principle, which ensures data is collected from citizens, businesses and governments in strict compliance with data protection laws and regulations. Since its establishment in 2020, the platform has recorded more than 20 million total transactions and has facilitated the registration of over 19,000 companies through its online platform, with a total of \$5.6 billion in capital in 2022 (Mengheng, 2022).

## Digitalization of tax administrations:<sup>3</sup> Building trust and increasing revenues

The digitalization of tax administrations through tools, such as e-filing, e-invoicing, or electronic fiscal devices, has a positive impact on tax revenues in developing countries because a simplified tax process incentivizes voluntary compliance. This results in a larger taxpayer base, reduces tax avoidance, and enables a more effective use of scarce tax enforcement resources (Better Than Cash Alliance, 2020). A recent study by the International Monetary Fund found that the implementation of e-filing could lead to an increase in tax revenue of 3 percentage points of GDP, while the implementation of e-invoicing and electronic fiscal devices could increase tax revenues by, respectively, 0.7 per cent and 0.5 per cent of GDP (Amaglobeli and others, 2023).

The digitalization of tax administration contributes directly to Targets 17.1 (Strengthen domestic resource mobilization to improve domestic capacity for tax and other revenue collection), and 16.6 (Develop effective, accountable, and transparent institutions at all levels) of the Sustainable Development Goals. The additional tax revenues that can be mobilized through the implementation of digital tax solutions can be instrumental in funding public programmes and investments to achieve important targets such as 1.a (Ensure significant mobilization of resources from a variety of sources to provide adequate and predictable means for developing countries, to implement programmes and policies to end poverty in all its dimensions), or 15.a (Mobilize and significantly increase financial resources from all sources to conserve and sustainably use biodiversity and ecosystems).

<sup>2</sup> This case study was contributed by the Tony Blair Institute of Global Change.

<sup>3</sup> Contents on digitalization of tax administration in this study are taken from Alberto Isgut and Alfonso Pellegrino, "Digitalization of tax administrations in Asia and the Pacific: Progress, challenges, and opportunities", United Nations Economic and Social Commission for Asia and the Pacific (ESCAP), MPFD Working Paper Series, No. WP/24/01 (Bangkok, forthcoming).

## The Internet of things: Enabling sustainable production and consumption

The Internet of things (IoT) is enabling the more efficient use of resources and has the potential to greatly support energy transition and more sustainable production and consumption. IoT refers to a global infrastructure for the information society, enabling advanced services by interconnecting physical and virtual objects based on existing and evolving interoperable information and communication technologies (ITU, 2012). That enables IoT technology to be embedded into infrastructures with smart capabilities. With the use of sensors in physical objects, IoT systems collect data and monitor the movement of goods and resources, enabling more efficient distribution, consumption and disposal of scarce resources.

IoT-enabled smart grids allow the delivery of essential resources, such as water and energy, in an economical and efficient manner. For example, sensors coupled with advanced data analytics in IoT systems are enabling predictive maintenance and prevention of power outages, improving power system security. Developments in automated switching, digitalized control, monitoring and communication capabilities are enhancing grid flexibility, enabling the secure and cost-effective integration of higher shares of variable renewable energy (Goal 7). Consumers have benefitted from the digitalization of the power sector, with smart meters providing real-time data on electricity consumption, and behind-the-meter generation and storage transforming households and businesses into “prosumers” benefiting and contributing to the grid.

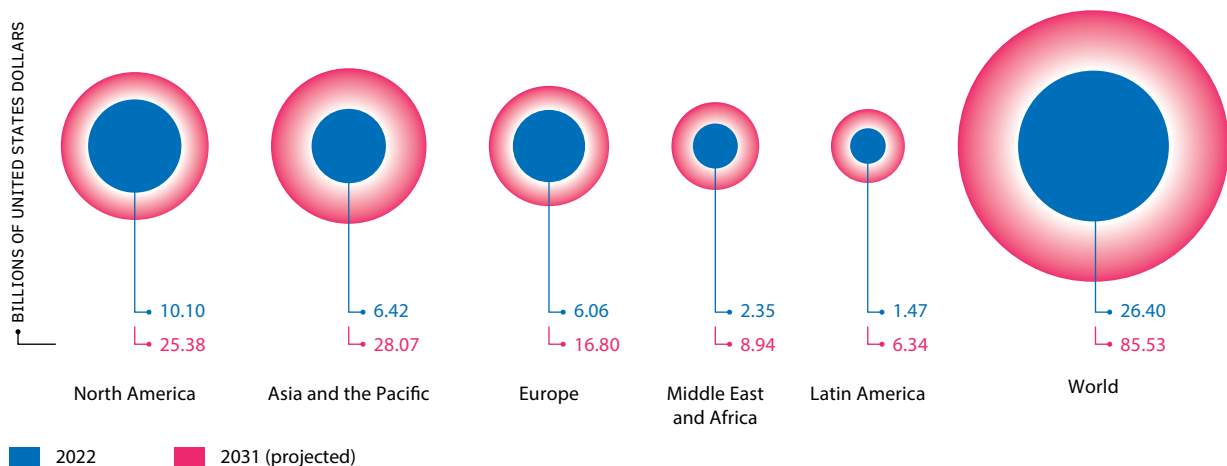
## Digitally-driven sectors: Pillars of the regional economy

Several economic sectors are predisposed to the diffusion and adoption of digital technologies and if regional connectivity can continue to be strengthened and digital innovations brought to scale, these hold great promise for sustainable development.

Digital innovation is beginning to drive more sustainable production and consumption. Many cutting-edge power sector technologies originate in the region. Their application could support the efforts of countries to meet the rapidly increasing demand for electricity while pursuing decarbonization goals, especially if digitalization is used to accelerate cross-border power system integration. IoT smart grids are already facilitating access to electrical power to households that would otherwise not be economically viable to reach (IEA, 2023). Equally, many digital innovations lie at the heart of government initiatives which promote the reuse, repair and recycling of manufactured products in industrial supply chains, following the model of the circular economy (Medaglia, Rukanova and Tan, 2022; Korhonen, Pajunen and Puustjärvi, 2003). Digital platforms are supporting the transition of small and medium manufacturing enterprises to reduce waste and environmental impacts of increased productivity and consumption.

All parts of the regional transport network are undergoing profound transformation, underpinned by the digitization of the sector, and new technologies and innovations are driving low-carbon mobility and smart transport systems. Improved vehicle technology and data analytics for logistics and monitoring are improving the use of highways in the region. Digitalization and application of new technologies is enhancing operational efficiency and lowering energy intensity of rail networks. Digitization is supporting the rapid development of dry ports and multimodal hubs, transforming the way logistics are conducted and improving efficiency by using the IoT. Sensors and smart containers are enabling real-time freight monitoring, and automated stacking cranes and robotic automation are improving productivity and reducing human error. Similar innovations could transform seaborne trade in a region that is home to over half of the world’s busiest ports, and where a major development challenge is upgrading the sustainability of port functions.

FIGURE 1.2 Intelligent transport systems market sizes, by region, 2022 versus 2031



Source: ESCAP calculation and illustration based on data from Transparency Market Research, "Intelligent Transport Systems Market", 2023.

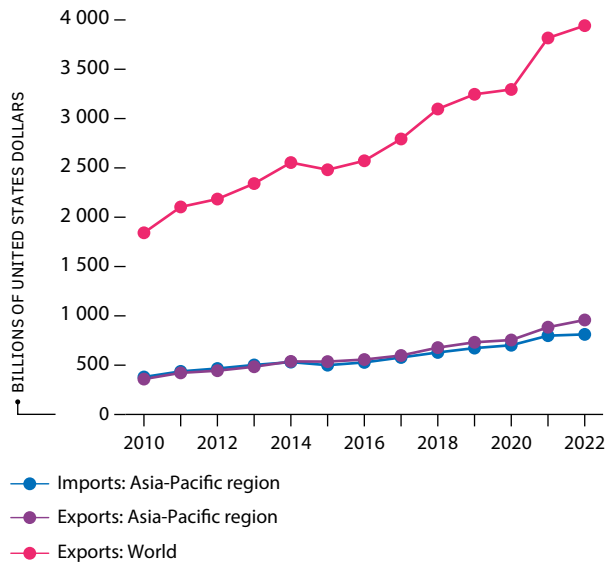
Digital trade has grown significantly in recent years in Asia and the Pacific. This has been particularly the case for digitally deliverable services which can be procured and used online in sectors, such as IT, professional services, finance, retail, education and legal services, related to intellectual property. These accounted for trade worth approximately \$958 billion by 2022, which is 52 per cent of the region's total service exports. Indeed, the region holds a quarter of the global market in the digital services sector. Cross-border e-commerce transactions represent a small but growing part of total e-commerce activities, particularly in East and North-East Asia (ENEA) and South-East Asia (SEA) which are emerging as global hotspots for business-to-business commerce.

The Asia-Pacific region has seen a significant increase in digital foreign direct investment (FDI), particularly in data processing, communications, and semiconductors. China and India emerged as primary destinations, with substantial intra-regional contributions as well. Post-COVID-19, countries like Viet Nam and Malaysia have seen notable increases in FDI related to electronic components and communications. This suggests a geographical redistribution and diversification of digital FDI, moving away from traditional host countries and indicating a shift in the digital economic landscape of the region. The increasing importance of digital trade in Asia and the Pacific reveals how sectors driven by digital transformation are at the heart of regional economic integration and growth. Finding pathways to ensure that this digitally-driven economic growth is sustainable and inclusive is crucial.

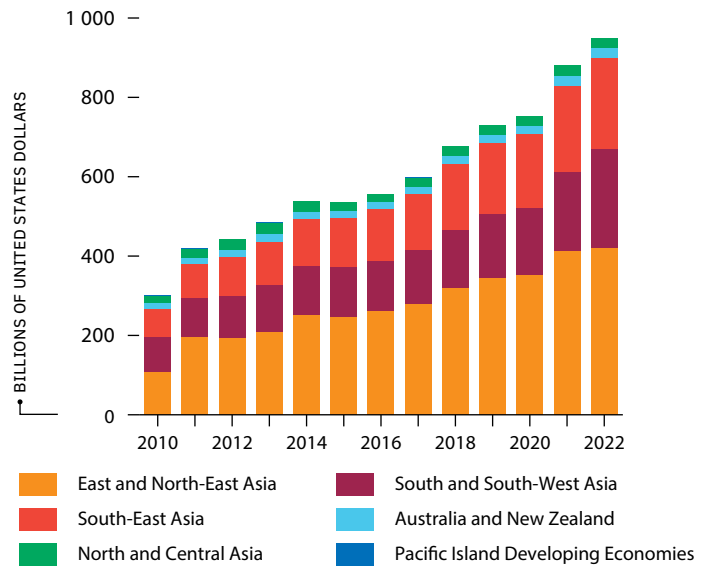
Although there remains much to be done across the region, legal frameworks are evolving to respond to the evolving digital environment. This is necessary as these legal frameworks have a major role to play in helping countries build confidence among stakeholders, ensuring that online transactions are secure, delivered goods and services conform to expectations, and data remains safeguarded against misuse. Since January 2020, Asia-Pacific economies have introduced a significant number of measures affecting digital trade and online activities. China is leading the regional trend (figure 1.5). New regulations in digital trade areas largely focus on data governance, operational conditions, content moderation, competition, business registration, and licensing.

**FIGURE 1.3 Trade in digitally deliverable services in the Asia-Pacific region and subregions**

**A) TRADE IN THE ASIA-PACIFIC REGION AND THE WORLD, 2010–2022**



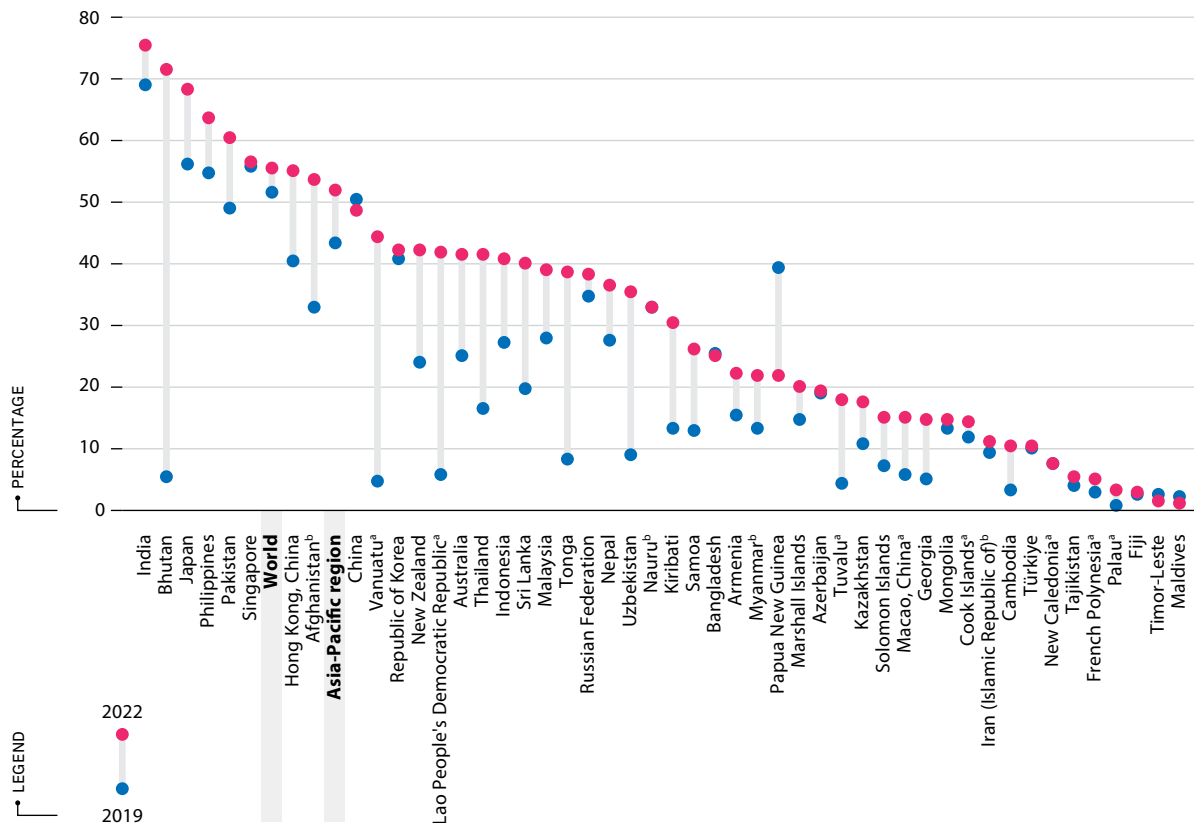
**B) EXPORTS BY SUBREGION, 2010–2022**



Source: Based on United Nations Conference on Trade and Development (UNCTAD) STAT, “Digital Economy”, Data Centre, 2023. Available at <https://unctadstat.unctad.org/wds/>.

Note: Includes inter-regional trade.

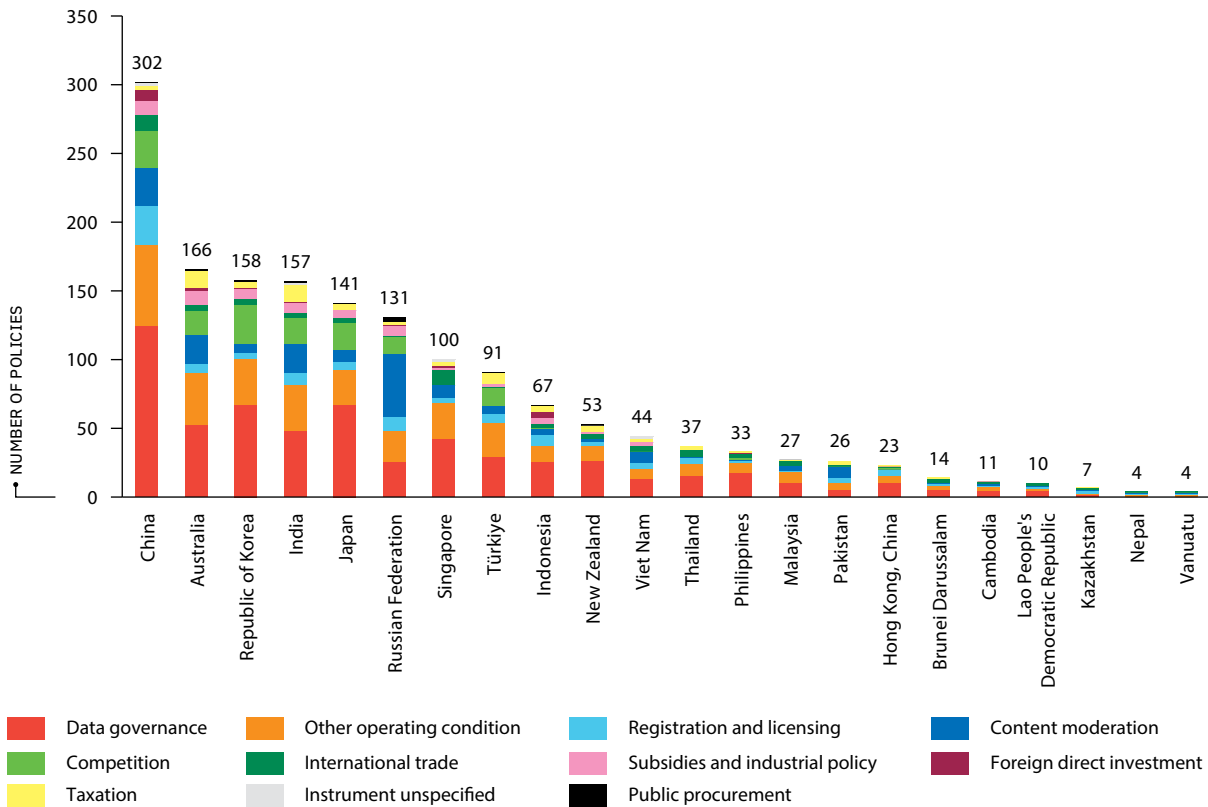
**FIGURE 1.4 Percentage of digitally deliverable services in total services exports for Asia-Pacific economies, 2019 and 2022**



Source: Based on United Nations Conference on Trade and Development (UNCTAD) STAT, “Digital Economy”. Data Centre, 2023. Available at <https://unctadstat.unctad.org/wds/>. Accessed on September 2023.

Note: a=2021 instead of 2022; b=2020 instead of 2022.

**FIGURE 1.5** Number of digital policies adopted since January 2020 in the Asia-Pacific region



Source: Based on data from Digital Policy Alert (DPA). Available at <https://digitalpolicyalert.org/> (accessed on 26 October 2023).

Note: The DPA database specializes in tracking digital policy advancements in G20 countries. While it does offer important information on certain non-G20 nations, the policy coverage for these countries is generally less exhaustive.

Digital innovations have already had a positive impact on efforts to achieve the Sustainable Development Goals in many areas in Asia and the Pacific, yet many challenges remain. While the region leads the world in the use of renewable energy technology, it still accounts for more than half of global greenhouse gas emissions. Digital innovations are facilitating breakthroughs in reducing greenhouse gas emissions by providing better monitoring mechanisms as well as in resilience and food security, but Asia and the Pacific remains exposed to the increasing frequency and intensity of climate-related disasters. These carry severe implications, including land degradation and periodic food shortages, as well as loss of lives and livelihoods. Digital innovations cannot alone tackle all such challenges, but intelligently deployed their successes demonstrate the positive contribution they could make to the region’s effort to achieve the Sustainable Development Goals. It is worth considering, therefore, how such digital innovation successes can be replicated and scaled up.



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CHAPTER 2

# Harnessing digital innovation: A framework

## Implementing the 2030 Agenda for Sustainable Development

**Accelerating progress towards the Sustainable Development Goals (SDGs) is a priority in Asia and the Pacific.** For many of the 17 SDGs in the region, progress is alarmingly slow, with not a single Goal on track to be achieved by 2030. With each passing year since the adoption of the 2030 Agenda in 2015, the expected time required to achieve the SDGs has increased. On its current trajectory, the region will achieve less than half of the necessary progress by 2030 (ESCAP, 2024). While strides have been made towards eradicating poverty and building sustainable industry, innovation and infrastructure, population groups in vulnerable situations continue to remain particularly exposed, the gap between countries in special situations and the rest of the region shows no signs of narrowing, and strengthening climate action remains an immediate priority. Intelligently deployed and properly governed, digital innovation could support the extraordinary collective effort needed for a meaningful course correction (Mäkitie and others, 2023).

This chapter presents a framework to structure our understanding of the links between digital innovation and sustainable development. As digital technologies extend their reach and grow in complexity, and while achieving the SDGs in the Asia-Pacific region remains challenging, the proposed framework serves as a tool to support four key activities: identifying relevant stakeholders and enabling actions in each phase of the digital innovation process; identifying areas of impact of digital innovation on sustainable development outcomes; enabling benchmarking of digital innovation initiatives for sustainable development; and devising regional cooperation pathways to foster digital innovation in the Asia-Pacific region. This framework aims to support all relevant stakeholders in Asia and the Pacific, such as governments, businesses and citizens, to leverage digital innovation for sustainable development.

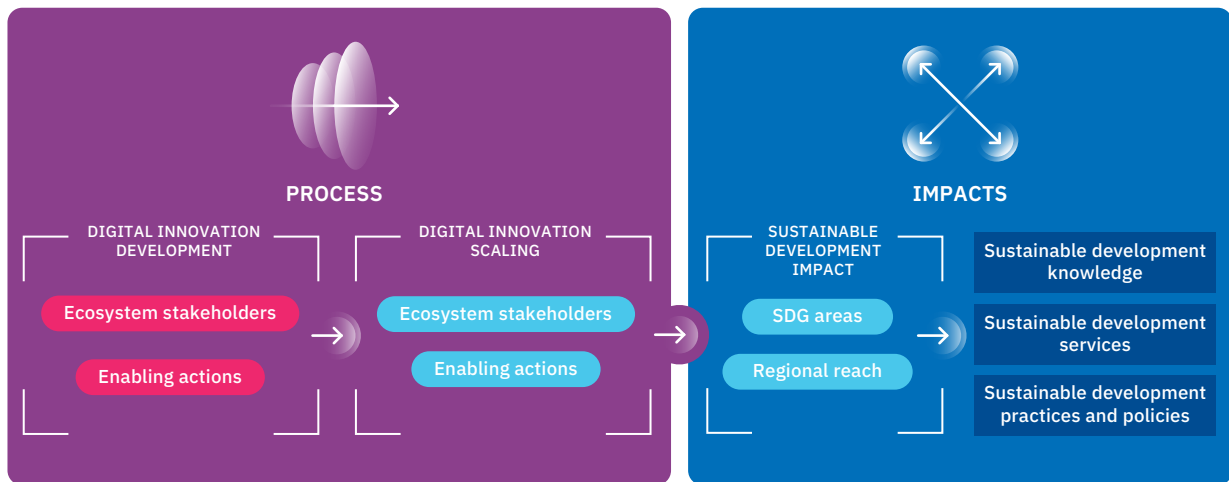
This chapter also demonstrates how the framework can be used by applying it to assess an empirical case. The choice of the empirical case analysed through the framework is not meant to be considered as representative of all cases of digital innovation in the Asia-Pacific region, but rather illustrates how the framework can be used.

## Introducing the framework: Interlinkages between digital innovation and sustainable development

**To leverage the potential of emerging digital technology trends in the Asia-Pacific region, a framework is proposed that is designed to enhance our understanding of the positive interlinkages between digital innovation and sustainable development.** While the potential of digital innovation is often considered in terms of economic output, such as increased efficiency and enterprise profitability, the ways in which digital innovations can foster sustainable development are frequently overlooked and inadequately assessed. The framework aims to address this gap by articulating the process of digital innovation and linking it to its impacts on various dimensions of sustainable development by breaking down the interlinkages in three main areas. First, it allows for the identification of relevant stakeholders and enabling actions at each phase of the digital innovation process. Second, it highlights areas of impact on sustainable development outcomes. Third, it facilitates the benchmarking of digital innovation initiatives aimed at sustainable development, ensuring a comprehensive and multidimensional approach to assessing and leveraging technology.

Figure 2.1 illustrates the framework for digital innovation and sustainable development that is proposed.

**FIGURE 2.1 A framework for digital innovation and sustainable development**



Source: ESCAP.

When seeking to enhance the digital innovation process, states in Asia and the Pacific should focus their efforts on two different stages: digital innovation development, and digital innovation scaling. This dual and simultaneous focus on the digital innovation process enables states to leverage existing digital technology trends and their existing applications for sustainable development, while searching for new angles to tackle currently unresolved challenges. Both stages are integral to ensuring that the benefits of digital technology are widespread and inclusive, addressing the needs of marginalized groups and catering to a diverse range of societal needs. As we delve into the specifics of these phases, it becomes apparent that successful digital innovation requires more than just technological advancement; it requires careful consideration of inclusivity and active stakeholder engagement. Building technical capacity and addressing the gaps in skills related to digital technologies across all levels of government is equally essential.

### Digital innovation development: The process

In the phase of digital innovation development, a variety of actors experiment with digital technologies seeking to find new value-added areas. The development of digital innovations stems from the combination (or re-combination) of resources to provide novel offerings in the form of products or services. These resources can include public or private financial investments, such as government subsidies or venture capital; intellectual property, such as patents and copyrighted material; and institutional infrastructures, such as policies, regulations, and norms. In the phase of digital innovation development, relevant ecosystem stakeholders (government, businesses, and citizens) engage in enabling actions aimed at kickstarting the combination of these resources using digital technologies. It is important to ensure inclusion in the digital innovation development phase, involving marginalized groups in stakeholder engagement, so that digital innovations can tackle challenges that specific groups face, and to avoid unintended consequences on marginalized groups from digital technologies.

In the digital innovation scaling phase, digital innovations with a proven impact on sustainable development expand and reach a larger or different population. Without the scaling phase, digital innovations are unable to realize their impacts. This endeavour involves challenges related to timing, appropriateness, stakeholder readiness, stakeholder support, and the policy and regulatory environment. Stakeholders need to consider five key questions in the scaling phase to ensure that the benefits of existing digital innovations successfully transfer into a larger scale (Bessant and Gray, 2023).

First, stakeholders must consider whether an innovation should be scaled. This question involves careful considerations about whether a digital innovation should stay local or be replicated in different geographical contexts, and whether a digital innovation in a specific product or service should be extended to other categories of products or services. Second, the scaling phase requires defining a strategic vision for the innovation, including its ultimate goals, the benefits and risks associated with scaling, and the values and principles behind the investments in digital innovation. Third, stakeholders must assess a digital innovation's readiness to be scaled. This requires an assessment of whether the combination, or re-combination, of resources carried out in the development phase was well planned, and whether it can support the extension in scope and reach required. The fourth question is whether there is an agent, team or organization that is capable and ready to scale such innovation. This question applies to all stakeholders involved, who need to assess whether the capabilities, competencies and processes they have in place are sufficient and apt to support scaling.

Finally, stakeholders must consider whether the innovation has an ecosystem and an enabling policy and regulatory environment in place to scale it. This last crucial question concerns the presence of the policy and regulatory frameworks necessary for digital innovation to thrive. Policies and regulations are in fact needed to equip stakeholders with the certainty and predictability to engage in innovation. At the same time, over-regulation can stifle innovation and needs to be avoided. Additionally, digital innovation policies should not be exclusively top-down but should stem from a participatory interaction between government authorities and other stakeholders.

### Involving stakeholders

In addition to making deliberate efforts for each of the two stages of the digital innovation process, States in the Asia-Pacific region should identify all relevant ecosystem stakeholders and enabling actions in each of the phases. Different stakeholders can engage in similar or different enabling actions, and such actions can differ based on the stage of digital innovation. Relevant stakeholders might include governments, businesses, entrepreneurs from different backgrounds, or citizens. For example, a government authority can aim to kickstart a digital innovation development phase by providing financial subsidies to other stakeholders, such as research institutions and businesses. In the digital innovation scaling phase, the same government authority might not engage in any supporting action, while the main supporting initiatives may come from other stakeholders, such as business investors injecting financial resources to scale up existing solutions.

### Measuring impact

Successful development and scaling of digital innovation requires multidimensional impact measurement. As a starting point, the impacts of digital innovation on sustainable development are first categorized according to the sustainable development areas they touch upon, measured according to the 17 SDGs and on their geographical and population reach. The well-established metrics of the 17 SDGs allow easy comparison of areas of impact with similar metrics used in different existing frameworks. Moreover, the familiarity of stakeholders - government, businesses, and citizens - with the SDG metrics represents an additional point of strength in the usability of the framework.

Besides the focus on the SDGs, the proposed framework for digital innovation and sustainable development provides for a multidimensional analysis of impacts according to three areas: knowledge, services, and practices. Each of these three areas can be operationalized according to the type of digital innovation that is analysed using the framework. Impacts on sustainable development knowledge refer to the consequences that digital innovation has on new understandings, cognition, and know-how related to sustainable development in individuals, organizations, and the public. These include raising awareness of sustainability development issues among the public, achieving formal education goals related to sustainable development by individuals, and building knowledge capabilities in organizations facing sustainable development challenges.

Measuring the impacts on knowledge can include assessing levels of awareness of sustainability development issues among the public as indicated by quantitative methods, such as opinion polls, or qualitative methods, such as interviews and focus groups with citizens. Such metrics can also include evaluating the achievement of formal education goals related to sustainable development by individuals, as indicated by the increase in the number of graduates of specific training programmes, or scores on dedicated knowledge assessment tests. Lastly, they can include the building of knowledge capabilities in organizations facing sustainable development challenges. This is exemplified by the increase in the number of trainees on sustainable development, and the number and size of teams with capabilities related to sustainable development in business organizations.

Impacts on sustainable development services include services in physical products or infrastructures related to sustainable development. This dimension of impact concerns cases where a digital innovation affects the way a service is used for sustainability purposes. It also relates to cases where a digital innovation results in an existing product, or in a new product being used in a more sustainable way. This dimension can also address the use and development of infrastructures, for example intelligent transportation infrastructure and smart power grids, for more efficient resource use.

The metrics of impacts on services can include measuring changes in the way a service, a product, or an infrastructure is used for sustainability purposes. The results of sustainable development services can be assessed by looking at the reduction in energy consumption achieved by digital innovations, such as smart buildings or energy-efficient algorithms in data centres or measuring the reduction in waste and material losses enabled by digital innovations, such as waste-tracking systems. At a societal level, impacts can be measured in terms of job creation, by assessing the number and quality of jobs created by digital innovations in sustainable industries. For disaster preparedness, impacts can be measured by evaluating the ability of digital innovations to support short- and long-term resilience policies, particularly the country National Adaptation Plans, and improve critical infrastructure resilience, as indicated by reduced downtimes of critical infrastructure in the event of a disaster.

Impacts on sustainable development practices include impacts on processes, institutions, beliefs, norms, and values related to sustainable development. This dimension is usually the most difficult to assess, be it at the individual, the organizational, or at the larger societal level. Digital innovations can in fact affect what beliefs individuals have in relation to sustainability, by enhancing their commitments to new attitudes towards production and consumption. Organizational and corporate cultures can also be impacted by digital innovations, as enterprises and institutions can embed sustainability tenets within their brand values and operational practices. At a societal level, digital innovations can result in increasingly embracing sustainability values. This may be reflected in the programmes of political parties running for elections, and public discussions on sustainability reflected in media coverage. Yet, digital innovations can also stimulate and shape policymaking and the legislative process. This type of impact can be assessed by looking at the amount and type of policy documents on sustainable development stimulated by a digital innovation, and the amount and type of laws and regulations enforced for sustainable development purposes that are linked to a specific digital innovation.

The framework represents a heuristic for analysing a complex phenomenon and requires a certain level of simplification for analytical purposes. The framework depicted in figure 1 presents the relationship between digital innovation and sustainable development impacts as being linear. However, feedback loops can frequently occur. Outcomes of improved sustainability can stimulate further digital innovations. Moreover, the division of the digital innovation process in two stages should not suggest that such a process is necessarily one-way. Concrete examples of digital innovation can consist of iterations between innovation stages, for example when a scaled solution stimulates the development of a new digital innovation.

## Applying the framework: Artificial intelligence for cancer treatment in hospitals in China

**The adoption of an artificial intelligence (AI) system in hospitals in China to support medical doctors in exploring cancer treatments illustrates how the framework can be applied.** This subsection of the report discusses the adoption of AI systems, the evolution phase, its impacts on sustainable development and how it is linked to the framework.

The digital innovation used in this case was an AI platform, IBM Watson for Oncology, designed to aid physicians to formulate personalized treatment recommendations for their patients. The system analyses individual patient data and compares it against an extensive repository of medical knowledge comprising millions of pages of medical literature, such as textbooks, journals, treatment guidelines, clinical trials, electronic health records, treatment histories of analogous patients, and health-care provider notes. Although its developer has exited the Chinese market, the platform's adoption is a good example of the impacts of a digital innovation on sustainable development.

Initially implemented at Zhejiang Provincial Hospital of Chinese Medicine, this platform grew to cover over 40 hospitals within a year, addressing the region's doctor shortage and growing patient population by increasing patient treatment capacity at sustainable costs. Traditionally, aligning patients with clinical trials is a multilevel, manual process. This AI system offers oncologists a more efficient decision-making tool, allowing for standardized treatment protocols and access to the latest medical knowledge, thereby enhancing patient care.




During the development phase, key stakeholders in the local ecosystem undertook enabling actions to facilitate the adoption of the AI system in hospitals, ranging from establishing a regulatory framework to training the workforce. In this case, while the adoption of the AI system ultimately affected patients in a positive way, the immediate impact and focus of the enabling actions were the users of this digital technology; the medical doctors in hospitals.

To kickstart the adoption of the AI system, government authorities established a framework regulation to be applied to hospitals using AI. Relevant government authorities included the Ministry of Science and Technology, which develops policies on AI and health care to frame technology development and the AI application environment (People's Republic of China, Ministry of Science and Technology, 2017); and the National Development and Reform Commission, which is responsible for drafting relevant laws and regulations concerning national economic and social development (National Development and Reform Commission, 2024).

Another key enabling action was training the workforce. IT firms with different areas of expertise collaborated with the Zhejiang Provincial Hospital of Chinese Medicine to provide know-how on how to operate the AI system, including how to translate treatment decision challenges into inputs for the system, and how to apply the system's output to patient interactions. Key IT firms instrumental in this initiative were Hangzhou CognitiveCare, an IBM China partner specializing in adapting Watson for Oncology for China's health-care sector and training physicians in six cancer types; EWELL, a health-care R&D firm providing technical support and English-to-Chinese translation services; and IBM China, overseeing R&D, marketing, and product development in China under IBM's Global guidance.

Table 2.1 provides an overview of stakeholders and the corresponding enabling actions taken in support of the digital innovation development phase.

TABLE 2.1 Stakeholders and enabling actions in the digital innovation development phase

	 GOVERNMENTS	 HOSPITALS	 IT FIRMS
Establishing framework regulation	✓		
Training workforce		✓	✓
Public investing	✓		
Sharing datasets		✓	✓

Source: ESCAP.

In the digital innovation scaling phase, relevant stakeholders supported the widespread implementation of the AI-driven Watson for Oncology system in a large number of hospitals across the country. Chinese government authorities, including the State Council and the Ministry of Science and Technology, identified that the adoption of AI in public hospitals had the potential to effectively tackle the challenge of reaching an increasing number of cancer patients with a limited number of specialized physicians. To encourage the use of the AI solution across the country, government authorities allotted public investments to an ambitious national policy plan, intending to make the country a global innovation hub for AI by 2030 (State Council of the People’s Republic of China, 2017).

Concurrently, IT firms and hospitals acknowledged the importance of sharing datasets to enhance the efficacy of Watson Oncology. Although data-sharing faced obstacles due to the proprietary concerns of the hospitals, the benefits of a centralized database for AI applications were recognized, supported by government initiatives (Sun and Medaglia, 2019).

Impacts of the adoption of the AI system as a digital innovation in public health care clearly support progress towards the SDGs and the qualitative dimensions of knowledge, services, and practices as highlighted by the framework. It has significantly contributed to progress towards good health and well-being (SDG 3), particularly targeting the reduction of mortality from non-communicable diseases, such as cancer (Target 3.4). Its impact has been the improved effectiveness of doctors in treating cancer patients in more than 40 hospitals that adopted the innovation one year after its initial introduction.

Concerning impacts on sustainable development knowledge, the adoption of the Watson for Oncology system increased the awareness and proficiency of doctors in using AI for cancer treatment. This resulted from both the training initiatives put in place, and from the practical learning which occurred as the system was used. Where impacts on sustainable development services were concerned, the development and scaling of the system stimulated the creation of enhanced patient databases. As data quality and volume represented a key requirement for quality outputs, hospitals had to invest in building quality patient datasets as input sources for useful treatment recommendations.

The adoption of the AI system, the establishment of new norms among doctors to make treatment decisions more accountable, including inputs from Watson Oncology, greatly improved sustainable development practices. Multidisciplinary teams have been established in the Zhejiang Provincial Hospital of Chinese Medicine to discuss treatment decisions recommended by the AI system, comprising a minimum of five doctors needed to sign a collective report to ensure accountability of the treatment decisions. Overall, the use of AI in cancer treatment in Chinese hospitals demonstrates that this framework provides policymakers with a tool to capture the link between digital innovations and their potential impacts on sustainable development. It can help guide policymaking by enabling the formulation of supportive actions that are contextualized and relevant to the ecosystem of stakeholders and the policy and regulation environment of the Asia-Pacific region.



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CHAPTER 3

# Digital innovation: Case studies for the future

**This chapter will illustrate how digital innovation can promote inclusive and sustainable development across Asia and the Pacific.** It provides examples which contextualize the links between digital innovation and its impacts on sustainable development in the areas of knowledge management, public services, and development practices. The impacts on these areas are not mutually exclusive as digital innovations can lead to positive outcomes across the board. Digital innovations shape not just products or services, but also the way in which we tackle sustainable development challenges. Yet, despite many cases with measurable impacts on sustainable development in the region, digital innovation still faces barriers and limiting conditions that hinder the translation of digital technology development into tangible impacts. This chapter also explores these barriers and conditions, and how they might be overcome.

## Present and emerging practices

### Knowledge: Understanding sustainable development needs

**From big data to digitally-assisted impact assessments, digital innovations are enhancing our knowledge and understanding of sustainable development needs and methods to address them.** While most digital innovations lead to knowledge which affects services and practices, making concerted efforts to achieve and measure the impacts of this knowledge is crucial to the digital innovation process. Digital technologies that enable an understanding of societal and environmental challenges uncover areas requiring digital innovation or the scaling of existing solutions. There exists a feedback loop between the impact on knowledge of some digital innovations and the different phases of the digital innovation process.



*Digital innovations shape not just products or services, but also the way in which we tackle sustainable development challenges.*

Big data is a prime example; digitization and digital innovation is driving the creation and analysis of extensive datasets that enable a deeper understanding of sustainable development. In the Asia-Pacific region, this is evident in the transport sector, where the collection and analysis of vast quantities of data generated by transport systems allows Governments and other stakeholders to gain insights into transport patterns and trends. The advent of smart transport systems has fuelled this data revolution, and recent advancements in big data analytics have paved the way for harnessing the vast quantity of transport data. Improvements in predictive capabilities and real-time functionality of applications have enabled more reliable, efficient, and evidence-driven decision-making in shaping transport policies and strategies for the SDGs. In all transport modes, data are now available to improve aspects such as performance, efficiency, productivity, safety, and security. Mobile phones, global navigation systems, social media and smart card systems generate transport Big Data that can inform real-time traffic operations and management.

Leveraging digital technology in urban planning more broadly presents several opportunities to enhance the liveability and sustainability of urban environments. Incorporating satellite-derived information and geospatial data enables planners to visualize, question, and interpret data to understand spatial relationships and patterns. This facilitates more informed decision-making. The use of such information can also be used to monitor and analyse environmental data, traffic flows, and energy usage, providing crucial insights for developing more efficient and sustainable urban spaces.

Long-term improvements in transport systems can be shaped by the data collected from various devices across an entire city. For example, the World Bank's Platform for Urban Management and Analysis evaluates diverse transport systems, including infrastructure investments, which can overcome limitations associated with traditional surveys or projected data (World Bank, 2015). The Australian Urban Research Infrastructure Network offers a platform for managing and analysing big data related to urban areas and transport. This data helps address issues as varied as pollution, safety, health, and unemployment by using property ownership and characteristics, street maps, land parcels, census tract data, assessed values, and land use information (AURIN, 2024). The impact of digital innovations on knowledge rarely occurs in isolation; it is often interconnected with its effects on services and practices. Cities in the Asia-Pacific region that have utilized big data to provide insights in the transport sector have been able to translate these insights into operational changes to upgrade services.



*Cities in the Asia-Pacific region that have utilized big data to provide insights in the transport sector have been able to translate these insights into operational changes to upgrade services.*

Climate adaptation is another field where new technologies can enable crucial connections between datasets which support knowledge impact. Technology enables initiating communication among environmental sensors and databases; monitoring, and tracking ecosystem changes; analysing relevant data for disaster and climate risk management using AI and other forms of cognitive digital technologies; optimizing sustainable supply chains; and developing highly accurate forecasts for traffic and weather phenomena. These developments underscore the transformative power of digital technologies in reshaping the landscape of early warning systems and climate resilience. As with big data in the transport sector, the impacts of digitally-driven knowledge in climate change adaptation is ongoing and vital to achieving adaptation through resilient and responsive services and practices.



*The impacts of digitally-driven knowledge in climate change adaptation is ongoing and vital to achieving adaptation through resilient and responsive services and practices.*

Recognizing the need for policymakers to have a nuanced understanding of climate risks and their impacts in present and future climate change scenarios, ESCAP has put in place the *Asia-Pacific Risk and Resilience Portal*. It provides users with comprehensive, easy-to-use data analytics (using machine learning and automation) on the disaster and climate-related trends in the region. It includes risk scenarios for 56 nations, including economic costs, multi-hazard risk hotspots, and adaptation priorities. Policymakers can access estimates on average annual losses and identify priorities for climate adaptation in any one country and their costs. The Portal includes a knowledge product called 'storyboards', which offers policymakers an interactive means of exploring scientific information on resilience-building. Its ambition is to support policymakers navigate the intricate landscape of climate and inform measures to strengthen resilience and sustainability.

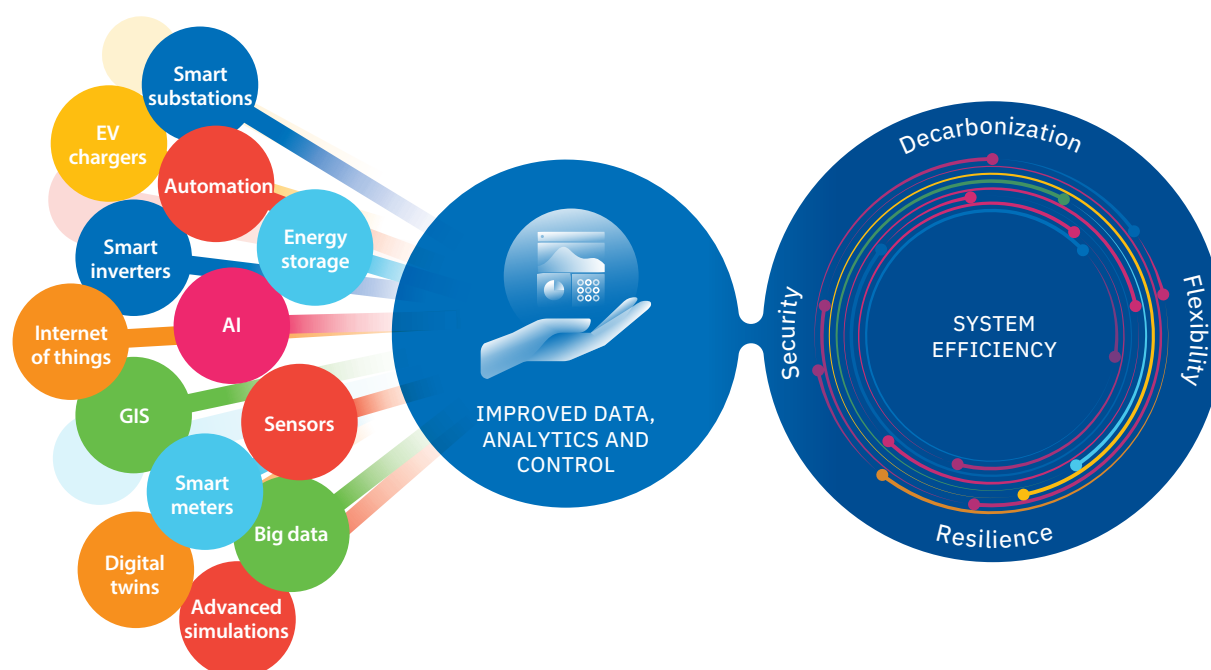
## Services: Impacting the society and the environment

The most visible and common impact of digital innovation on sustainable development is observed in services related to sustainable development. Examples from sectors, such as power, transport, and government administration, demonstrate how digital innovations are leading to new sustainable development services or modifying existing ones to better address societal and environmental needs.

### Digitalizing the energy sector

Digitalization has transformed the electricity value chain, as demonstrated by technologies such as smart grids, blockchain-enhanced energy trading platforms, and distributed energy resources management systems. Smart grid technology has significantly enhanced grid reliability and efficiency by integrating sensors and real-time data analytics for better management of electricity flow, enabling operators to anticipate and handle disruptions. Additionally, smart appliances allow consumers to shift electricity use to off-peak periods, reducing grid stress and saving money. However, these benefits require effective data collection and integration into system operations, which have yet to be fully developed in many countries.

FIGURE 3.1 Digital solutions for clean energy and system-wide efficiency



Source: ESCAP, adapted from International Energy Agency (IEA), *Unlocking smart grid opportunities in emerging markets and developing economies* (Paris, 2023).

Under its Smart Grid Roadmap, the Republic of Korea is aiming for a fully smart grid by 2030. This involves the deployment of advanced metering infrastructure (AMI), distribution automation, and demand response programs. Regulatory measures helped to make significant progress in deploying AMI, also known as smart meters. These meters provide real-time data on electricity consumption, allowing consumers to monitor and manage their energy usage more effectively. Smart meters can be read remotely by utility providers, thereby reducing the need for manual meter reading. The roadmap envisages the deployment of distribution automation systems to enhance grid reliability and efficiency by helping utility operators respond quickly to outages and optimize grid operations. To incentivize consumers to reduce electricity consumption during peak demand periods, demand response (DR)

programs have been introduced. Through smart meters and communication infrastructure, consumers can receive signals and pricing information to adjust their energy usage. DR programs help balance supply and demand, reduce grid stress, and avoid blackouts. The Republic of Korea expects energy savings of around 3 to 5 per cent by household, annually, in electricity consumption thanks to the implementation of smart metering, demand response programs and increased consumer awareness.

Blockchain technology can enhance the security, transparency, and traceability of data in peer-to-peer (P2P) energy trading platforms, as shown in Thailand's T77 development, which is the world's largest block-chain based P2P solar power trading project. In the T77 development, buildings have a total installed capacity of 635 kilowatts from rooftop solar panels and can sell or buy excess electricity from neighbouring buildings as needed. By using a virtual token to represent each unit of energy traded, the blockchain-based application allows the buildings within the network to trade solar electricity in real time. As a result of the success of this project, the Government of Thailand is now considering opening the energy market to allow private electricity trading. Other regional applications of blockchain in the power sector include Bangladesh's rural energy trading network, Singapore's solar energy certificates, and Malaysia's pilot initiative for solar trading and carbon certificates. In the Russian Federation, blockchain is being tested to improve electricity metering and payments.

Distributed Energy Resources Management Systems are crucial for the Pacific small island developing States (SIDS). These systems integrate local renewable resources, like rooftop solar panels and battery storage, and enable decentralized and resilient power systems with extensive data exchange and digital solutions. They can make a major contribution to sustainable development, as has been demonstrated outside the region, in particular in Hawaii and Puerto Rico, where these systems have significantly improved the management of disruptions and extreme weather events. These systems represent a shift towards flexible, multi-directional communication power systems capable of handling renewable energy variability and weather events. There is scope to build on this success in many parts of Asia and the Pacific.



*Distributed Energy Resources Management Systems are crucial for the Pacific small island developing States (SIDS).*

## **Responsive transport services**

Across the Asia-Pacific region, countries are actively embracing emerging technologies, such as smart mobility, Mobility-as-a-Service (MaaS), transport Big Data, cooperative-intelligent transport systems (C-ITS) and connected autonomous vehicles (CAVs) to create positive social benefits and drive sustainability. These emerging technologies demonstrate tangible benefits including reduced congestion and improved air quality, which speaks to their truly transformative potential.

Aside from unlocking new insights, big data has also led to considerable changes in transport services in the Asia-Pacific region. For example, Singapore's Land Transport Authority initiated the Bus Service Enhancement Programme, using data analysis to pinpoint areas where the demand for bus services exceeded supply. This data-driven approach resulted in improved route optimization and an increased number of buses in accordance with user-demand (Seoul Solution, 2014). The Owl Bus is a demand-responsive late-night bus service that has been in operation since 2012 in Seoul, the Republic of Korea. The service employs transport Big Data to identify pick-up and drop-off destinations for late-night transport users. This creates optimal service lines which have adjusted frequency depending on the time of day. This initiative is very useful for low-income or vulnerable groups, as taxi services are relatively expensive at these times (Seoul Solution, 2014).

Transport Big Data can enable the real-time or short-term provision of transport services. For instance, in Hangzhou, China, the City Brain platform integrates data from various sources, including transport ministries, traffic control, safety and planning departments, and service providers. City Brain employs AI techniques to adjust traffic signal timing for traffic congestion reduction with 128 CCTVs based on traffic volumes and vehicle movement (Sohu.com, 2017; Hangzhou China, 2020). Singapore's Fusion Analytics for Public Transport Event Response project uses transport Big Data analysis of railway services, buses, taxis, and CCTVs, as well as IoT sensors like Wi-Fi and mobile phones. This system has proven effective in predicting incidents and optimizing bus service route planning for passengers (AFI Labs, 2018). Similarly, Japan's Vehicle Information and Communication System (VICS) and its expansion, VICS WIDE, provides real-time road and traffic information, leading to a significant reduction in traffic congestion costs and CO<sub>2</sub> emissions.



*Barrier-free vulnerable road user (VRU) service is an urban planning and mobility initiative which aims to remove the physical and psychological barriers that encumber vulnerable groups.*

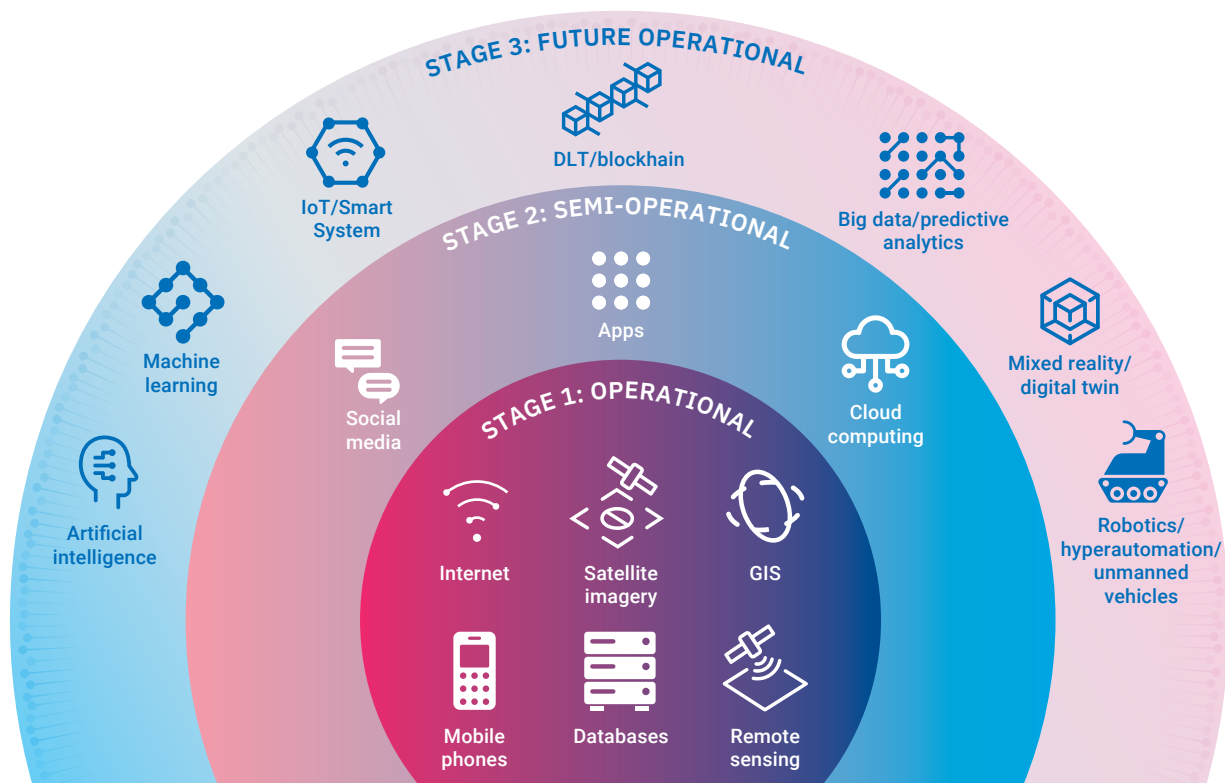
Other technologies affecting sustainable development services in the transport sector include cooperative-intelligent transport systems (C-ITS) and connected and autonomous vehicles (CAVs), which enhance safety and traffic efficiency, and optimize transport networks. Using advanced technologies, such as communication systems, AI, satellite positioning and a range of sophisticated sensors, including radar, ultrasonic, infrared, and laser sensors, C-ITS and CAVs facilitate communication between vehicles and infrastructure, improving situational awareness and traffic flow. The Cooperative and Automated Vehicle Initiative in Queensland, Australia is testing vehicle platooning and intersection safety applications (Queensland Government, 2021). In the Republic of Korea, pilot projects are deploying C-ITS infrastructure along 300 km of roads in Jeju, and 121 km of rapid transit bus routes and urban expressways in Seoul, with 500 commercial vehicles being equipped with on-board units (The Korea Transport Institute and ITS Korea, 2013; ESCAP, 2019). In Singapore, the Centre of Excellence for Testing and Research of Autonomous Vehicles has established a testbed for automated vehicles, simulating a range of road-traffic situations. This supports enhanced fuel efficiency and reduces the incidence of collisions.

Digital innovation improves inclusivity and accessibility in transport. Barrier-free vulnerable road user (VRU) service is an urban planning and mobility initiative which aims to remove the physical and psychological barriers that encumber vulnerable groups. Barrier-free VRU Service is currently being implemented in Busan, the Republic of Korea, and features barrier-free navigation, barrier-free stations, and barrier-free ride-sharing platforms. Barrier-free stations are stops that serve as a hub for public transport and ridesharing platforms, helping reduce usage time, waiting time, and transport costs for people with disabilities when compared to regular transport (2022 Busan Smart City Challenge, 2022). In Narita City, Japan, demand-responsive transport with taxi data improves transport services for the elderly, showcasing enhanced accessibility and efficiency. Thailand's ViaBus application offers functionalities like real-time bus locations and route planning, improving public transport efficiency and user satisfaction. Similarly, the multimodal ticketing system 'Ulasim Asistani' in Istanbul, Türkiye allows seamless journey planning across various transport modes, enhancing public transport experience.

## Digital innovation supporting climate change adaptation

Technologies like big data have increased our understanding of risk and the potential approaches to adapt to the impacts of climate change in Asia and the Pacific. Utilizing contemporary digital technology has enormous unrealized potential for the entire value chain of climate services. This potential extends from data collection to the co-design, dissemination, and the personalization of services. Digital technologies offer a unique ability to support adaptation financing by increasing process efficiency, transparency, and accessibility at multiple points. The visual representation of the role of digital technologies is illustrated in Figure 3.2.

FIGURE 3.2 Ecosystem of digital technologies for climate change adaptation



Source: ESCAP, adapted from Asian Development Bank (ADB), *Digital technologies for climate action, disaster resilience, and environment sustainability*, (Manila, October 2021). Available at <https://www.adb.org/publications/digital-technologies-climate-change>.

In responding to the impacts of climate change, digital innovations are strengthening multi-hazard early warning systems (MHEWS) used in Asia and the Pacific. MHEWS are recognized as a vital and cost-effective adaptation measure in mitigating the impacts of various hazards. These systems are crucial in providing timely and accurate information to prevent losses and damages associated with disasters due to natural hazards. The integration of innovative technology solutions, such as an automated impact-based forecasting tool used in ESCAP's Risk and Resilience Portal, into MHEWS has transformative potential.

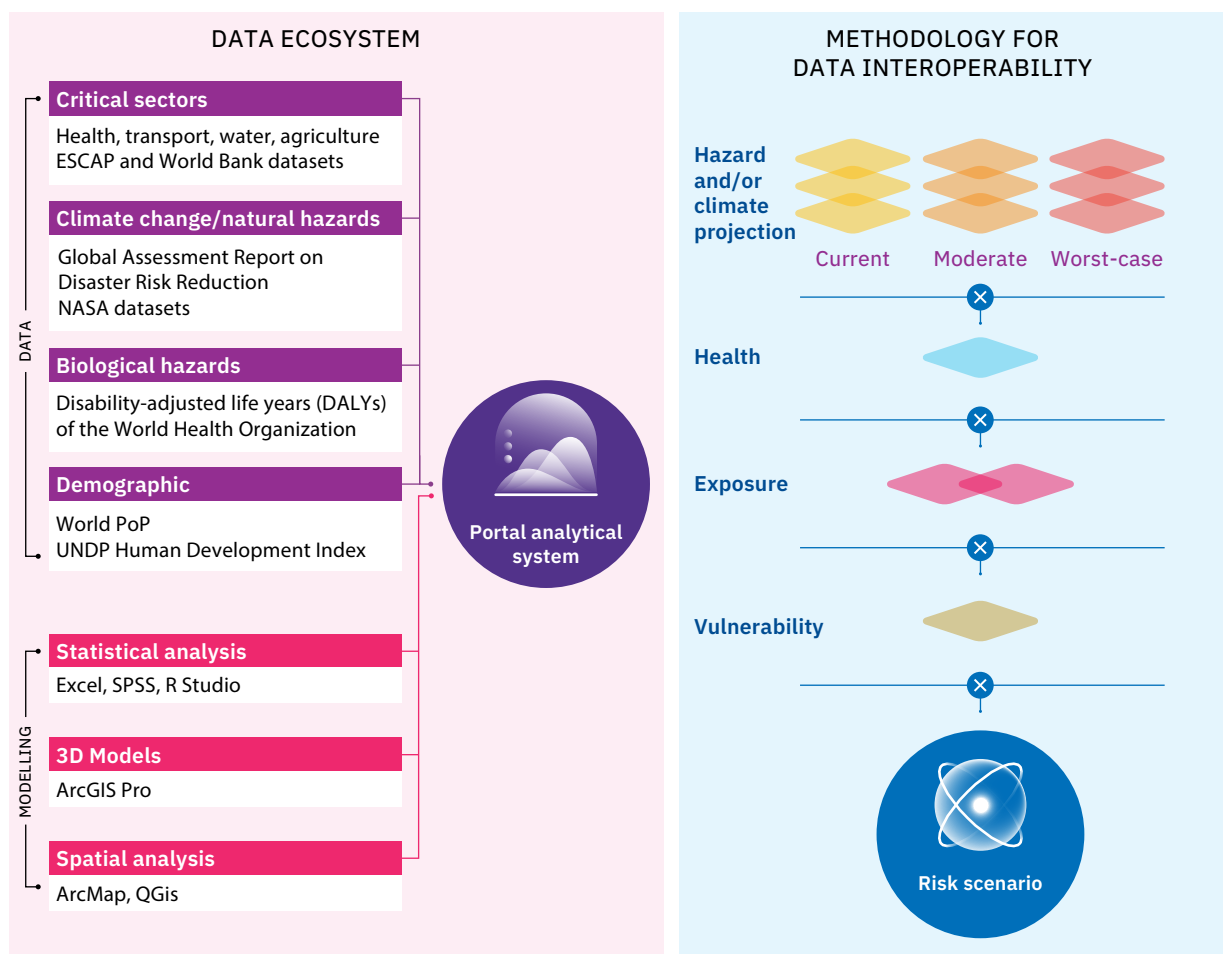
The use of AI in combination with Numerical Weather Prediction models can improve the weather forecast for early warning systems. These models use mathematical equations to simulate weather conditions. The data collected from them can be used by AI models to generate accurate weather forecasts. In a recent study, a deep neural network was used to analyse typhoon satellite cloud images and accurately identify typhoon rapid intensification trends, even with missing or imbalanced data in the north-west Pacific and in the South China Sea (Zhou and others, 2022). Researchers tested this method on operational typhoon satellite cloud images in 2019, and on four typhoon cases with rapid intensification processes from 2019 to 2021. They found that it could forecast and identify the trend of typhoon rapid intensification with higher accuracy. While this method is still in the testing phase, it holds great promise for regional and global application.



Beyond climate hazards, technological advancements have also shown potential in strengthening alert systems for geophysical hazards. For example, Google for Earthquakes in India uses Android smartphone sensors, such as accelerators, to detect tremors across a network of ‘mini seismometers’. Working with India’s National Disaster Management Authority and the National Seismology Center, Google can issue alerts in local languages directly to smartphones reflecting the magnitude of the earthquake (Berman, 2023). This technology offers critical seconds of advance warning and can be lifesaving. ESCAP’s Asia-Pacific Risk and Resilience Portal also exemplifies the role of digital transformation in early warning systems. It integrates hazard, exposure, vulnerability and risk information, supporting the Early Warnings for All (EW4All) initiative and providing data for adaptation strategies. The Resilience SDG Action Tracker within the portal monitors and tracks disasters and climate-related SDG targets, using comprehensive data analytics and machine learning.

The role of digital transformation in early warning systems is exemplified by the Asia-Pacific Risk and Resilience Portal (see figure 3.3). It integrates hazard, exposure, vulnerability, and risk information to support Pillar 1 of the EW4All initiative. The Resilience SDG Action Tracker (RSAT), within the ESCAP Asia-Pacific Risk and Resilience Portal, diligently monitors and tracks disaster and climate-related SDG targets and indicators accessible through the ESCAP SDG Gateway. This powerful tool equips users with comprehensive data analytics, integrating machine learning and automation, to assess disaster and climate-related SDG trends within countries and subregions of the Asia-Pacific region. It highlights the impacts on social, economic, and environmental sectors while promoting the pivotal adaptation pathways capable of either reversing regressive trends or supporting positive trends in SDG implementation for resilience.

**FIGURE 3.3 ESCAP Asia-Pacific Risk and Resilience Portal ecosystem support to multi-hazard early warning systems**

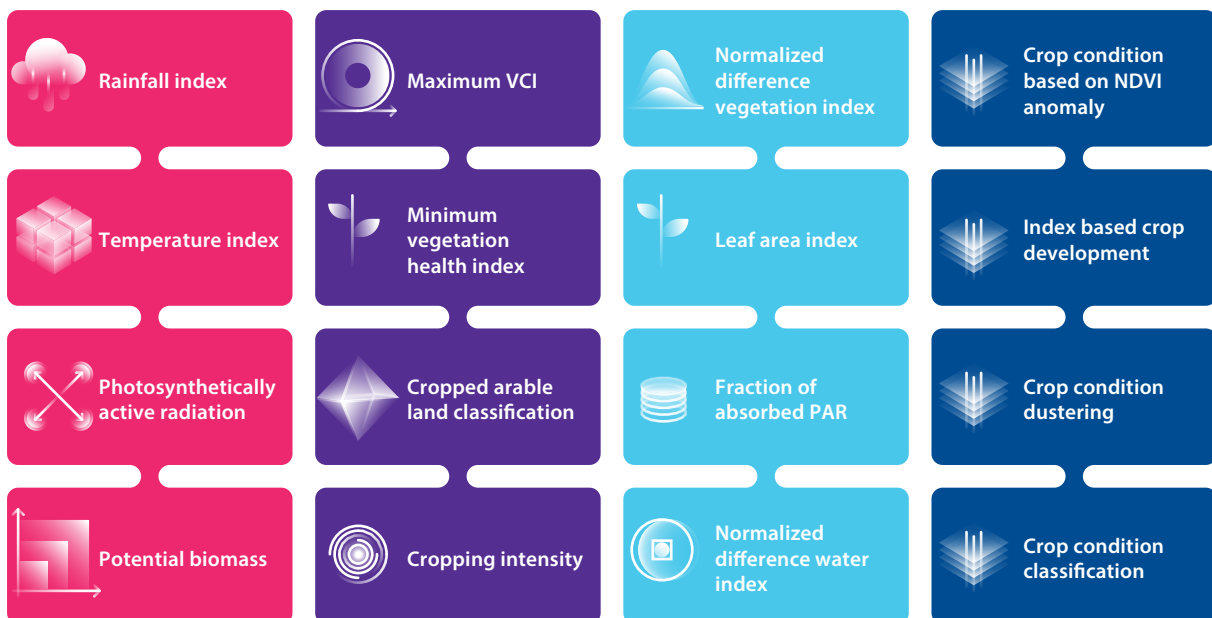


Source: ESCAP, Asia-Pacific Risk and Resilience Portal 2.0. Available at <https://rrp.unescap.org>.

## Strengthening agricultural resilience and food security

Digital innovations that affect resilient agriculture and food security can have significant impacts for sustainable development for Asia and the Pacific: a region that is home to half of the world's undernourished population, with over 370 million people in this predicament (FAO, 2023). Innovations in AI can improve early forecasts on crop production, as shown by the CropWatch system that has been developed by the Chinese Academy of Sciences since 1998. Early forecasts are essential for policymakers to make evidence-based decisions on the potential need to import food, and the possibility of having to provide food aid to regions with food shortages. Farmers and communities can make science-based decisions to enhance crop management by gaining a better understanding of crop stressors through satellite imagery and tracking climatic patterns (Bingfang and others, n.d.). CropWatch is an automated system that can perform quantitative and dynamic crop monitoring and produce early predictions of crop production. Figure 3.4 shows the indicators that can be computed on the CropWatch Cloud Platform.

FIGURE 3.4 Indicators available on CropWatch



Source: CropWatch. Available at <http://cloud.cropwatch.com.cn>.

Note: VCI = Vegetation condition index, NDVI = Normalized difference vegetation index, PAR = Photosynthetically active radiation.

The incorporation of cloud computing and artificial intelligence into CropWatch automates the processing of large amounts of remote sensing data into analysis-ready crop monitoring products and virtual collaborations on crop monitoring analyses. These new technologies allow the borderless retrieval of open data essential for early predictions and warnings of crop yields when necessary. Moreover, with all data stored on cloud-based platforms, the need of purchasing non-real-time data from third parties or having heavy infrastructure investment are removed compared to traditional crop monitoring approaches. This enables more countries and people of different levels of expertise to harness advancements in digital innovations for improved food security.

In addition to significantly improving processing and storage of data, there are also innovations to improve the delivery of information to users. Since 2022, the FieldWatch application, has been added to CropWatch to allow smartphone users to harness the power of satellite data, cloud platform, and artificial intelligence (AI) for field-level precision agriculture (Zeng and others, 2023). With AI-assisted image recognition, FieldWatch counts the crop ears and kernels, and thus predicts crop yields by combining other information such as crop type, crop photos and dimensions of the field. The model is currently available for wheat, and a rice model is being finalized (Qin, 2023a, 2023b; Zeng and others, 2023).

As digital technologies continue to evolve, innovations will get better. However, the potential for technologies and the resulting innovations to help adapt to climate change or solve food security in places where they are most needed have yet to be fully tapped. For example, many of the innovations for climate change adaptation are found in the global North, but most people in the firing line of climate change impacts are in the global South. Consequently, it is important to take steps to harness digital innovations which benefit the most vulnerable populations.

## Strengthening government administration

Digital solutions dramatically improve the speed and responsiveness of government processes and the digitalization of tax administrations can be particularly beneficial. Automated systems, such as e-invoicing or e-filing solutions, reduce the need for manual interventions and the associated administrative burdens. Moreover, the use of digital tools considerably minimizes the margin of error inherent to manual processes and increases transparency.

The most common innovation in tax digitalization is e-filing, which allows the submission of tax documents through online platforms. Such systems simplify tax filing, cut down errors, and offer cost-effective administrative solutions. They also allow for speedier tax refund processes, enhancing taxpayer trust and compliance. In India, the Income Tax Department introduced an e-filing system in September 2004 to streamline the filing of central government and state-level taxes. In June 2021, the system was upgraded through the introduction of a new portal, e-filing 2.0, designed for enhanced user experience. E-filing 2.0 features a comprehensive dashboard for all taxpayer interactions, rapid processing of returns for expedited refunds, and free income tax return preparation tools. These innovations have markedly reduced return processing times and allowed refunds to be issued promptly, boosting taxpayer trust and compliance. This increased efficiency was reflected in a 16 per cent year-on-year increase between 2022 and 2023 in the number of income tax returns filed by the 31 July deadline (India, Ministry of Finance, 2023).

Another important innovation in tax administration, particularly beneficial to the private sector, is e-invoicing. For businesses, e-invoices offer a more efficient alternative to traditional paper invoices by eliminating manual data entry, reducing the chances of human errors, and improving accuracy. E-invoices can be sent and received instantly, allowing businesses to process transactions quicker and at a lower cost. E-invoicing systems can provide real-time or near real-time access to invoicing data to tax authorities. This enhances the efficiency of tax administration by ensuring that tax amounts are calculated and remitted correctly, and it facilitates tax compliance by generating reliable data for audits.

In Asia and the Pacific, countries such as Australia, Japan, New Zealand and Singapore implemented e-invoicing with the goal of improving business efficiency, while other countries have done so to improve tax compliance. Examples of the latter include the Republic of Korea and Uzbekistan. The Republic of Korea's electronic tax invoicing (ETI) system, implemented in 2010, follows the so-called real-time reporting model of e-invoicing,<sup>1</sup> with all e-invoices reported to the Korean National Tax Service. The ETI system resulted in substantial savings in tax compliance costs for both businesses and the tax administration, as well as a significant reduction in the issuance of fraudulent tax invoices (Kim, 2023).

Uzbekistan's national e-invoicing platform called SoliqOnline, introduced in 2019, follows the so-called centralized exchange model (GENA, 2022). Businesses must register on the platform to obtain an electronic signature from the State Tax Committee before they can create e-invoices using the platform. The e-invoices are generated in a standardized electronic format, which can be sent to customers via email or other electronic means. Once the customer receives the e-invoice, they must

<sup>1</sup> For a description of various models of e-invoicing, see Global Exchange Network Association (GENA), "A next-generation model for electronic tax reporting and invoicing – DCTCE v2.0", 3 August 2022.

verify and approve it through the platform. The platform also allows users to make payments, and businesses to easily access and manage their invoicing records, as well as simplifying tax reporting and compliance (VAT Update, 2023).

Governments in Asia and the Pacific are also transforming health care through digitization. Telemedicine platforms in countries like Bangladesh offer remote health-care services, connecting patients with health-care professionals through digital channels such as video calls, phone consultations, and mobile apps. This approach has reduced travel time by 94 per cent and costs by 56 per cent compared to traditional consultations. This proved crucial during public health emergencies like the COVID-19 pandemic, when the Government's telemedicine hotline handled 80,000 consultations a day. This transition was supported by the creation of user-friendly platforms accessible via smartphones and basic Internet, which were integrated with electronic health records for continuity of care. Training health-care professionals for virtual consultations and developing a regulatory framework was required to ensure patient safety and data security. Expanding Internet connectivity, government policy support, regulatory frameworks, partnerships with health-care providers, and public awareness campaigns were all key to the success of telemedicine. This holistic strategy addressed unequal health-care access, improved health-care outcomes and reduced disparities, promoting health and well-being for all citizens.



*Expanding Internet connectivity, government policy support, regulatory frameworks, partnerships with health-care providers, and public awareness campaigns were all key to the success of telemedicine.*

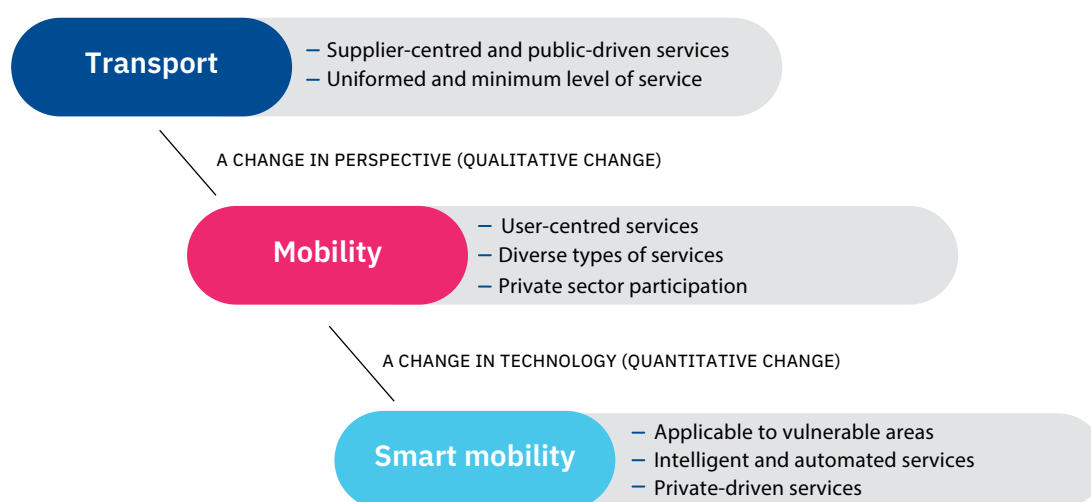
## Practices: Transforming processes and institutions

**The impacts on sustainable development practices leads to transformations in processes and institutions that can drive systemic changes underpinning sustainable development.** While isolating these impacts from those related to sustainable development knowledge and services is complex, the focus on practices is crucial due to their lasting effects. Digital innovations can give rise to new paradigms on how to tackle sustainable development issues. At the organizational or individual level, digital innovations can affect culture, and thus the way sustainable development efforts are implemented.

### Transforming transport usage

For example, the emergence of innovative technologies in our society has brought about profound shifts in how we perceive transport. These changes focus on prioritizing the movement of people rather than vehicles, aiming to enhance municipal operations, ease urban traffic congestion, and ultimately enhance the quality of life within cities. This transformation represents a departure from the traditional notion of 'transport' towards a broader concept known as 'mobility', where technology responds to the specific needs of travellers. While 'transport' refers to the movement of people and goods using vehicles (ESCAP, 2022), this paradigm shift distinguishes 'mobility' as the ability to move freely and conveniently.

FIGURE 3.5 Paradigm change from transport to smart mobility



Source: ESCAP.

This transition is encapsulated by smart mobility, and involves using technology to optimize transport systems, reduce congestion, and enhance the overall travel experience. Smart mobility can be defined as an advanced form of mobility that is an agglomeration of diverse transport technologies, services and modes (ESCAP, 2022). Some of the mediums that support smart mobility include e-scooter sharing, on-demand transport, Mobility-as-a-Service (MaaS), and ridesharing/ride-hailing services (ESCAP, 2023).



E-scooter sharing service in Thailand. Photo: Changju Lee, ESCAP.

Despite being a relatively new concept, the Asia-Pacific region has witnessed the emergence of numerous initiatives to build smart mobility. There were around 20,000 ride-hailing drivers in Thailand in 2019 (Jotikasthira, 2018). E-scooter sharing has also been introduced in major cities in Thailand, and around 200 e-scooters were placed in Bangkok’s Thong Lor zone, supporting 500-600 trips daily (Mahavongtrakul, 2019).

In many urban areas, public transport is the only accessible mobility solution for individuals who do not have access to private vehicles. In this context, demand-responsive transport is a viable alternative, particularly in mobility-vulnerable areas where public transport services are not provided or are inadequate. In Australia, 36 demand-responsive transport trials have served over a million residents by adjusting routes in real time based on traveller demand. Peer-to-peer car-sharing is also gaining traction, especially in less densely populated areas. In Malaysia, over 300 vehicles were in service (with over 20,000 registered users) near Klang Valley as of 2020 (Chan, 2020).

One emerging concept within the realm of smart mobility is MaaS, which is offered as a medium to bundle various modes of transport together. MaaS is a type of service with joint digital technologies which represents the evolution of current public transport into user-centred and seamless multimodal mobility solutions that offer various mobility alternatives. This integration is achieved through a unified platform where an entire journey can be planned, booked and paid for, thereby simplifying the planning and payment of multimodal trips. Because of the nature of the service provided by MaaS, various applications are used, including car-pooling, ridesharing, e-scooter sharing, bike sharing and on-demand transport. MaaS not only improves commuter time efficiency but also optimizes

traffic flow, energy utilization, and vehicle deployment throughout a city with the integration of these different applications. Beijing, China, partnered with big tech companies to introduce the 'MaaS Mobility for Green City' initiative in 2020 which included a carbon credit-inclusive incentive (Mobility Transition in China, 2021). It is expected that eventually this scheme will collect credits equivalent to an estimated 100 tons of carbon per day (Mobility Transition in China, 2021).

## Financial technology: Risks and opportunities

Digital innovation trends, in areas such as blockchain, have also affected sustainable development practices, requiring adjustments in institutions and norms to align the impact of technological trends with societal needs. For example, cryptocurrencies and stablecoins, which use blockchain technology, offer potential for financial inclusion and economic policy impact. Yet, the collapse of crypto exchanges, such as FTX and Terra Luna, underscores the need for transparent regulations to protect investors. ESCAP has assessed cryptocurrencies as being high-risk, and stressed the need for consumer safeguards (Hrnjic and Clarke, 2022). The IMF has advocated for clear policies, cautioning against recognizing crypto as an official currency and urging integration into existing financial frameworks and tax policies.

Central bank digital currencies (CBDCs) compete with other technologies to facilitate payment processes, lower transfer costs, reduce operational risks, accelerate settlement of payments, increase transparency, combat illicit transactions, and foster financial inclusion. Central banks in the region are experimenting with CBDC technologies for both national and international payment systems. In doing so, they are expanding the global research pool and contributing to the development of regulations which safeguard the stability and security of monetary and financial systems. A deeper understanding of the risks related to implementing CBDCs is important given their role in credit intermediation and their permanent digital footprint which raises issues of data governance and privacy (BIS, 2023). As CBDCs are at an early stage of development and because there is insufficient evidence on their net benefits compared to other technologies, regulations should encourage competition between emerging digital payment solutions offering similar advantages. This diversity is essential to the development of more sustainable and inclusive financial systems (Gross and Letizia, 2023). In this context, the Maldives is working to develop a regulatory sandbox framework. Staff are being trained to test a central bank digital currency in a controlled setting for improved efficiency and financial inclusion, and equipping the national economy with a payment system which can support the tourism sector. China has already launched a CBDC, and other countries are developing and piloting similar schemes, including the Russian Federation, Thailand, India and the Republic of Korea.

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CHAPTER 4

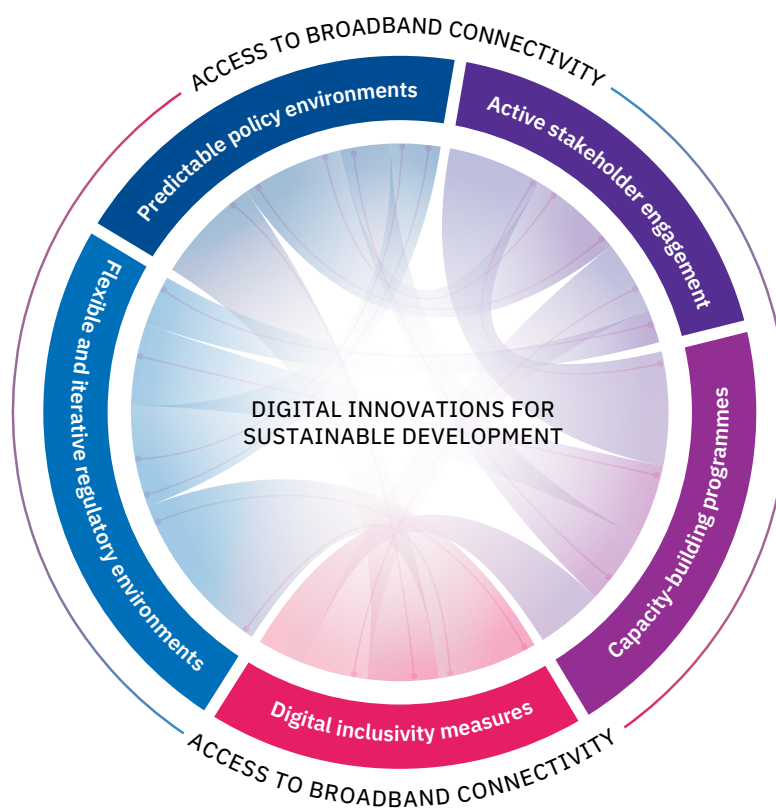
# Building an enabling environment



To create an environment that nurtures digital innovation and supports sustainable development, proactive measures and collaborative support from diverse stakeholders are essential. Building on the framework presented in Chapter 2 and the practices set out in Chapter 3, this chapter considers the nuances of creating a supportive environment for scaling up digital innovations with high impact. The first precondition is ensuring access to broadband connectivity and adequate digital infrastructure connectivity.

Beyond this essential requirement, five enabling actions are considered: 1) predictable policy environments; 2) regulatory reforms; 3) skills and capacity-building initiatives; 4) stakeholder engagement; and 5) digital inclusivity measures. These measures are particularly important in the region's developing countries, which require an approach that incorporates technological, administrative, socioeconomic, and behavioural elements. Drawing on real-life examples from the Asia-Pacific region, this chapter explores effective strategies for stakeholder engagement, building enduring collaborations, and improving digital access and participation, particularly for underserved communities.

FIGURE 4.1 **Five enabling actions**



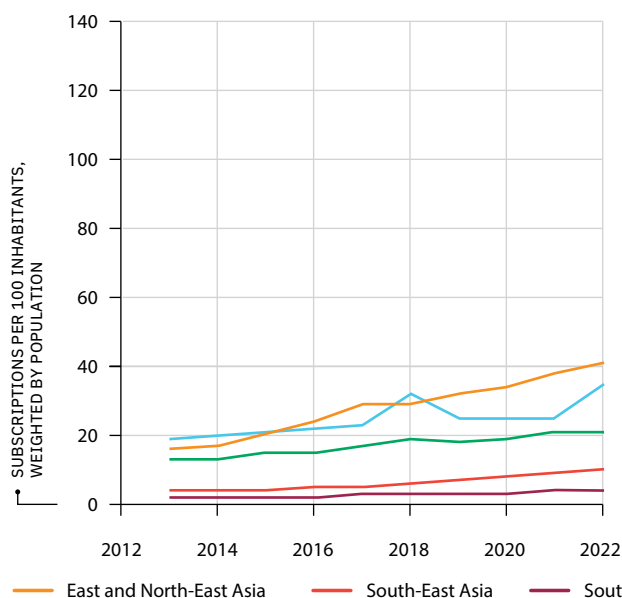
Source: ESCAP.

### Access to broadband connectivity

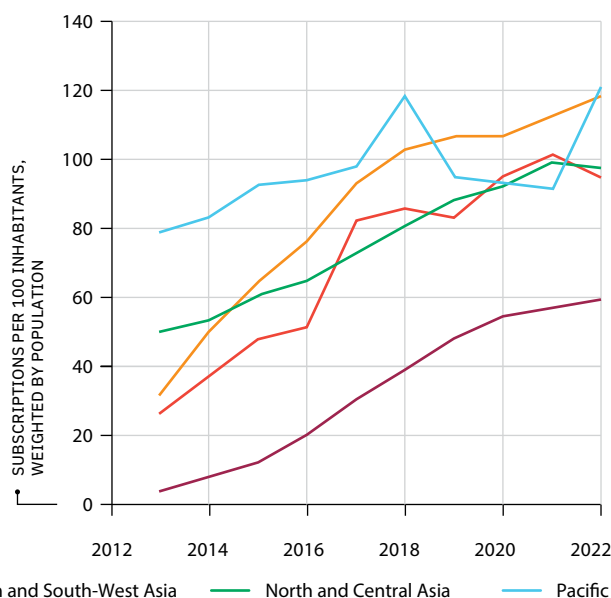
The digital infrastructure and connectivity needed to underpin technological breakthroughs varies across the region, but its recent development has greatly expanded Internet coverage. Ninety-eight per cent of the population in the region is now covered by a mobile or fixed network and 96 per cent of the population was covered by a 4G mobile network in 2022, with a relatively low urban-rural coverage gap (ITU, 2022b). Access to broadband connectivity has also improved on an unequal basis in the ESCAP subregions (ESCAP, 2022a). For mobile and fixed broadband services, while all ESCAP subregions experienced a positive trend, South-East Asia and East and North-East Asia have advanced faster over the past five years driven by the continued strong growth of access in Singapore and in the Republic of Korea. The Pacific small island developing States and South and South-West Asia on average, are notably lagging in fixed broadband access (see figure 4.2).

FIGURE 4.2 Broadband Internet access in ESCAP subregions

## A) FIXED BROADBAND



## B) MOBILE BROADBAND



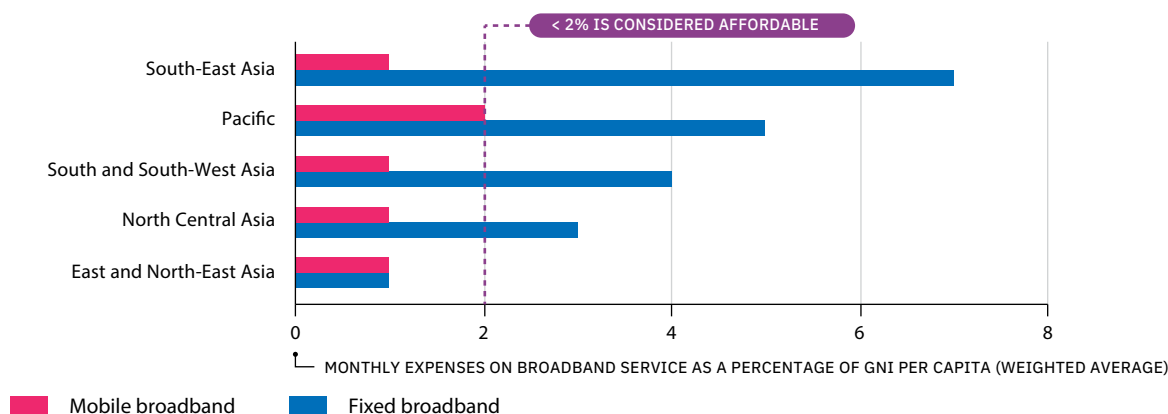
Source: Produced by ESCAP based on statistics from International Telecommunication Union (ITU), "World Telecommunication/ICT Indicators Database 2023, (27th edition/July 2023)"; 2024. Available at <https://www.itu.int/en/ITU-D/Statistics/Pages/publications/wtid.aspx>.

Several accessibility challenges remain between and within ESCAP's subregions. While mobile broadband services are considered affordable<sup>1</sup> in all five ESCAP subregions, fixed broadband services are considered unaffordable everywhere except in East and North-East Asia (see figure 4.3). In South and South-West Asia, only 10 per cent of the population has fixed broadband subscriptions. Within countries, significant accessibility gaps also remain, especially between women and men, youth and older persons, persons with and without disabilities, people living in urban and rural areas, and people with different income levels and educational backgrounds. Many who are covered do not have the necessary skills to make use of digital innovations. Consequently, 37 per cent of the population with access to broadband do not use the Internet (ITU, 2022a). Addressing these connectivity challenges are a precondition for realizing the full potential of digital innovation to deliver inclusive and sustainable development.

The gender digital divide is particularly evident. Available data suggests the percentage of women using the Internet stands at 63 per cent compared to 69 per cent of men in Asia and the Pacific (ITU, 2023b). The gender gap in mobile ownership is 2 per cent in East Asia and the Pacific, and 15 per cent in South Asia. Moreover, while the smartphone ownership gap remains at 2 per cent in East Asia and the Pacific, it reaches 42 per cent in South Asia.<sup>2</sup> Divides linked to age, disability and place of residence are also clear. In the 16 Asia-Pacific countries and territories with data, Internet usage is markedly skewed towards younger populations. Equally, the median percentage of mobile and Internet usage stands at 81 per cent and 35 per cent for women with functional difficulties compared to 92 per cent and 48 per cent for women without. Men with functional difficulties also use a mobile phone and the Internet less than those without (ESCAP, 2022b). The remaining urban-rural divide is quantifiable. Eighty per cent of individuals use the Internet in urban areas compared to 52 per cent in rural areas in Asia and the Pacific (ITU, 2023b).

1 Using the United Nations Broadband Commission target of 2 per cent or less of monthly expenses on mobile broadband services as a percentage of gross national income.

2 The gender gap refers to how much less likely a woman is to own a mobile phone than a man. It is calculated using the following formula: (male owners as a percentage of male population - female owners as a percentage of female population) / male owners as a percentage of male population. See Global System for Mobile Communications Association (GSMA), "The Mobile Gender Gap Report 2023", London, 2023a.

**FIGURE 4.3** Affordability of broadband services in ESCAP subregions

Source: Produced by ESCAP based on statistics from International Telecommunication Union (ITU), "ICT Prices: historical data series, April 2023 release", 20 April 2023a. Available at <https://www.itu.int/en/ITU-D/Statistics/Pages/ICTprices/default.aspx>.

Note: The United Nations Broadband Commission sets targets to make universal broadband affordable by 2025, including making entry-level broadband services affordable in low- and middle-income countries at less than 2 per cent of monthly gross national income (GNI) per capita by 2025. For more details, see: <https://www.broadbandcommission.org/advocacy-targets/>.

ESCAP's Leaving No One Behind (LNOB) methodology provides further insights into the digital divide between persons who are furthest behind and furthest ahead<sup>3</sup> within and between countries in the Asia-Pacific region. The gap in Internet usage is more than tenfold in some countries. Individuals living in poorer households - the bottom 40 per cent of household wealth distribution - with lower education and over 35 years of age are most often left behind. Among those individuals left behind, Internet usage is under 5 per cent in Afghanistan, Bangladesh, the Lao People's Democratic Republic, Pakistan, Papua New Guinea, and Timor-Leste, as opposed to over 50 per cent in Armenia, Kyrgyzstan, Tonga and Tuvalu. The divide between individuals furthest behind and furthest ahead is observed in terms of mobile phone ownership. In most countries, an average of three-quarters of the population own mobile phones. However, in Afghanistan, India, Kiribati, Pakistan, Papua New Guinea, and Tajikistan, less than one-third of those who are furthest behind possess such devices.<sup>4</sup> Gaps between the furthest behind group and the furthest ahead group are noticeably wide in these countries.

Driving the development and scaling up of digital innovations requires overcoming all these accessibility gaps, but also disparities in skills. Only 40 per cent of the region's population, in countries where data is available, have basic digital skills (ESCAP, 2023c). In most countries, marginalized groups are particularly ill equipped, which prevents them from using digital technologies effectively (ESCAP, 2023c). Women are less likely than men to be able to use technology for basic activities, such as creating simple formulas in spreadsheets, and women in manufacturing face a higher risk of being replaced by computers than their male counterparts (ESCAP, 2022a). An estimated 86 million people, 14 per cent of the workforce, in Australia, India, Indonesia, Japan, New Zealand, the Republic of Korea and Singapore, need training to keep pace with technological developments and gain new digital skills to succeed in their careers (AlphaBeta, 2022).

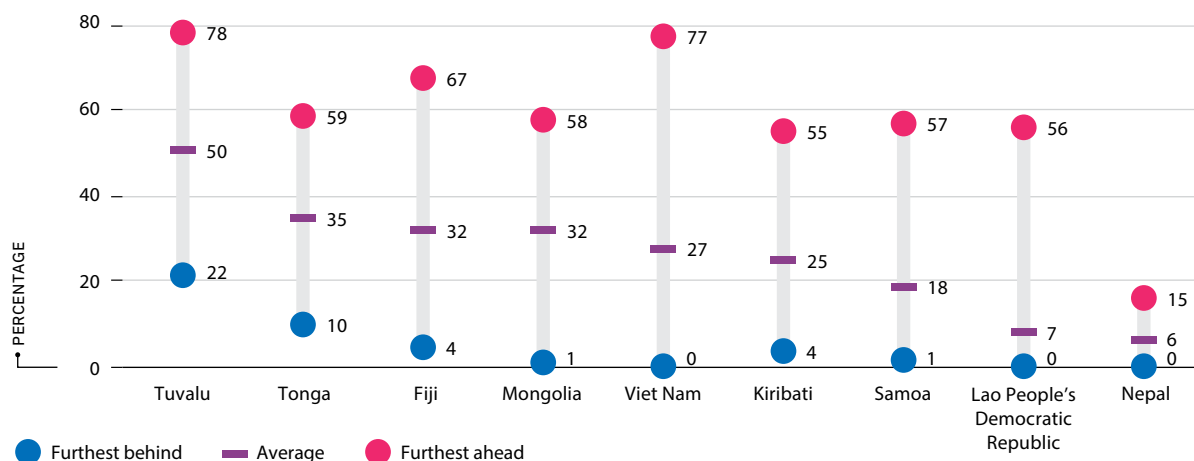
More broadly, the lack of skills is a barrier to digital innovation ecosystems which can benefit from population-wide linkages. Figure 4.4 illustrates the chasm between the ICT skills of the furthest behind and furthest ahead groups in several Multiple Indicator Cluster Survey<sup>5</sup> countries where adequate data is available for the 2017-2021 period. Investments in the inclusive expansion of digital skills training is critical and programmes are needed at different levels, offering foundational skills and digital literacy for all, digital skills for the workforce, and advanced skills held by specialists working in the ICT sector.

3 The LNOB analysis uses the Classification and Regression Tree methodology and the Dissimilarity Index (D-index) to identify households and individuals furthest ahead or behind in accessing basic opportunities in the Asia-Pacific region. For a detailed introduction to the methodology, please see ESCAP, "Leaving No One Behind (LNOB): A methodology to identify those furthest behind in Asia and the Pacific". Available at <https://lnob.unescap.org/methodology>.

4 Individuals living in poorer households - the bottom 40 per cent of household wealth distribution - with lower education and in the 15-24 age group are often left furthest behind.

5 Multiple Indicator Cluster Surveys (MICS) are nationally representative household surveys collected by National Statistics Offices in partnership with UNICEF across the world. Over 15 countries in Asia and the Pacific collect MICS data for over two decades. A variety of SDG indicators are readily available in MICS data which are comparable across countries and over time. MICS surveys are accessible publicly online at <https://mics.unicef.org/surveys>.

**FIGURE 4.4 Share of the population with basic information and communications technology skills, by furthest behind and furthest ahead groups (men and women aged 15–49 years)**



Source: ESCAP elaborations based on Demographic and Health Surveys (DHS) and Multiple Indicator Cluster Surveys (MICS) (2017–2021). ESCAP, “Leaving No One Behind”, online platform, n.d. Available at <https://lnob.unescap.org/> (accessed on 15 September 2023).

## Predictable policy environments

**Predictable policy environments and streamlined legal and regulatory frameworks are vital for nurturing digital innovations.** Attracting investments, necessary to achieve economies of scale and network effects, depends on clear and coherent regulations. Similarly, establishing clear and transparent regulatory guidelines builds a climate of trust and compliance, which is the foundation of a successful digital ecosystem. The ambition should therefore be for regulations that support digital transformation by providing predictability and stability, while building a robust regulatory architecture for data privacy and user rights. Examples from the power sector, tax administration and digital trade in the Asia-Pacific region illustrate the successful implementation of such practices. They highlight the benefits of harmonizing regulatory standards and aligning compliance costs with international standards.

### Green energy needs regulatory predictability

The power sector relies inherently on multi-stakeholder efforts to generate, transmit and distribute electricity, often combining different technologies and crossing jurisdictional lines. The successful green transformation of power systems requires the creation of smart grids and distribution of energy resources, which necessitates policy coordination and predictable environments for investors. The considerable amount of private and public resources required to make the power sector sustainable can only happen if such conditions are met.

The expansion of smart grid networks is central to many government strategies to increase energy efficiency and security while gradually decarbonizing their economies. Digital smart metering allows real-time measurements and two-way communication on energy consumption. The Asia-Pacific region is the world’s largest metering market with around 2.6 billion electricity and gas customers and an annual demand of around 110–190 million units of electricity meters (Berg Insight, 2022). In its 12th Five Year Plan (2011–2015), the Government of China announced an ambitious roadmap to develop renewable energy and smart grids. This was followed by the issuance of the Guiding Opinions on the Implementation of Smart Grid Construction in 2011. Through these policy measures and centralized planning, which provide predictability and clear “rules of the game,” China has deployed smart meters on a massive scale, reaching 100 per cent installation of residential smart meters by 2021. Australia and the Philippines have implemented regulatory policies to support the development and integration of Distributed Energy Resources (DERs) into their energy grids, encouraging the use of renewable energy sources and enabling consumers to participate in the energy market.

Launched in 1998, Australia's National Electricity Market (NEM) allows for the trading of electricity generated from residential solar panels and other DERs. This encourages peer-to-peer energy trading and innovation in the DER sector. Several Australian states have introduced feed-in-tariff (FIT) schemes that provide incentives for homeowners and businesses to install rooftop solar panels. These tariffs ensure that surplus electricity generated from DERs, such as solar PV systems, can be sold back to the grid at favourable rates, making solar investments financially attractive. Net metering regulations encouraged the adoption of DERs by ensuring that users are fairly compensated for the electricity they produce and contribute to the grid. The financial attractiveness of the required investments on DERs ultimately relies on investor confidence in the stability of the regulations that allow such schemes to exist.



*The expansion of smart grid networks is central to many government strategies to increase energy efficiency and security while gradually decarbonizing their economies.*

In the Philippines, the Renewable Energy Act of 2008 established a robust and clear regulatory framework for net metering, catalysing the growth of renewable energy sources. This regulatory policy allows consumers to generate their own electricity and contribute excess power back to the grid. The introduction of this system has spurred reliable financial incentives to invest in solar panels, steering a shift away from fossil fuels. This shift bolstered energy security and resilience by lessening dependence on traditional, centralized power generation.

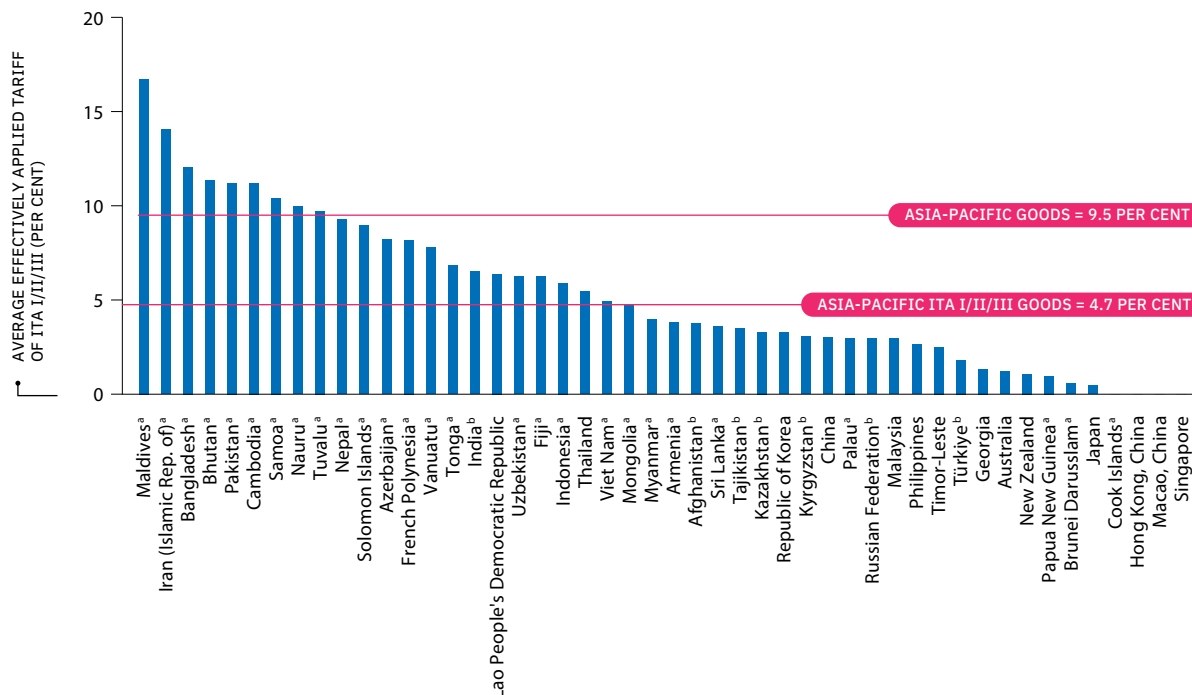
### **Tax administrations: Focus on clarity and transparency**

An enabling legal and regulatory environment is crucial for the effective implementation and operation of digital tax platforms (Basse, Mulligan, and Ojo, 2022). Initiatives in countries, such as New Zealand, highlight the importance of establishing clear regulatory guidelines and optimizing tax codes to align with digital processes. New Zealand's Binding Rulings regime, which offers taxpayers clarity on the tax implications of their actions in advance, creates the foundations for a trustful and compliant environment, essential for any effective digital tax system. Outside of Asia and the Pacific, Germany has focused on revising its tax code to make it more digital-friendly, highlighting a user-centric approach that integrates seamlessly with digital tax platforms. This shift towards a modern and efficient digital tax landscape serves as an archetype for other countries.

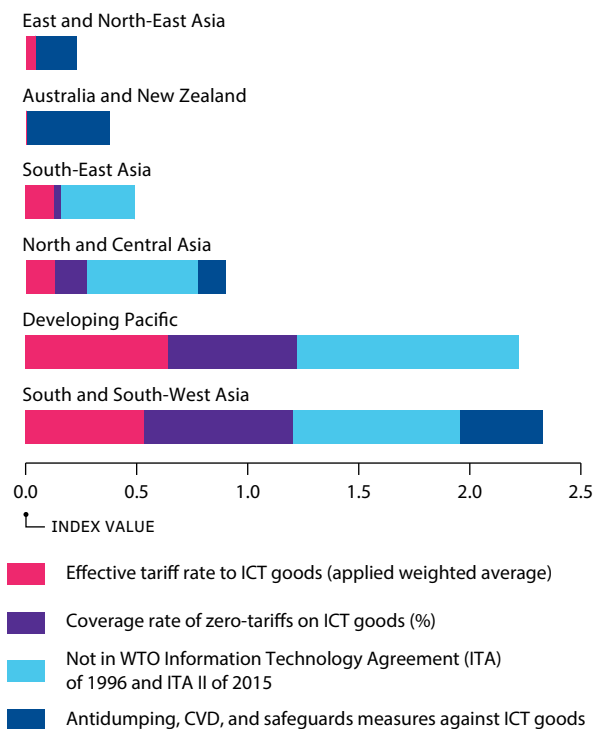
In Australia, legislative reforms have been implemented to enhance data privacy, thereby boosting public confidence in digital platforms. Similarly, Singapore has embraced collaborative dialogues and regulatory sandboxes, creating a synergistic relationship between regulators and innovators. This approach not only fosters an enabling environment for innovation but also ensures adherence to legal frameworks. These efforts demonstrate the crucial role of a well-structured legal and regulatory environment in not just enabling the smooth operation of digital tax platforms, but also in ensuring the protection of user rights and data privacy. By observing and learning from these international approaches, Governments worldwide could foster an environment that not only facilitates the smooth operation of digital tax platforms but also safeguards user rights and data privacy through a streamlined legal and regulatory architecture.

**FIGURE 4.5 Indicators of policies affecting digital infrastructure and cost access: Asia-Pacific region, 2022**

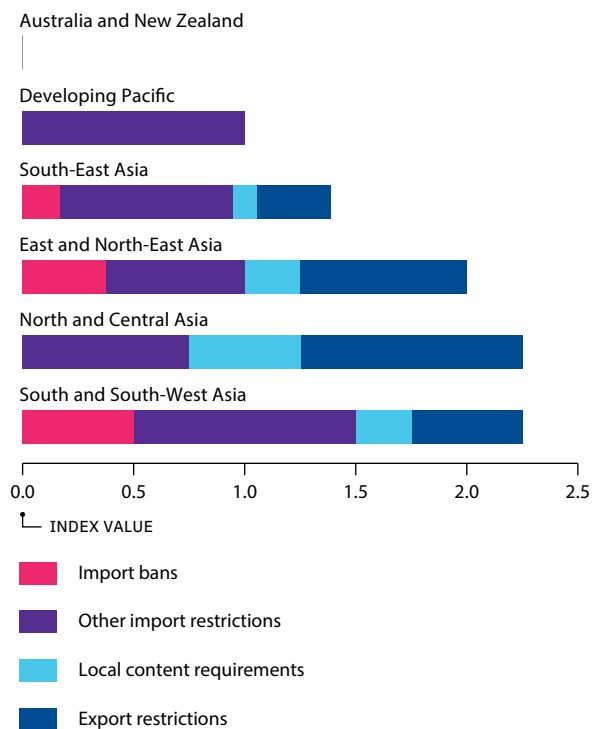
**A) AVERAGE TARIFFS ON ICT GOODS, 2022**



**B) TARIFF-RELATED MEASURES**



**C) NON-TECHNICAL NON-TARIFF MEASURES**



Source: ESCAP, based on the Regional Digital Trade Integration Index for Asia-Pacific. Available at <https://dtri.uneca.org/escap/trade-integration> and the United Nations Conference for Trade and Development, "TRAINS database". Available at <https://trainsonline.unctad.org/home> (accessed in May 2023).

Note: Figure 4.4a: The Information Technology Agreement (ITA), originally signed in 1996 (ITA I) eliminates tariffs on a wide array of information and communications technology (ICT) products, including computers, telecommunications equipment, and semiconductors. In 2015, participating countries collaboratively completed an expansion of the ITA (ITA II), implemented in 2016, which removed tariffs on an additional 201 ICT parts, components, and products. This expansion encompasses new IT products and technologies that have emerged since the original agreement in 1996. However, as technologies continue to evolve and give rise to an ever-expanding range of ICT products, a proposal made by the Information Technology and Innovation Foundation (ITIF) for ITA III expansion emerged. The proposal which aims to broaden the scope of tariff elimination to include additional next-generation ICT products. These categories include semiconductor manufacturing, energy-efficient technologies, medical devices and equipment, meters, electronics packaging and transport, flat panel displays, high-speed digital cameras, 3D printers, smartphones, drones and satellites, and industrial robots.

Note: a= not in ITA I; b= In ITA I but not in ITA II.

## Digital trade requires streamlined, predictable policy

Digital trade in Asia and the Pacific can enable sustainable economic growth, but complex trade policy environments stop the region from reaching its full potential. While many economies have moved towards lowering tariffs on ICT goods, there remains significant heterogeneity across the region. The average regional tariff was 9.5 per cent in 2022, but tariffs on ICT goods range from 0 per cent in economies such as Singapore and Hong Kong, China, to more than 17 per cent in the Maldives (figure 4.5.a.). In addition to tariffs, ICT goods and services frequently become targets of trade defence measures. Over 30 per cent of the surveyed economies implement anti-dumping measures, safeguards, and countervailing duties, with 27 per cent of them outrightly banning certain ICT goods or services, especially in South and South-West Asia (figure 4.5.b.). Therefore, measures to create a streamlined, predictable digital trade policy environment would help create the necessary conditions for investment in ICT products and digital trade innovation.

Trade in ICT products is frequently subjected to Non-Tariff Measures (NTMs), including licensing, certification, and various labelling standards (figure 4.5.c.). While these measures are intended to protect domestic interest, the compliance cost becomes significant when they deviate from international standards. However, economies are increasingly adopting good practices, like allowing foreign businesses to participate in technical standard-setting consultations and aligning their standards with those established by the recognized organizations (ESCAP, ECA, and ECLAC, 2023). Noteworthy examples include Malaysia's adoption of the International Telecommunications Union standards for managing human exposure to electronic magnetic fields (EMFs) emitted by telecommunications equipment, and the Philippines's implementation of ITU-T Recommendations as part of its national telecom policy.



*Measures to create a streamlined, predictable digital trade policy environment would help create the necessary conditions for investment in ICT products and digital trade innovation.*

Enhancing commitments and implementation of World Trade Organization (WTO) agreements to eliminate trade and investment barriers in the ICT sector could help establish a stable digital trade policy environment at the regional level. The WTO Information Technology Agreement (ITA) aims to eliminate tariff barriers on ICT goods. However, a substantial portion of the Asia-Pacific economies have not participated. Furthermore, about one-fifth of these economies enforce Local Content Requirements (LCRs) for ICT goods or services, a position that contradicts the WTO Agreement on Trade-Related Investment Measures (TRIMs). For instance, Indonesia mandates a minimum of 35 per cent LCRs for 4G and 5G devices to bolster its domestic telecommunication industry (Limenta and Ing, 2022; Indonesia, Ministry of Communications and Informatics, 2021).<sup>6</sup>

<sup>6</sup> For official document, please see Ministry of Communication and Information Technology (MOCI) Regulation No.13/2021 in effect 1 April 2022.

## Regulatory reform

While stable policy environments are a key enabler for investment and long-term business decisions, regulatory reforms and iterative and agile regulatory environments are needed to ensure outdated rules do not stifle innovation. Regulatory reform can be a powerful stimulus for digital innovation in most fields, driving advancements that contribute to sustainable development. Iterative regulatory environments can support digital innovations by allowing the rules to keep abreast of digital breakthroughs and enabling the mass adoption of digital innovations that support sustainable development. If patents themselves are used as a parameter for judging innovation, the World Bank's score on ease of doing business indicates that countries with the most business-friendly regulatory environments have seen stronger growth in the number of patents filed (Table 4.1). Among the countries listed in Table 4.1, with the exception of India, all countries are ranked in the top 25 per cent of the World Bank's ranking on ease of doing business.

In Asia and the Pacific, countries with flexible regulatory environments have been able to support innovation in sectors like cryptocurrency assets and power systems, while mitigating the evolving risks of new technologies. External technical assistance is available for low and middle-income countries in the region to develop appropriate and flexible regulatory frameworks and mitigate the risks inherent to the adoption of any innovation.

**TABLE 4.1** Number of patents versus ease of doing business in selected countries

SELECTED COUNTRIES	NUMBER OF PATENT APPLICATIONS (BY NATIONALS OF) IN 2019	EASE OF DOING BUSINESS (1 = MOST BUSINESS-FRIENDLY REGULATORY ENVIRONMENT) IN 2019
China	1,243,568	32
United States of America	285,113	6
Japan	245,372	30
Republic of Korea	171,603	5
Germany	46,632	22
Russian Federation	23,337	29
India	19,454	62
France	14,103	33
United Kingdom	12,061	8

Source: World Bank, "World Development Indicator Database", 2024. Available at <https://databank.worldbank.org/source/world-development-indicators#>.

Note: Ease of doing business ranking from 1 (most business-friendly) to 190 (least business friendly) for 190 countries.

Note: Patent applications are worldwide patent applications filed through the Patent Cooperation Treaty procedure or with a national patent office for exclusive rights for an invention; a product or process that provides a new way of doing something or offers a new technical solution to a problem. A patent provides protection for the invention to the owner of the patent for a limited period, generally 20 years.

## Central bank digital currencies

The ESCAP secretariat has examined the opportunities for central bank digital currency (CBDC) in the Maldives. It concluded that CBDCs can play an important role in improving financial inclusion and has practical benefits for smaller developing economies. These benefits include cost savings on cash reduction; more effective monetary policy to manage monetary supply and interest rates via a combination of CBDC and cash supply and interest rates; and better management of inexpensive and real time cross boarder transfer payments and remittances. CBDCs can assist smaller economies with a higher level of foreign remittances to manage the potential disruption caused by the inflow of foreign dollars to a local currency and preserve monetary sovereignty. As discussed in Chapter 3, the secretariat together with UN DESA are supporting the Maldives Monetary Authority and government ministries to cautiously evaluate the opportunities and risks of implementing a national CBDC.



## Regulation supporting grid digitalization

Adopting flexible and iterative regulatory environments is crucial for spurring innovation and investments in the power sector, particularly in grid digitalization. Digital analytics and data intelligence enable better management of grid assets. The digitalization of grid components allows for remote monitoring and precise automated management, leading to enhanced operational efficiency and reduced costs. In the Asia-Pacific region, where most power utilities are state-owned, the drivers for digital transformation in the power sector are twofold: political and financial. Political drivers stem from public demands for cheaper, cleaner electricity and more efficient state utility management. Financially, there is a strong impetus to improve cost savings and revenue growth. Research suggests that smart grid deployment can lower overall costs although evidence is still limited (Rangelov, Nikolaev and Stanev, 2019). However, digital technology providers have little incentive to focus on deploying high-cost smart grids technologies in the least developed countries (LDCs). Thus, government interventions incentivizing smart grid investments may be required. At the same time, Governments could consider investing in domestic innovation and technology facilities that support home-grown smart grid technologies and combine research and resources through increased South-South and triangular cooperation.

Initiatives taken in Singapore, Australia and Japan illustrate how innovative programs and regulatory flexibility can encourage private-sector engagement in energy innovation. In 2019, Singapore launched a project on AIoT-Enabled Smart Grid Application for Sustainable and Resilient Digital Ports (ASGARD Project) with the aim of designing, implementing and validating cutting edge smart grid technologies and solutions using the Port of Singapore's Pasir Panjang Terminal as a living lab (Energy Innovation, 2022). In Australia, the Energy Innovation Tool-Kit (EIT) helps energy innovators and start-ups navigate the complex regulatory framework, and test new products and services. The EIT acts as a regulatory sandbox with three components including: (a) an innovation enquiry service that provides innovators with guidance on how to deliver new technologies or business models under the current regulatory scheme; (b) a time-bound trial waiver on specified laws and rules; and (c) a trial rule change process that allows a temporary change of existing rules or introduction of a new rule to enable a trial of technologies/business models (AER, 2023).

Japan's Feed-in Tariff (FiT) Program is a notable case of using innovative tax reforms to drive shifts towards cleaner energy. Launched in July 2012, following the Fukushima disaster, the program provided incentives for renewable energy, significantly influencing Japan's energy market and contributing to its sustainable energy transition. The program offered guaranteed above-market rates for electricity generated from renewable sources, including solar, wind, geothermal, and biomass. These incentives encouraged innovation and investment in renewable energy technologies, and by the end of 2021 Japan had installed more than 78.4 gigawatts (GW) of solar photovoltaic capacity, making it one of the world's largest solar markets (Japan, METI, Agency for Energy and Natural Resources and Energy, 2012).

## Capacity-building initiatives

**Capacity-building in both the public and private sector is vital to leverage the opportunities emerging from digital innovation.** Educational programs and training for the public sector are essential to ensure that policymakers and civil servants have the skills to navigate the digital world and foster environments conducive to digital innovation, particularly in the development phase. By understanding global best practices, emerging threats, and the potential impacts of new technologies, public servants can craft policies that foster innovation while ensuring security, equity, and inclusivity. Similarly, regular training programs integrated into digital platforms and ecosystems can address barriers to the scaling of digital innovation that stem from unfamiliarity or lack of expertise. The development of digital tax platforms and regional power infrastructure provides examples of how capacity-building programs can facilitate digital innovation.

## Adopting digital tax platforms

The adoption of digital platforms can face resistance due to a lack of familiarity or expertise (Lee and Tan, 2019). Addressing this issue strategically through the meticulous development and implementation of regular training programs can enable a smooth transition to digitalized tax and government environments, as shown by regional and global examples.

For instance, India's experience with its e-filing system underscores the essential role of continual education to achieve optimal engagement. While the platform is user centric, it also required taxpayers to possess a baseline digital competency, hence the country's emphasis on ongoing educational efforts. Other concerted efforts through programs such as Digital India, with its strong focus on digital literacy, aim to make India's government services electronically accessible. Similarly, Australia's approach to the Single Touch Payroll system necessitated a degree of digital literacy, both for businesses and individuals, to ensure smooth operations. The Republic of Korea, in its quest for tax efficiency through point-of-sale integration, realized the necessity of training both business owners and consumers, given the pivotal role of these systems in everyday transactions. Given the evident importance of digital literacy and capacity-building highlighted by these cases, proactive initiation of extensive training and educational programs is key. Collaborations with educational institutions and technology firms can also enrich these training initiatives by enhancing their relevance and allowing existing resources and expertise to be tapped. Additionally, creating educational content for diverse user profiles, from novices to tech experts, enables the establishment of an inclusive digital tax environment.

## Connectivity capacity-building programmes

Connectivity-focused capacity-building programs for regulators are central to the development of regional power and digital infrastructure, laying the groundwork for effective regulations that incentivize renewable energy and supportive technologies like storages and grids. Regulators are instrumental in accelerating connectivity efforts, including the harmonization or alignment of regional and national regulations. While most current power connectivity projects in the region are bilateral, there is considerable scope for more integrated planning on a broader regional scale, which requires regulators across the region to be aligned and informed about the required adjustments for regulatory harmonization among countries. Overcoming this obstacle is crucial for successful regional power system integration. The Capacity Building for Regulators in Asia to Support Increased Sustainable Power System Connectivity project led by the secretariat aims to improve the ability of regulators and other stakeholders to support cross-border and regional power system integration. Through a series of workshops and the development of an online forum, the project has augmented stronger links among regulators across Asia and within targeted subregions, ultimately supporting increased collaboration on the topic of regulatory harmonization. As part of this initiative, the Asia-Pacific Regulatory Forum on Power System Connectivity, an annual event, brings together multiple stakeholders from different subregions. This forum encourages collaboration and experience-sharing, focusing on topics relevant to increasing power sector connectivity to support the energy transition. Working with partner institutions, the secretariat has also developed a series of capacity-building exercises which are accessible to interested audiences on ESCAP's community and e-learning platforms.

## Supporting job creation

Indonesia's Kartu Prakerja, is an online platform-based programme which is boosting job skills development and entrepreneurial capabilities. In partnership with the Asian and Pacific Training Centre for Information and Communication Technology for Development (APCICT), Kartu Prakerja caters to diverse groups, such as jobseekers, micro- and small business owners, women, persons with disabilities, and individuals from disadvantaged communities through in-person, online and hybrid training modalities (ILO, 2023b). Beyond the direct impact on Indonesian entrepreneurs,

the collaboration between APCICT and Kartu Prakerja can yield significant spin-off benefits for various sectors. The online platform is accessible to underrepresented groups, including senior citizens, persons with disabilities, and other individuals from disadvantaged communities. As digital skills become more widespread and accessible, the overall capacity of the workforce to adapt and thrive in a rapidly evolving digital landscape is being strengthened. This can increase productivity and competitiveness, improve services through digitalization, and create a more versatile, adaptable labour force capable of driving innovation and economic growth.

## Active stakeholder engagement

**Comprehensive stakeholder engagement is crucial to overcome barriers to the adoption of digital platforms.** It requires continuous dialogue, complemented when relevant by private sector partnerships and public awareness campaigns. This approach should be considered for both the initial phases of digital innovation development and in the scaling and post-scaling phases, with continuous feedback driving an iterative improvement process. This subsection explores the importance of stakeholder engagement through examples of digital tax platforms. It highlights successful cases of public awareness and advocacy campaigns, and a multi-faceted engagement approach that makes the tax system responsive to the needs of all stakeholders. Such a strategy paves the way for efficient and transparent tax systems, crafted with a deep understanding of the varied needs and realities of everyone involved in tax administration.

### Public awareness and advocacy campaign

The complexity and unfamiliarity of digital tax platforms pose significant barriers to their adoption (Kumar and Rani, 2020). To overcome this, Governments can implement effective public awareness and advocacy campaigns. Singapore's efforts to demystify digital platforms through campaigns, highlighting benefits such as efficiency and transparency, serve as a notable example. Showcasing success stories and testimonials can further illustrate the positive effects on tax compliance ease. Similarly, Australia's approach of conducting public campaigns, supported by comprehensive guides and FAQs, addresses concerns about data privacy and cybersecurity. This reassures the public about the safety of their information. Canada's use of multi-channel campaigns, combining social media with traditional media, exemplifies how to reach a broad audience. Employing such diverse strategies ensures inclusivity and encourages wider adoption across various demographics.

### User-centric design and iterative feedback

An essential principle in the roll out of digital tax platforms is to emphasize user experience and accessibility (Singh, Patel and James, 2021). Governments can ensure a user-centric design by creating a platform that is easy to navigate, intuitive, and accommodates users with varying levels of digital literacy. For example, outside of the region, Finland has successfully integrated real-time feedback channels in their digital platforms, enabling spontaneous user input to guide further improvements and ensure the platform adapts to changing requirements. New Zealand adopts a similar strategy, actively collecting feedback and transparently sharing updates based on user suggestions, fostering a sense of community involvement and shared ownership. Additionally, the Government of the Republic of Korea employs artificial intelligence tools to analyse user feedback efficiently, pinpointing improvement areas more effectively. This approach of analysing extensive feedback to continually refine and align with user needs and expectations can be a model for other Governments in the region to enhance their digital services.

## Collaborative partnerships with the private sector

Engaging in collaborative partnerships with the private sector can serve as fertile ground for innovation and resource optimization (Harris, 2020). In India, the Government partnered with Infosys to revamp its income tax system, aiming to improve the taxpayer experience through a more responsive and intuitive interface. Outside the region, in Brazil for example, collaborations with companies, such as Serpro, have facilitated significant advancements in digitalizing tax processes, streamlining operations and introducing efficiencies. In the United States, the IRS has collaborated with various tech firms, including Intuit and H&R Block, to offer free tax-filing services to citizens, in a move aimed at making tax compliance more payer-friendly and efficient. In Estonia, which is often hailed as a digital society, the Government has fostered partnerships with various tech firms, nurturing an ecosystem where private sector innovation plays a critical role in public service delivery.

Such collaborations can engender more refined and efficient digital solutions, foster a broad base of stakeholder buy-in, and distribute the costs and risks associated with large-scale digital transformations. The different perspectives and expertise brought in through these partnerships serve to enrich the digitalization process, offering a well-rounded approach to ushering tax administrations into the digital age.

## Regular system audits and upgrades

A regimen of regular audits and upgrades ensures that digital tax platforms remain modern, secure and effective (Smith and Dawson, 2022). These assessments are pivotal in identifying vulnerabilities, enhancing efficiency, and earmarking areas ripe for refinement. In Singapore, the Inland Revenue Authority of Singapore (IRAS) actively solicits feedback, and regularly updates its systems based on insights gathered, fostering a culture of continuous improvement and responsiveness to the needs and preferences of its user base. The Republic of Korea's National Tax Service also stands as an exemplar in the realm of regular system evaluations and upgrades, investing in state-of-the-art technologies and expertise to ensure their digital platforms remain at the pinnacle of efficiency and security. By nurturing a culture of perpetual upgrades grounded in meticulous audits, Governments can ensure that their digital tax platforms not only remain in line with the evolving landscape but are also trusted by their users.

## Pilot programs and phased roll-outs

Before nationwide adoption, it is prudent to initiate pilot programs targeting specific regions or sectors, to accrue insights and facilitate a smoother transition to digital tax administration platforms (Lee and Tan, 2019). These pilot initiatives enable Governments to test the functionality and acceptability of digital solutions in real-world settings, identify existing and potential challenges, and refine strategies for broader roll-outs. India offers a demonstrable blueprint through its phased introduction of the Goods and Services Tax (GST) system. The Government undertook a stepwise approach, starting with awareness campaigns followed by pilot programs in selected states before a nationwide roll-out. This approach allowed for fine-tuning the system based on the feedback and experiences garnered during the pilot phase. In the Republic of Korea, the Government opted for a gradual introduction of its Home Tax Service. This permitted learning and adjustments over time, based on the feedback from the users during the early phases of the roll-out. By embodying a spirit of iterative learning and readiness to adapt, countries in the region can edge closer to a future where digital tax solutions are a catalyst for enhanced governance and sustainable development.

## Digital inclusion

**The prerequisite for digital inclusion is broadband accessibility, supported by the appropriate digital connectivity infrastructure.** Yet beyond this, the diligent planning and monitoring of digital technologies is necessary to avoid exacerbating existing inequalities. In this context, it is worth considering how universal and meaningful connectivity can be built, how the digital skills of marginalized groups can be strengthened and enabling ecosystems built while combating online violence against marginalized groups. For purposes of this report, digital inclusion is defined as “equitable, meaningful, and safe access to use, lead, and design of digital technologies, services, and associated opportunities for everyone, everywhere”. Promoting such digital inclusion is central to achieving the vision of the 2030 Agenda for Sustainable Development.

### Building inclusive connectivity

Building inclusive connectivity enables marginalized groups to harness the opportunities brought about by digital innovation and transformation. Three types of particularly noteworthy initiatives are set out below.

- 1 The Giga joint initiative of ITU and the United Nations Children’s Fund (UNICEF) works to connect every school to the Internet. It maps schools and their connectivity levels, mobilizes resources to accelerate the delivery of infrastructure, and supports Governments in procuring connectivity services. In Kyrgyzstan, Giga mapped the locations of all of the country’s 2080 schools, out of which 2061 are connected. Giga strived to connect the remaining 19 hard-to-reach schools located in mountainous areas, providing marginalized students with access to digital learning (Giga, 2023; UNICEF Kyrgyzstan, 2022).
- 2 The Smart Villages and Smart Islands initiative of the ITU empowers remote and marginalized communities by enhancing broadband connectivity, reducing costs and strengthening digital skills. In Vanuatu, the Government and ITU launched a pilot initiative in the southern region of Malekula to facilitate digital transformation at the grassroots level. Villagers have been connected to the Internet with Very Small Aperture Terminal (VSAT) satellite communications infrastructure. These efforts have helped transform remote villages and islands into digitally-enabled communities (Okuda, 2023).
- 3 Targeted financing of devices and Internet connection for marginalized communities can bridge usage gaps and digital divides. In India, Vodafone and Sonata Finance initiatives addressed the gender gap in accessing smartphones. The Smart Snehidi programme of Vodafone provided microloans to low-income women entrepreneurs for the purchase of smartphones. In addition to assisting women entrepreneurs in acquiring Internet-enabled devices, Sonata Finance sensitized older persons in rural communities to the advantages of women owning smartphones and using the Internet, tackling the cultural barriers related to women’s access to smartphones (Broadband Commission for Sustainable Development, 2022).

In addition to such interventions, universal service funds (USF) - collected via levies on telecommunication operators - can be used to support marginalized groups in accessing devices and services (See, for example, GSMA, 2023b and ITU, 2022a; ESCAP, 2017). The Government of Malaysia, in partnership with mobile network operators, used its USF to provide a partial subsidy for entry-level smartphone purchases by young people in rural areas. The Sanchar Shakti pilot scheme of the Universal Service Obligation Fund in India is another noteworthy example. The scheme promoted rural women’s access to information and communications technologies (ICTs), skills, knowledge, financial services and markets. Through a bottom-up and collaborative approach, the scheme covered mobile value-added services and involved self-help groups and other civil society organizations in the development of customized content for women in rural areas, such as education, training, employment, health and social care.

The design of ICT devices, apps, websites and services must incorporate accessibility features that cater to the needs of diverse population groups, such as persons with disabilities and older persons. The Government of China has formulated guiding standards and encouraged information technology companies to develop accessible products for persons with disabilities. Huawei undertook secondary development on Android's TalkBack feature to make mobile devices accessible for persons with a visual impairment. Alibaba set up an independent full-time team to support accessibility optimization of its various app products, including Alipay, a platform for payments and digital services. The Government of the Republic of Korea established the Age-Friendly Industry Support Center to promote the research and development of age-friendly technologies. It provided financial support to companies and offered consultations on the diversification and quality enhancement of products.

Applying the principle of universal design to technology development could maximize the benefits of digital innovation for marginalized groups and beyond. This means creating products and services in a way that allows them to be used by all people to the greatest extent possible, without requiring adaptation and specialized design. Examples of universal design include text-to-speech functions built into mobile phones and digital assistants enabling people to control various communication and home-based functions with their voice. The Government of Australia has actively developed legislation and policies to promote accessibility through universal design across sectors, including ICT and transportation.



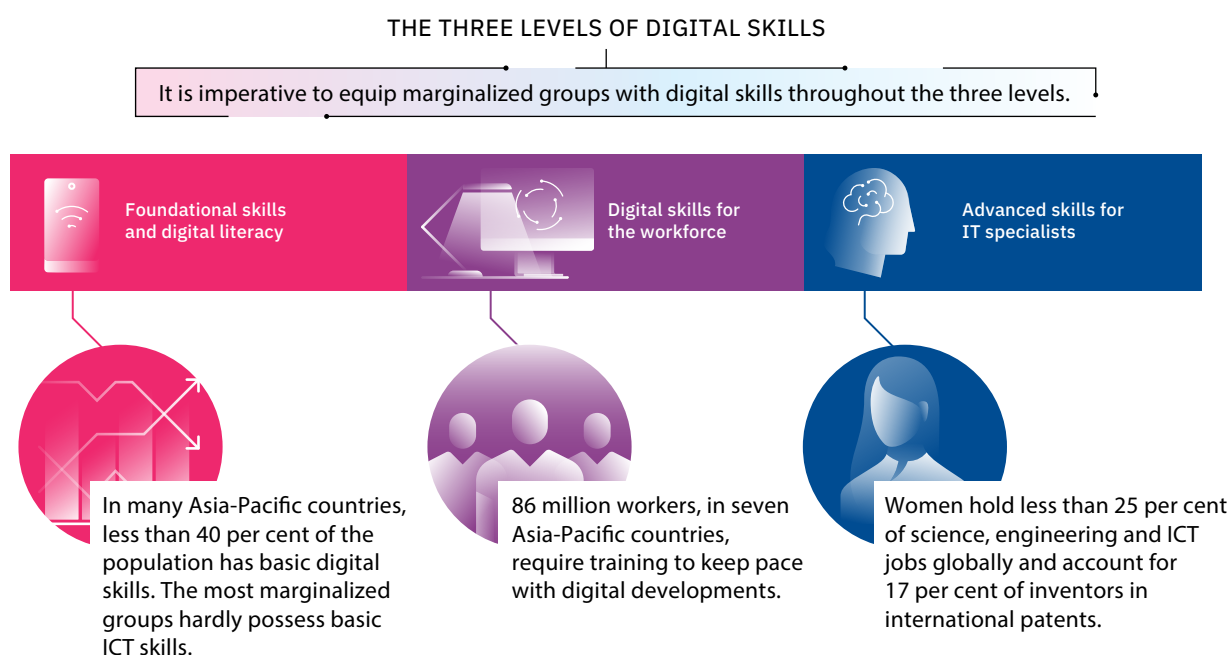
*The design of ICT devices, apps, websites and services must incorporate accessibility features that cater to the needs of diverse population groups, such as persons with disabilities and older persons.*

The effective engagement of people in vulnerable situations in the design, development, testing and assessment processes is essential to ensure the accessibility and relevance of digital products, services and content (United Nations Office of the Secretary-General's Envoy on Technology, n.d.). In Indonesia and Mongolia, UNICEF worked with adolescent girls and created an age- and culturally appropriate app, Oky, to improve their menstrual health and hygiene management. Insights into the needs of young women and girls were gathered through co-creation sessions, user-centred design, and remote and in-person user testing (UNICEF Office of Innovation, 2020). In Australia, a national-scale and indigenous-led technology development project was implemented to co-design a mobile app, #thismymob, with indigenous people. The app seeks to create a safe and culturally-sensitive online space for interactions between indigenous users and their communities (Lawrence, 2018; The University of Melbourne, n.d.). In Nepal, the Shuvayatra mobile app provides migration-related information in local languages, making the migration process smoother for individuals embarking on work opportunities outside Nepal. The app connects users to a rich repository of multimedia content supplied by their peers, experts and advocates (The Asia Foundation, 2016).

### **Strengthening the digital skills of marginalized groups and promoting their participation in science, technology, engineering, and mathematics (STEM) education and careers**

A significant digital skills gap exists in the Asia-Pacific region, particularly affecting women, older persons, and persons with disabilities. The continuum of critical digital skills for sustainable development can be considered on three levels: foundational skills and digital literacy, digital skills for the workforce, and advanced skills held by specialists working in the ICT sector (ESCAP, 2022a).

FIGURE 4.6 Continuum of critical digital skills



Source: Adapted from ESCAP, "Leveraging digital innovation for inclusive and sustainable development in Asia and the Pacific", working paper (Bangkok, 2023b).

Foundational skills and digital literacy are considered as one of the top barriers to Internet connection encountered by people who remain unconnected, particularly those in vulnerable situations (ESCAP, 2022a). These include using keyboards and touchscreens, managing files on laptops and basic online operations. In many Asia-Pacific countries with available data, less than 40 per cent of the population have basic digital skills (ESCAP, 2023c). In response to such skills gaps, several examples from region showcase how digital skills programmes can support marginalized groups. In Kazakhstan, a Government-led basic digital literacy program is offered free of charge in schools, colleges, and libraries, with a focus on older participants (GSMA, 2023a). Sri Lanka has established 300 centres in public libraries and religious institutions to provide digital training in rural, low-connectivity areas (UNESCO, 2020). New Zealand's Digital Literacy Programme for Seniors is designed to help older persons keep up with technology and gain confidence in online activities, supported by an Essential Digital Skills/Literacy Evaluation Framework to assess training quality (WHO, 2021).

In addition to foundational skills and digital literacy, proficiency in digital skills is essential for individuals to effectively navigate the evolving landscape of work. With the rise of technology, including digital platforms, big data, cloud computing and AI, the next five years are expected to bring significant business transformations. This technological shift is anticipated to result in a 2 per cent net decrease in current job opportunities, with substantial job growth in sectors like education, agriculture, and digital commerce, and declines in administrative, security, and traditional commercial roles (World Economic Forum, 2023). About 86 million workers in seven studied Asia-Pacific countries, representing 14 per cent of the total workforce, require training to keep up with these technological advancements (AlphaBeta, 2022).<sup>7</sup> Marginalized groups, such as women, persons with disabilities and migrants, are particularly vulnerable (ILO, Fundación ONCE, and ILO Global Business and Disability Network, 2021; European Commission and others, 2018).

The economic benefits of digital skills are evident. In the Asia-Pacific region, workers with advanced digital skills, such as software developers, earn 65 per cent more than their peers without such skills. Even those using basic digital tools, like email and word processing, earn 39 per cent more (Gallup, 2023). Recognizing this, Governments have initiated programs to upgrade workforce skills.

<sup>7</sup> The seven countries are Australia, India, Indonesia, Japan, New Zealand, Republic of Korea and Singapore.

For example, Singapore's SkillsFuture Digital Workplace initiative focuses on areas like automation and cybersecurity, targeting mid-career workers and small businesses (SkillsFuture Singapore, 2023). Yet the private sector's role in aligning digital training with market needs is also critical.

The benefits of partnerships among diverse stakeholders across sectors have been demonstrated in Australia, where a collaboration between the Queensland Government and Fujitsu Australia has launched a program for indigenous communities, focusing on digital skills for economic development (Fujitsu, 2022). In Bangladesh, a project led by the Bangladesh Business and Disability Network offers technical training and job placement support for youth with disabilities, with over 20 individuals finding employment and several employers becoming more inclusive (BBDN, 2023). Telegraph and Telephone Corporation in Japan supports working mothers, persons with disabilities, and diverse gender identities with flexible work arrangements and childcare support. This approach has led to increased female employment and representation of persons with disabilities in their workforce (ESCAP, 2023a; Nippon Telegraph and Telephone Corporation, n.d.).

Building inclusive education and training systems, including technical and vocational education and training (TVET), can help boost much needed equality and diversity in STEM fields. Initiatives, such as scholarships, curriculum improvements and mentoring, can enhance the effective participation of marginalized groups in STEM education and careers.

In the Philippines, for instance, various scholarship programs<sup>8</sup> promote female participation in STEM TVET. Additionally, the Technical Education and Skills Development Authority focuses on increasing female enrolment in non-traditional TVET programs through gender-sensitive training (UNESCO and UNEVOC, 2020). In Malaysia, ESCAP has collaborated with the National Council for the Blind, Malaysia (NCBM) to accelerate disability-inclusive digital transformation, for example, with trainings in web accessibility and advocacy skills for persons with disabilities (ESCAP, 2020). In Kazakhstan, Kyrgyzstan and Uzbekistan, UNICEF, in partnership with the Al-Farabi Kazakh National University and international experts, implemented the UniSat Nanosatellite program to tackle gender stereotypes in STEM and facilitate skills development. Girls and young women participated in a nanosatellite course, culminating in the launch of three nanosatellites for air pollution analysis in early 2022 (UNICEF, 2022).

## Developing enabling ecosystems that support the inclusion of marginalized groups in the digital age

Currently, many individuals from marginalized groups lack access to decent employment and social protection. Available data show downward trends in the female labour force participation rate in the region, standing at only 44 per cent compared to 73 per cent for men (ESCAP, 2023c; ESCAP and UN Women, 2020). The unemployment rate of young people aged 15 to 24 years is estimated to have reached 15 per cent, higher than for adults in many countries (ILO, 2023b). Additionally, a significant portion of older persons and persons with disabilities engage in informal or precarious work, leading to limited access to social protection. In Asia and the Pacific, only 44 per cent of the population and 25 per cent of people in vulnerable situations have access to social protection benefits.<sup>9</sup> Employment injury protection, unemployment benefits, and coverage for maternity, old age and disability are limited (ILO, 2021). Against this background, delivering impactful employment and entrepreneurship support, along with social protection measures, to marginalized groups is of paramount importance. Digital technology and innovation can enhance the effectiveness of public employment services (PES), digital labour platforms, support for micro-, small and medium enterprises (MSMEs) and social protection programs.<sup>10</sup>

<sup>8</sup> These programs are provided under the Universal Access to Quality Tertiary Education Act, Special Training Program for Employees, Training for Work Scholarship Program, and Private Education Student Financial Assistance.

<sup>9</sup> Calculated by subtracting from total population all people of working age who are contributing to a social insurance scheme or receiving contributory benefits, and all persons above retirement age receiving contributory benefits.

<sup>10</sup> For more information on harnessing digitalization to enhance the coverage, efficiency and effectiveness of PES, digital labour platforms, support for MSMEs and social protection programs, please see ESCAP, "Leveraging digital innovation for inclusive and sustainable development in Asia and the Pacific", working paper (Bangkok, 2023b). Available at <https://www.unescap.org/kp/2023/leveraging-digital-innovation-inclusive-and-sustainable-development-asia-and-pacific>.

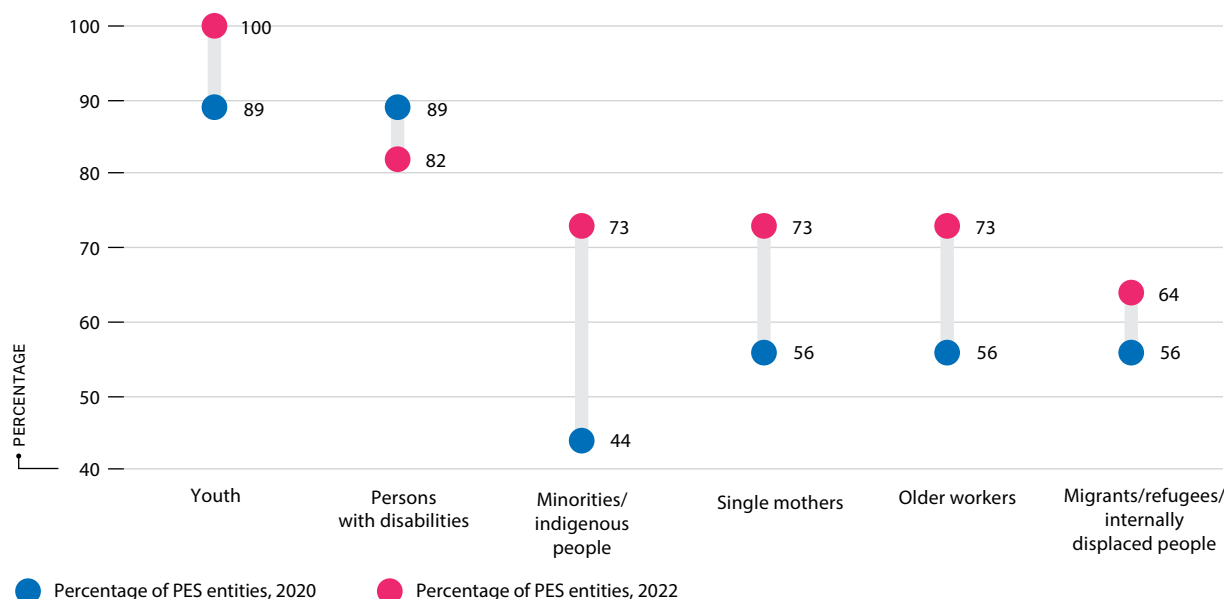


Public employment service agencies can improve their efficiency and service delivery by leveraging digital technology for back-office infrastructure and front-office services (OECD, 2022). The Government of Viet Nam has made efforts to connect its IT systems and create a unified digital back office. In Indonesia, recognizing the fragmentation of employment information systems at the provincial, district and city levels, the PES agency has developed an interconnected Employment Information System (SIAPkerja) to facilitate data-sharing among offices (ILO, 2023b). The availability of such back-office infrastructure enables targeted and enhanced services for marginalized groups. Similarly, New Zealand’s Occupation Outlook app helps jobseekers find employment opportunities, and Japan’s online employer portal connects employers with jobseekers (ILO, 2023b).

Big data and AI systems are being used for personalized job recommendations and vocational guidance. The Republic of Korea’s PES agency created “The Work”, an AI-based system available on the institution’s website. The system uses algorithms and psychological testing to analyse data from jobseekers and provide customized job recommendations. In addition, it offers personalized advice on training, qualifications, suitable enterprises and vocational guidance (ILO, 2023a).

Nonetheless, the International Labour Organization (ILO) surveys indicate that while technology has improved service delivery for various groups (figure 4.7) (ILO, 2023b), some groups including migrants, older workers, and single mothers, have not benefited as much. This underscores the need for specific inclusion programs to ensure equitable access to these digital services.

**FIGURE 4.7 Percentage of public employment service (PES) agencies reporting that technology has improved service delivery for jobseekers from marginalized groups, by survey year**



Source: International Labour Organization (ILO), “Technology in public employment services to promote youth employment in Asia and the Pacific” (Bangkok, 2023).

### Fighting violence against marginalized groups and protecting their rights

Digital platforms, while promoting connectivity and information-sharing, can also become places of online violence, particularly against marginalized communities. This violence manifests in various forms, including harassment, cyberstalking, and image-based abuse, often facilitated by the anonymity and extensive reach of digital platforms. Such negative experiences can deter marginalized groups from participating in digital spaces, further perpetuating existing inequalities and digital divides.

Particularly concerning is the prevalence of online gender-based violence, which poses significant challenges to women and girls, especially those with a notable online presence like politicians and journalists. Global studies reveal that a high percentage of women have experienced or witnessed online violence, with figures alarmingly high in regions like Asia and the Pacific (The Economist Intelligence Unit, 2021). Young women are also increasingly affected by online misinformation and disinformation, impacting their mental health and participation in civic activities (Plan International, 2021). Children and youth are not spared. Surveys conducted across various countries indicate that a significant portion of young people have been victims of online bullying, with the highest rates reported in Asian countries (UNESCO, 2015). Additionally, there is a growing concern about the sexual exploitation of children and adolescents in online environments (UNICEF, 2016).

Tackling online and technology-facilitated violence requires a comprehensive and integrated approach. This involves developing specific laws and policies, strengthening the capacity of the justice system, providing support to survivors, and conducting awareness campaigns. Collaboration is essential across various sectors, involving justice, social welfare, health, and education, as well as with stakeholders in the technology industry and civil society.

In Australia, the eSafety Commissioner (eSafety), the world's first government agency dedicated to online safety, exercises its regulatory power under the Enhancing Online Safety Act 2015. It has a team consisting of policy analysts, investigators, lawyers, educators, technology experts, digital specialists and other professionals. The team works to address violence across all platforms, including private messaging apps, video gaming platforms and dating websites. eSafety operates within a holistic framework comprising three pillars: prevention through research, education programmes and awareness-raising; protection through regulatory schemes and investigations; and proactive and systemic change informed by technology trend tracking. eSafety supports industries improve user safety standards and strengthen cross-border impacts (Council of Europe, 2022; UN Women, 2022; eSafety Commissioner, n.d.).

In the Philippines, to combat technology-facilitated child sexual exploitation and abuse, the Inter-Agency Council Against Child Pornography coordinates, monitors and oversees the implementation of the Anti-Child Pornography Act and the National Response Plan to Address Online Sexual Exploitation and Abuse. In 2019, the Philippine Internet Centre for Computer Crimes Against Children, composed of national and international law enforcement agencies, was set up to address specific technology-facilitated child sexual exploitation and abuse cases. Moreover, there are specialized units in the Philippine National Police, the National Bureau of Investigation and the Office of Cybercrime within the Department of Justice. Significant progress has been achieved, including the piloting of child-sensitive court procedures, the development of a multidisciplinary curriculum for Family Court judges and personnel, and the approval of the guidelines for the compensation of survivors (UNICEF, 2021).

The Asian and Pacific Training Centre for Information and Communication Technology for Development (APCICT), a regional institute of ESCAP, is proactively working to ensure that all members of society, particularly those at risk of marginalization, can benefit from technological advancements. Through comprehensive capacity-building programs, policymakers can be equipped with the necessary knowledge and tools to develop and implement inclusive strategies. These programs extend to empowering women entrepreneurs, an essential step towards economic inclusivity. In Thailand, APCICT in collaboration with the Ministry of Social Development and Human Security, the Digital Economy Promotion Agency, and Sukhothai Thammathirat Open University supports digital literacy among women entrepreneurs, students and youth, and assists older persons and persons with disabilities navigate the digital world. In Cambodia, the partnership with SHE Investments aids women entrepreneurs in using mobile technology for essential business functions such as bookkeeping and financial management. Similarly, in Fiji, APCICT's collaboration with the Ministry of Women, Children, and Poverty Alleviation focuses on training women entrepreneurs in digital marketing and e-commerce.

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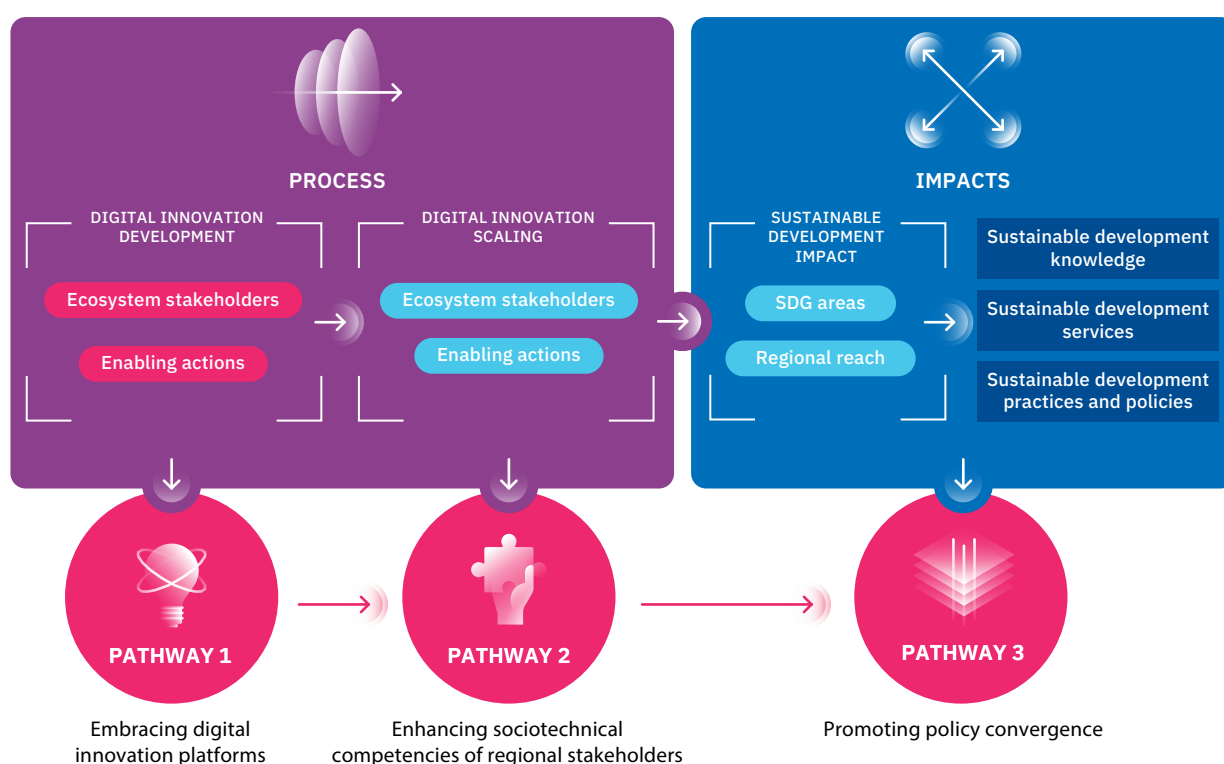
The background features a large, abstract graphic composed of numerous concentric, overlapping circles and arcs in various colors including pink, blue, yellow, and green. These lines are scattered across the dark blue background, creating a sense of dynamic movement and connectivity. The central text is positioned within the innermost part of this graphic.

CHAPTER 5

# Regional cooperation for digital innovation and sustainable development

**Regional cooperation can leverage the link between digital innovation and sustainable development in Asia and the Pacific.** Drawing on the framework proposed in Chapter 2 and the existing cooperation within the region, this chapter recommends the implementation of three pathways to accelerate progress towards the SDGs: embracing the platform model of digital innovation; enhancing multidisciplinary sociotechnical competencies for key regional stakeholders; and promoting policy convergence to strengthen enabling ecosystems and financing of digital innovations. Each of the pathways corresponds to one or more of the phases of digital innovation devised in the framework. Figure 5.1 provides a graphic representation of the correspondence between recommended pathways and components of the framework on digital innovation and sustainable development.

**FIGURE 5.1 Three cooperative pathways of digital innovation for sustainable development**



Source: ESCAP.

## Pathway 1: Embracing digital innovation platforms

**Governments should allow the development of digital innovation platforms with tools and resources which are not only beneficial in themselves but can also be used to support new applications.** This requires coordination among stakeholders from public and private organizations, as well as between countries. A notable example is that of disaster early warning efficacy. A seamless global-to-local weather information value chain is the digital collection, processing and transmission of Earth observation-generated information, at the upstream and downstream segment of the information chain. Platforms can enable connections between regional actors that can combine modular assets, such as data or applications, to produce novel offerings. This cooperative pathway focuses on embracing the platform model of digital innovation for sustainable development, predominantly during the development phase.

Following the “Government-as-a-Platform” (GaaP) model, Governments can shift from being exclusive policy executors to collaborating with a diverse network of individuals, including other public and private organizations, and those from other countries (Brown and others, 2017). Digital platforms can help Governments manage interactions within and across national borders and leverage this expanded network to improve services while reducing risk and improving scalability and inclusiveness. The sustainable development impact of digital innovation platforms is demonstrably superior to top-down innovation efforts if they combine flexibility and scalability with inclusivity and decentralized governance. Yet, the most relevant applications of digital innovation for sustainable development can only be as good as the data from which they are drawn. The platform model therefore requires domestic governance systems of big data assets, guided by evolving principles of data sovereignty and shared ownership at the global and regional levels.

Building on existing digital platforms can help shape the broader adoption of initiatives for sustainable development. India’s *Aadhaar* digital identity platform which matches citizens’ biometric and demographic data with recipients’ entitlements, enables accurate targeting, and reduces leakage and diversion of social protection payments. Careful platform governance is necessary to mitigate negative impacts on service inclusion and sustainability. There should be a focus on avoiding authentication mismatches on a platform, due to user errors or technology downtime, as these can wrongfully exclude entitled recipients. Similarly, certain platform design features which impose undue burdens on specific citizen groups must be avoided, such as increased monitoring of those distributing government benefits (Masiero and Arvidsson, 2021).

As the region’s most inclusive intergovernmental development platform, the secretariat stands ready to support its members and associate members in realizing this pathway through a number of options. One, it can continue identifying and promoting scalable solutions and measuring their impact. The secretariat’s analysis will ensure that effective practices are not confined to their place of origin but adapted and adopted widely. This is done by documenting good practices and providing a collaborative environment where member States exchange solutions and strategies that have proven to be effective. For example, one of the many ongoing efforts by the secretariat is the documentation of innovations in using geospatial information for sustainable development via the online *ESCAP Geospatial Good Practices Database and Dashboard*. Second, the secretariat will also continue to support capacity-building to strengthen institutional and operational capabilities as elaborated further in the next section. Finally, the secretariat can help promote practices and norms necessary for implementing more accurate measurements of the impact of digital innovations on sustainable development, data-sharing principles and enabling policies for replicating success at scale and engaging a wide range of stakeholders in the process of developing, scaling, and increasing the impacts of digital innovations.

The secretariat is using the platform model to lower the entry barriers to adopting geospatial information-driven digital innovations through South-South cooperation. Under the Regional Space Applications Programme for Sustainable Development, the secretariat, the Aerospace Information Research Institute of the Chinese Academy of Sciences, and the Geo-informatics and Space Technology Development Agency of Thailand are working together to enhance the capacity of countries in the lower Mekong region to use cloud computing, machine learning, and big Earth data for crop monitoring to support resilient agriculture. Technical support is being provided to customize systems to suit local circumstances, generate indicators that are relevant to local and national decision makers at lower cost, and conduct field checks to verify the accuracy of crop information by comparing space data with ground data. Capacity-building support is being extended to technical professionals to help them process and interpret the data in user friendly formats. The ambition is to significantly increase access to crop monitoring systems with new digital innovations to process and deliver satellite data in the region based on requests by countries.



## Pathway 2: Enhancing sociotechnical competencies of regional stakeholders

**Digital innovation for sustainable development is a multidisciplinary sociotechnical endeavour.**

This means that digital innovation should not be viewed as a replacement for effective governance, but rather its complement. With this in mind, this cooperative pathway supports the scaling phase of digital innovations for sustainable development.

The development of training programmes for government officials is necessary as public administration employees can benefit from stronger AI skills. Public managers frequently lack expertise and access to individuals with multidisciplinary competencies who can effectively use AI technologies to their advantage (Ahn and Chen, 2022; Neumann, Guirguis and Steiner, 2022). The Asia-Pacific region should consider expanding existing regional efforts to develop digital innovation competencies in the government, as well as adapting relevant programs from outside the region. An example of a successful effort is represented by AI4GOV, the International Master's Programme in Artificial Intelligence supported by the European Union and developed by a consortium of European universities. Similar experiences can be used as a template for regional initiatives.

Aside from short-term training programs for sociotechnical competency in the public sector, digital innovation requires the development of relevant skills through life-long educational programmes. As the existing workforce matures in the tech industry and in other industrial sectors, there is an imperative to continuously update competencies. Programmes of life-long learning should be incentivized by Governments by establishing standard certification requirements in businesses, as well as by stimulating the creation of a market of educational offers in the region.

As digital tools and platforms become integral to public administration and service delivery, policymakers need to be adept in addressing the complexities of digital government. ESCAP's Asian and Pacific Training Centre for Information and Communication Technology for Development (APCICT) assists policymakers to take a whole-of-government approach to deepen their grasp of the technology landscape and apply digital technologies across policy domains. Its educational programmes prioritize competencies enabling seamless integration of digital innovation into effective governance frameworks and support strategic skills tailored to regional sustainable development needs.

For example, in the Lao People's Democratic Republic, APCICT has collaborated with the Ministry of Technology and Communications in training senior-level officials from ministries and local governments on the key principles for formulating effective digital government policies, while effectively safeguarding information security and privacy. In the Philippines, it worked with the Development Academy of the Philippines to provide local chief executives with a deeper appreciation of digital government strategies, the need for data-driven decisions, and the importance of data privacy and protection.

APCICT programmes have also focused on the ethical, societal, and economic challenges of emerging innovations, so as to maximize benefits and minimize potential pitfalls. In Indonesia, APCICT cooperated with the Ministry of Communication and Information Technology in raising awareness among policymakers, from central and local governments, on the opportunities and challenges of applying frontier technologies such as IoT and blockchain. Programme participants were introduced to the importance of upholding human rights in the era of AI, and how ethical considerations can be integrated into the development and deployment of AI systems.

Integrating digital solutions for disaster risk management and climate action is another area of focus. In Nepal, in partnership with the National Disaster Risk Reduction and Management Authority, APCICT trained government officials on the overall framework of disaster risk management and the practical use of ICTs in disaster prevention, preparedness, response and recovery. A similar training was undertaken in Mongolia, in cooperation with the National Emergency Management Agency, where participants learned about the applications of ICTs in addressing the challenge of natural hazards and resilient development.

The secretariat is also promoting the use of machine learning for analysing big Earth data through its Risk and Resilience Portal. It has also initiated several activities to build the capacity of developing countries in this domain. In collaboration with the United Nations University, Institute for Water, Environment, and Health, it is developing online courses, tools, and the Flood Hotspot Mapping Tool. These resources are designed to enhance the expertise of professionals in governments to use digital innovations for effective and evidence-based monitoring of SDGs, thereby accelerating their implementation.

## Pathway 3: Promoting policy convergence

**Increasingly harmonized policy frameworks across the Asia-Pacific region can support digital innovations by nurturing their growth, scale and alignment with the SDGs.**

First, the development of a shared methodology to identify key performance indicators and common regional metrics could support this endeavour by building a shared understanding of how digital innovations are impacting SDGs and long-term societal values.

Second, the development of predictable and converging digital data management policies across countries of the region is important. Big data assets need to be governed by regionally supported principles of data sovereignty and concurrently shared ownership. This means data should be subject to the governance, jurisdiction, and privacy policies and regulations of the country where it is located, and that such policies and regulations should seek convergence through regional approaches. Implementing shared ownership, both at the country and regional levels, can prevent concentrated control over data, empowering small and medium enterprises, NGOs and citizens. Regional forums and digital communities should be encouraged to facilitate negotiations on such convergence, drawing on experiences from global and regional climate policy. Such approaches, besides promoting consistency in innovation policies and stimulating further investments at a regional level, can also promote inclusive digital platforms.

Regional approaches that move towards standardization to measuring the impact of digital innovations can help ensure that investments in digital innovation result in inclusive and accessible technologies. Existing benchmarking tools often overlook the sustainable development impacts of digital innovations and lack regional specificity. Tools like the UN E-government Development Index (EGDI) and the Digital Economy and Society Index (DESI), for example, demonstrate the value of such assessments. For more than a decade, EGDI has been the key measurement for establishing an increasing focus on digital government initiatives by countries across the globe (Misuraca, Medaglia and Aquaro, 2021). Measuring challenges and progress in climate action is another area where relevant efforts have supported investments in initiatives to drive sustainable development (ESCAP, 2023). However, the Asia-Pacific region requires its own metrics that consider not only metrics of the impacts of SDG targets, but also metrics of reach and type of impact. The framework proposed in this paper can provide a blueprint for developing new metrics. The framework, in fact, has not only a descriptive potential use, but also a normative one.

Third, the convergence of definitions on what is meant by meaningful universal connectivity, digital trade, financing and investment for innovation is equally important for measuring impacts. This requires collaboration among governments, private sector operators and financial institutions. By aligning policies and financial strategies, Asia and the Pacific can collectively enhance the scalability, accessibility, and impact of digitally-driven sustainable development.

## ESCAP initiatives in support of the three pathways

ESCAP supports several cross-cutting initiatives to promote the three pathways.

### 1 The Asia-Pacific Information Superhighway

The Asia-Pacific Information Superhighway (APIS) is enhancing the availability and affordability of broadband Internet across the Asia-Pacific region. The APIS, supported by the secretariat, aims to foster regional cooperation in developing ICT infrastructure, services, and applications. Its goals include expanding broadband in underserved areas, promoting digital inclusion, and enhancing cross-border ICT infrastructure. This initiative is operationalized through an Action Plan for 2022–2026, which promotes research and partnerships among multiple stakeholders, especially between civil society and government, to address the digital divide in rural communities, build capacity and facilitate information-sharing. Aligned with the Secretary-General’s report, *Our Common Agenda*, APIS promotes regional policy dialogues with the ambition to build a seamless information and communication space for universal access. APIS exemplifies how ESCAP can support the platform model of digital innovation.

### 2 ESCAP initiatives on harmonization and interoperability of transport digitalization

ESCAP is leading initiatives that support the harmonization and interoperability of transport digitalization. This includes developing a regional road map, and policy and regulatory frameworks for smart transport systems, as well as guidelines on smart mobility and transport Big Data. The regional road map outlines major strategies and corresponding policy plans that countries in the region can refer to when devising or updating their smart transport-related policies, plans and strategies. Establishing a dedicated cooperation mechanism for smart transport systems in Asia and the Pacific is one policy plan that it proposes. The Regional Action Programme on Sustainable Transport Development in Asia and the Pacific (2022-2026) aims to deploy smart transport systems, to increase the awareness of innovative technologies and the use of big data, to interconnect maritime and port systems, and shift to smart regional transport networks.

This also involves digitalizing the regional transport network composed of the Asian Highways, Trans-Asian Railways Network, dry ports and seaports. Countries in the region are already implementing transport digitalization and policy harmonization initiatives along the Asian Highway Network. Countries in South-East Asia, for example, Malaysia, Singapore, and Thailand in the North-South corridor and through Cambodia, the Lao People’s Democratic Republic, Myanmar, and Viet Nam in the East-West corridor, have been implementing the ASEAN customs transit system. In South Asia, India and Nepal have taken steps to use innovative technologies to facilitate transit transport. Successful testing of tracking technologies along the transit route between India and Nepal demonstrated reduced transit transport costs for landlocked Nepal.

Similarly, Armenia, Belarus, Kazakhstan, Kyrgyzstan, and the Russian Federation signed an agreement on the use of navigation seals in April 2022. Upon ratification, the use of electronic seals will minimize control measures at the internal borders and increase efficiency of transit transport among the participating countries. Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan recently agreed to boost digitalization of land transport during the 5th Consultative Meeting of the Heads of States of the countries of Central Asia in September 2023 (News Central Asia, 2023). These developments reflect an increased regional collaboration among Asian Highway Network member countries, coordinating digitalization efforts across multiple transport modes.

Another good example of the regional cooperation on digitalizing the Asia-Pacific transport network is the new Annex on “General principles on electronic information exchange/data interchange among railways and between railways and control agencies along the Trans-Asia Railway network” adopted by the Parties to the Intergovernmental Agreement on the Trans-Asian Railway Network on 15 September 2023. The implementation of the new Annex would help harmonize and streamline digital rail border crossings processes including integrated risk assessment and joint execution of control measures both behind and across borders.

### **3 The Framework Agreement on Facilitation of Cross-border Paperless Trade in Asia and the Pacific**


The Framework Agreement on Facilitation of Cross-border Paperless Trade in Asia and the Pacific (CPTA) is an instrument accessible to countries at all levels of development to enhance their capacity to engage in cross-border paperless trade, and with the objective of accelerating the implementation of digital trade facilitation measures for trade and development. It is expected to reduce existing transaction costs by up to 30 per cent once it is fully implemented (Duval, Utoktham, and Kravchenko, 2018). Countries are increasingly acceding to regional agreements because it streamlines trade processes and facilitates exchange and mutual recognition of documents.

Legislative frameworks like the UNCITRAL Model Law on Electronic Transferable Records (MLETR) 2017, and the Model Law on the Use and Cross-border Recognition of Identity Management and Trust Services 2022 also facilitate electronic commerce. Although the model laws are not legally binding, they serve as internationally acceptable guidelines for the drafting and amendment of domestic laws. The United Nations Convention on Electronic Communications in International Contracts (ECC) further supports these initiatives, ensuring the legal validity and enforceability of electronically concluded contracts. Only a small number of Asia-Pacific economies are so far part of the CPTA and the ECC, highlighting the great remaining potential to harness existing agreements more effectively to facilitate cross-border e-commerce and other forms of digital trade.

Building on all these initiatives to implement the three pathways can consolidate the contribution of digital innovation towards the efforts of the Asia-Pacific region to achieve sustainable development. In a region where digital technologies are driving unrivalled innovation, supporting these technologies to accelerate progress requires collaborative governance and effective policy frameworks. Leveraging artificial intelligence, digital finance, GovTech, and the Internet of things comes with challenges but offers an unparalleled opportunity for progress. To achieve the 2030 Agenda for Sustainable Development, it is an opportunity which the Asia-Pacific region must seize.

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In an era of rapid digital transformation, Asia and the Pacific is uniquely placed to leverage digital technologies to overcome its sustainable development challenges. Already, the region is recognized as a dynamic hub for digitally-driven innovation fuelled by pioneering technologies, such as artificial intelligence, digital finance, GovTech, and the Internet of things. Yet, to encourage further ingenuity and tap into digital innovation to bolster the huge collective effort that is required to achieve the Sustainable Development Goals, the region needs a plan.

To help shape a coherent, inclusive approach, this report examines existing digital innovations which have accelerated progress towards sustainable development and explores ways to build on their successes. It proposes a framework to understand the interlinkages between digital innovation and sustainable development, investigates current and emerging practices, explores how an enabling environment might be created and provides recommendations for regional cooperation. To achieve the 2030 Agenda for Sustainable Development, a deliberate, strategic push is required. This report aims to inform this effort, which ESCAP stands ready to support at every step of the way.

