



REALIZING DIGITAL POTENTIAL IN NORTH AND CENTRAL ASIA

Summary

The paper provides an overview of the degree of digital transformation in North and Central Asian countries. It contains a discussion of opportunities and challenges posed to economies by digitalization and its potential to facilitate sustainable economic transformation and the achievement of the 2030 Agenda for Sustainable Development. Many national policies and legal frameworks in the subregion were developed in pre-digital eras. In the past decades, it became increasingly evident how digital solutions in manufacturing, agriculture and services can have tremendous effects on productivity, employability and social well-being. The recent pandemic and its aftermath highlighted the crucial role digitalization efforts play in the field of education and public services, as well as the future development of the subregion.

Various private sector initiatives as well as governmental policies have been implemented in this regard throughout North and Central Asia. Nevertheless, challenges such as infrastructure development, digital literacy and technological competitiveness prevail and hinder the realization of digital potential in the subregion. North and Central Asian countries exhibit heterogeneous degrees of digital transformation, however, the economies face similar challenges that policymakers need to address. Based on the assessment of the status of digital technologies in the subregion, four focus areas for digitalization efforts were identified: e-commerce, financial sector, agriculture and supply chains and logistics. Concrete policy actions to apply in these areas are: (i) design clear national policies and action plans for the development of the digital economy; (ii) consider implementing regulatory sandboxes to test the effects of new legal acts concerning digital technologies; (iii) increase investments for science, technology and innovation activities; (iv) improving data exchanges within the country and within the subregion; and (v) strengthen regional cooperation in digital infrastructure development. These efforts to realize digital potential in North and Central Asia will accelerate the achievement of the Sustainable Development Goals.

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1. Introduction

As technological innovations progress, the digital economy has become a crucial sector within national economies. In the era of globalization, digitalization in production, finance and education became indispensable for countries to actively take part in more efficient global value chains and benefit from global connectivity. In recent years, many North and Central Asian countries have initiated activities to tap into the growing potential of digital transformation, and they have facilitated strong research and development (R&D) sectors to become hubs of digital development in the subregion. However, there are still certain gaps, such as in infrastructure development, digital literacy and technological competitiveness, that limit the realization of their digital potential. Recognizing the importance of digitalization and the key role of regional cooperation to realize digital potential in North and Central Asia, the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP) has been working closely with member States and relevant stakeholders, such as the Eurasian Development Bank, through different platforms to facilitate knowledge sharing and capacity-building efforts.

This paper provides a discussion of the opportunities and challenges of digital transformation in the economies of North and Central Asia. It underscores the potential of digital transformation to facilitate sustainable development in the subregion in line with the Report of the United Nations Secretary General on the road map for digital cooperation, the Asia-Pacific Information Superhighway initiative and its Master Plan for 2018–2021¹ and the United Nations Special Programme for the Economies of Central Asia (SPECA) Innovation Strategy for Sustainable Development, among other global and regional frameworks. It provides an overview of the level of digital transformation in each of the North and Central Asian countries, including private sector initiatives, governmental policies and intergovernmental recommendations. Based on an assessment of the status of digital technologies in the subregion, four focus areas of digital transformation can be identified, namely: e-commerce, financial sector, agriculture, supply chains and logistics. Policy recommendations are provided considering the crucial role of Governments in enabling digital transformation and targeting the geographic and demographic peculiarities of North and Central Asian economies.

1.1 Opportunities and challenges of the digital transformation

A confluence of technological advancements, ranging from the progress in digital technologies, new materials and biotechnologies, open new opportunities for socioeconomic growth and industrial development. Scholars and practitioners conceptualized effects of emerging technological opportunities such as Industry 4.0, the Next Production Revolution, the Third Wave, or Smart Manufacturing. Combined with other global trends such as depleting natural resources and global warming, technological advancements will reshape industrial production, having tremendous effects on productivity, employability and social well-being. The next production revolution offers a variety of opportunities for economic development through optimization of processes and resource use, mass customization of products and services, automatization of industrial production and human-machine interaction (Lu, 2017).

Digital technologies, including artificial intelligence and big data, are general purpose technologies, which have “a range of characteristics [and are] particularly well placed to generate longer-term productivity increases and economic growth across a range of industries” (OECD, 2010). In comparison to previous stages of industrial development, the ongoing transformation of industrial production is characterized by higher volatility and speed of change. In traditional industries with high levels of R&D

¹ See www.unescap.org/events/fourth-session-asia-pacific-information-superhighway-ap-steering-committee-and-wsis-regional.

intensity, such as the automotive industry, innovation cycles usually take five to seven years. In the information and communications technology (ICT) sector, innovation processes have a much faster pace, from several weeks to several months. In the digital economy, all market incumbents from traditional sectors are facing the challenge of the transition to more agile and pro-active approaches. This process can be rather painful for enterprises as it requires shifting to a start-up mentality with flatter organizational hierarchies that improve information exchange and contribute to agile decision-making.

As opposed to a linear model of innovations, when innovation inputs are gradually transformed into innovation outputs, innovation activities in the digital economy evolve in parallel to each other and are characterized by constant improvements through feedback from customers. While the economic value in traditional industries is created within the enterprise, in the digital economy the value is created outside the boundaries of an enterprise at the moment of interaction among partners, suppliers and customers. The close nature of collaboration with external actors is dictated by the rising importance of data as a core input into innovation activities. The search for greater access to larger data volumes makes enterprises more externally oriented. The increasing technological complexity and the novelty of digital tools can be no longer treated by stand-alone enterprises. The emerging increase in partnerships and networking observed across industries illustrates the necessity to pool resources for R&D investments and unite scarce digital skills and competences. The essential competitive advantage in the digital economy is the ability to benefit from open innovations and crowd sourcing opportunities. That requires changes in organizational cultures to overcome resistance to using solutions developed externally.

As digitalization is increasingly taking place, data and algorithms are becoming key inputs for the development of new products and services. Due to their non-rivalry nature, data sets can be used without depletion by an unlimited number of users. Another feature of data is the fluidity, an ability “to be reproduced, shared or manipulated instantaneously, at any scale and at no cost” (OECD, 2018). Low costs of data processing and advances in machine learning and natural language processing algorithms contribute to a ‘scale-without-mass’ effect which makes it possible to scale up operations and increase market shares without significant follow-up investments.

Impacts of digital technologies and data-driven approaches on business organizations are very versatile and include shorter innovation cycles, mass customization, on-demand production and optimization of development, distribution and maintenance processes. Virtual simulations, digital twins and 3D printing enable greater levels of experimentation and streamlining of innovation processes. Digital products and services can be released early in alpha versions with updates and improvements to be made later on based on customer feedback and the analysis of trends of use. Access to ample and timely data enables more effective predictive maintenance of equipment (Susto and others, 2015).

Advanced prediction models and machine learning technology can forecast a malfunction before it happens, thus contributing to significant efficiency gains and the value creation if the malfunction is prevented. Proliferation of smart and connected devices and advances in algorithms enable major shifts in enterprise operations. Manufacturing enterprises are increasingly engaged in developing complementary digital services that would enhance the functionality of their products and create new revenue streams (Roy and others, 2009; Holmström and Partanen, 2014). The blurring of boundaries between products and services, often referred in the academic literature as “digital servitization”, enables transformational shifts in how economic value is created (Tronvoll and others, 2020).

Artificial intelligence can be applied to detect patterns in existing data sets, thus laying a foundation for drawing conclusions on current and future behaviours of manufacturing systems (Alpaydin, 2009). That is especially valuable for complex environments where identifying the causes of problems can be

very challenging. Machine learning can identify risks from failed internal processes, human mistakes and external factors and inform decision-making before negative impacts fully take place. Additionally, algorithms based in artificial intelligence can reduce cycle times and improve the use of resources.

Unlike physical products that have high marginal costs, digital solutions have zero marginal costs enabling digital businesses to scale up quickly. Digital solutions can be replicated and transported to global markets at nearly zero cost, thus enabling higher dynamism of cross-border trade. The phenomenon of scaling digital businesses in national and international markets having very limited human and financial resources is described as “scale-without-mass” (Brynjolfsson and others, 2008). Thanks to this ability, small and medium-sized enterprises (SMEs) in developing countries can gain access to global markets and create significant economic value even in spite of imperfect domestic business conditions and regulatory environments.

According to OECD (2019), the accumulation and combination of unique digital skills and competences with advanced managerial practices can enable urban agglomerations to serve as major hubs for the development of the digital economy. In this regard, policy initiatives aimed at developing economic clusters gain new importance for the digital transformation of the economy, government and society. While ensuring the inclusion of all regions and societal groups in the benefits of the digital transformation, national governments also need to consider supporting the development of centres of excellence and urban innovation ecosystems to accelerate digitalization and pave the way for other national stakeholders.

1.2 Digital transformation and sustainable development

Digital transformation provides enterprises with unparalleled opportunities to improve profitability and better serve customer needs. Described as an intervention into the DNA of an enterprise (Stief and others, 2016), digitalization calls for the reconsideration of conventional business practices and methods. Artificial intelligence and associated technologies (machine learning, natural language processing, neural networks) have a potential to contribute to efficiency gains and revenue streams at enterprises. The positive contributions of these technologies can be applied even beyond the private sector, as the development of e-governance would also increase the speed and efficiency of administrative processes.

As digitalization increasingly takes place, however, similar drawbacks crystallize throughout economies and societies. Recent research underlines that automatization and an associated progress in applications of artificial intelligence in production will eventually reduce job opportunities and increase unemployment (Frey and Osborne, 2017). While contributing to value creation, economic activities augmented by digital technologies will not require as many workers and a significant part of the population will remain unemployed. To deal with the potential and existing risks of digital technologies for employability, some developed countries are considering a broad array of experimental policy interventions ranging from the introduction of the universal salary to taxing robots and data centres. It needs to be emphasized that digitalization coupled with evidence-based policies can enable the development of digital technologies to go hand-in-hand complementing socioeconomic well-being.

According to academic findings (Balsmeier and Woerter, 2019), enterprise investments into digital technologies are positively correlated with the employment of high-skilled workers and are negatively correlated with the employment of low-skilled workers. As low-skilled jobs are in danger in the long term, governments are faced with the need to offer opportunities for life-long learning and retraining. Taking into account the existing level of technological capabilities and the capacities of enterprises to successfully integrate them into existing business models, the digital transformation at the current stage will mainly contribute to substituting specific tasks, rather than entire jobs. Automatization

mainly concerns simple and repetitive tasks providing a chance for people to engage more closely with creative tasks and dedicate more time to develop their talents.

The proliferation of digital technologies occurs unevenly across societies contributing to digital divides based on gender, geographical location and age. On average, the number of women pursuing careers in the ICT sector and developing programming competency is significantly smaller. Gender inequality remains a challenge in the subregion and is reflected in the sphere of science, technology and innovation, with unequal access to technology and relevant opportunities between men and women. Rural areas tend to have a very limited access to high quality fixed and mobile broadband infrastructure compared to urban centres. Few older people have sufficient skills and competences to be competitive on the job market in the digital age. Without having access to retraining opportunities, there is a risk that large parts of the population will be excluded from the digital economy. Resilient digital infrastructure has the potential to bridge the rural-urban divide accompanied by digital literacy. Inclusive sustainable development is reachable if women, rural population and elderly obtain appropriate digital skills. In order to avoid that only selected groups benefit from the opportunities of digitalization, it is important to ensure a multistakeholder approach aligning the development of inclusive digitalization with the 2030 Agenda for Sustainable Development.

2. The status of digital technologies in North and Central Asia

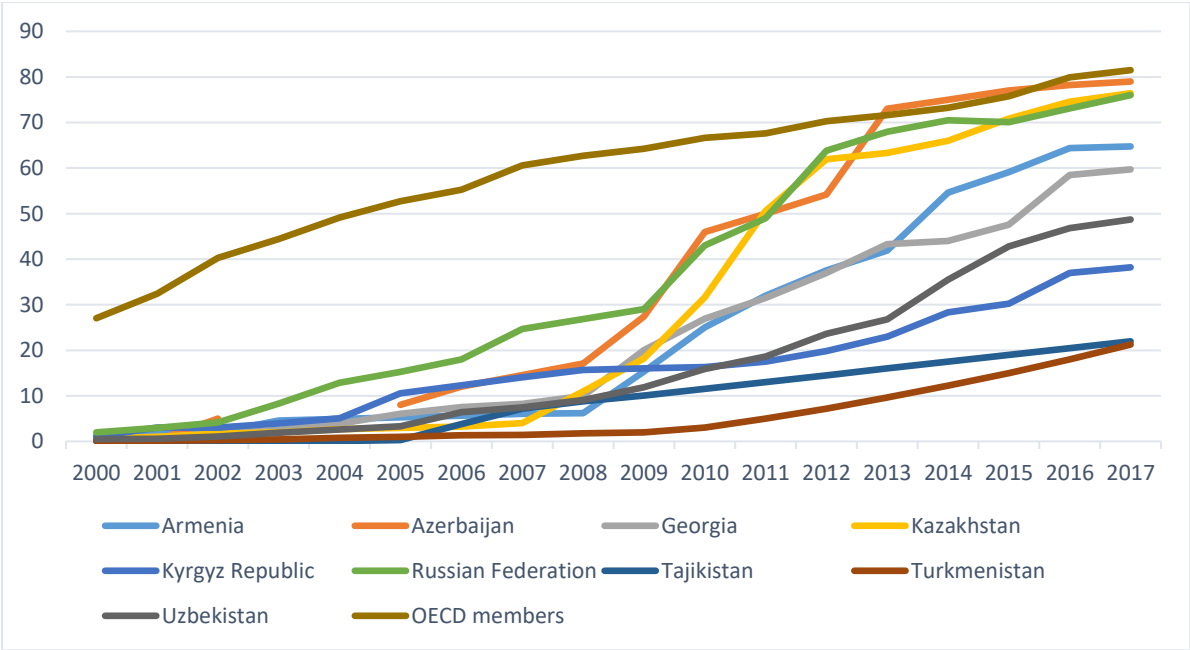
North and Central Asian countries face numerous challenges in adopting digital technologies for economic growth and social welfare. Legal frameworks are not fully mature to effectively support the digital economy. Technology governance and preparedness for recent advancements in digital technologies are still under development (Dutta and Lanvin, 2019).

Cheap access to reliable and fast Internet is essential to enable the development of the digital economy. Access to mobile Internet connections in North and Central Asian countries has been on the rise, while the number of fixed connections saw a decrease. The share of individuals using mobile Internet has grown significantly since 2000 (figure 1). In 2017, Azerbaijan, Kazakhstan and the Russian Federation approached the average share of the OECD member countries, while Turkmenistan and Tajikistan demonstrated sluggish growth in access to mobile Internet.

Limited access to mobile Internet is a serious obstacle to the development of the digital economy and e-commerce in particular. Digital Subscriber Lines (DSL) form the ICT infrastructure in the North and Central Asian countries, while the development of fibre-optic networks that can provide faster Internet access has just recently started in Kazakhstan and the Russian Federation. Other countries of the region do not have any active projects to build fibre-optic networks.

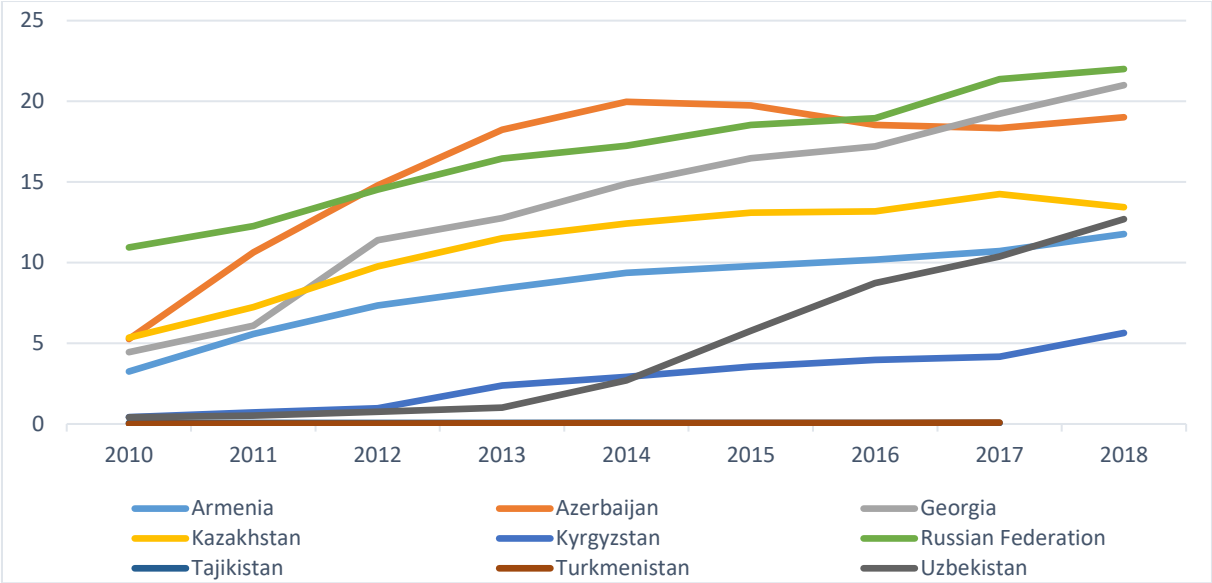
Fixed broadband subscriptions were rising constantly throughout the past decade in most of the countries in North and Central Asia (figure 2), and include cable modem Internet connections, fast DSL, fibre optics and similar technologies. As the figures below show, mobile Internet subscriptions surpass subscriptions for fixed broadband. The importance of mobile Internet is high for individuals in the subregion and suffices their needs. Nevertheless, stable and reliable fixed broadband connections are a crucial part of ICT infrastructure and are indispensable for academia, the private sector and the government, and thus the proliferation of fixed broadband requires committed investment.

Figure 1. Number of mobile Internet subscriptions per 100 persons



Source: International Telecommunication Union (ITU).

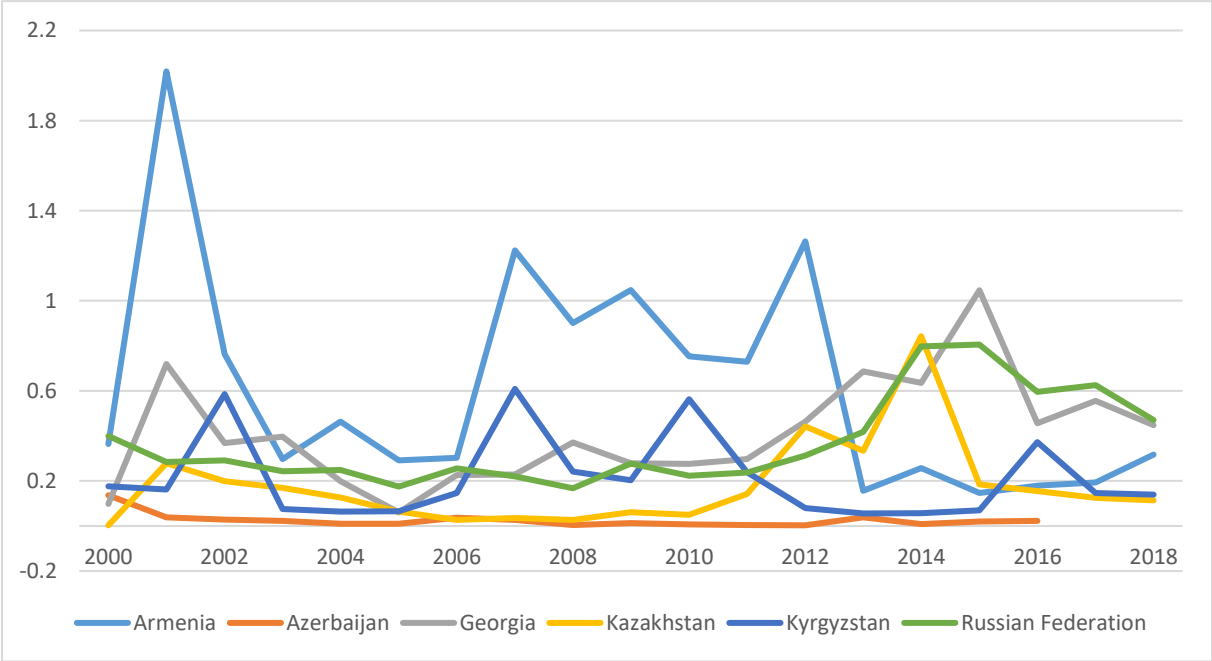
Figure 2. Number of fixed broadband subscriptions per 100 persons



Source: World Development Indicators, World Bank.

The share of ICT products in the exports in North and Central Asian countries as of 2018 was around 0.23 per cent on average, far below the average of 7.1 per cent for OECD member countries.² This low share can be attributed to economic structures that are less diversified and still demonstrate high reliance on exports of natural resources. ICT products occupy a more distinct share of Armenian exports compared to other countries of the region, which may illustrate the significance of the ICT sector and, at the same time, the growth constraints of other industrial sectors in Armenia (figure 3).

Figure 3. Share of ICT products in exports



Source: World Development Indicators, World Bank

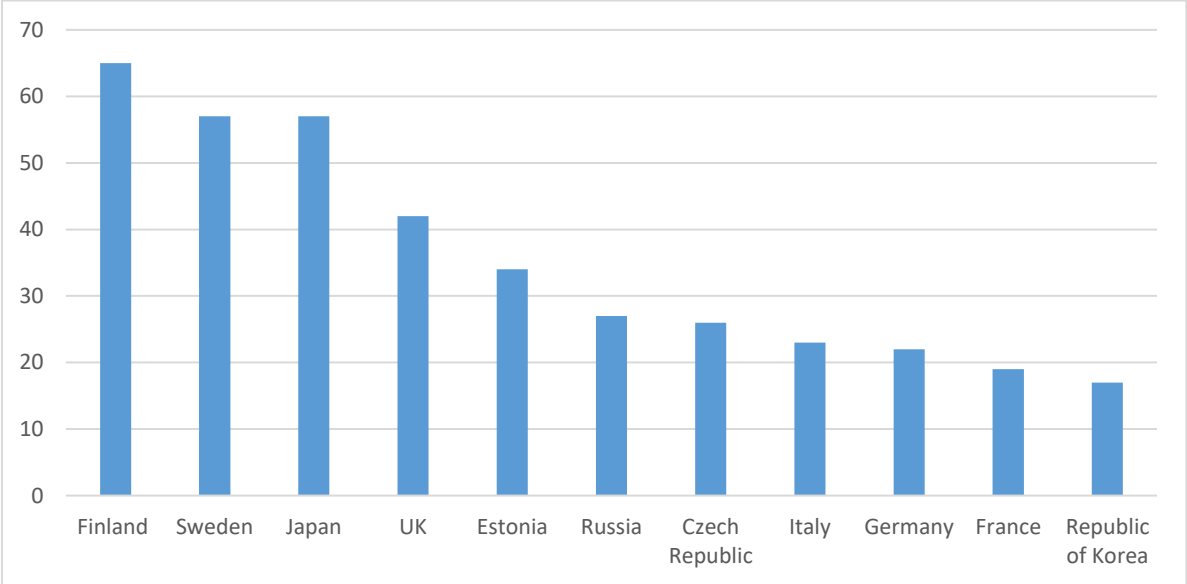
Note: Data on Turkmenistan, Tajikistan and Uzbekistan are not available.

² World Bank data, no values available for Tajikistan and Turkmenistan.

Data on the use of enterprise resource planning (ERP) and customer relationship management (CRM) systems can serve as a valuable indicator of the digitalization level of the economy. Due to the novelty of this indicator, national statistical offices in North and Central Asia do not always possess this information. For the Russian Federation, which has generally higher levels of the socio-economic development in the region, shares of enterprises in 2018 that adopted ERP and CRM systems amounted to 21.6 per cent and 17.6 per cent, respectively (Abdrakhmanova and others, 2019). For other countries of the region, these indicators are expected to be lower. The use of ERP and CRM systems in North and Central Asia is below the level of most European countries. In comparison, the share of Estonian enterprises with ERP and CRM systems reached 28 per cent and 24 per cent in 2018, while the same indicators for Finland were at 39 per cent and 39 per cent, respectively.

Another indicator that can show the degree of digitalization is cloud computing. Cloud computing is “on-demand network access to a shared pool of configurable computing resources (i.e., networks, servers, storage, applications and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction” (World Bank, 2016). In 2018, the share of Russian enterprises using cloud technologies was 27 per cent (figure 4).

Figure 4. The share of enterprises using cloud technologies in 2018



Source: Abdrakhmanova and others, 2019.

The above indicators show the differences in digital development in North and Central Asia and also illustrate the importance of further investments in the development of digital infrastructure in the subregion. The deployment of better infrastructure will form a solid foundation that countries can take advantage to further develop focus areas which will be further discussed in section 4. There are also opportunities for regional cooperation to develop regional digital infrastructure and to facilitate knowledge sharing, as was discussed during the SPECA Working Group on Innovation and Technology for Sustainable Development. Profiles in this paper describe the status of digital development in each country in North and Central Asia, informed by the discussions of the SPECA Working Group, proceedings of the third session of the Committee on Information and Communications Technology, Science, Technology and Innovation, and country responses to a questionnaire circulated to generate data for this paper. Aside from discussing strategies to steer digitalization efforts towards the achievement of the Sustainable Development Goals (SDGs), of particular concern is also the role of digital connectivity and inclusion in the context of building back better from the COVID-19 pandemic.

2.1 Armenia

Digital transformation is one of the policy priorities of Armenia. In cooperation with international donors and the Centre for Strategic Initiatives, the Government developed the Digital Transformation Agenda 2030 to stimulate the development of a globally competitive digital economy. The Agenda targets the adoption of digital technologies in five focus areas: ICT infrastructure; new managerial approaches; development of digital skills and competences; creation of supporting institutional frameworks; and investments into cybersecurity. Implementation of the digital transformation agenda will be carried out in close partnership with the business sector and other non-governmental stakeholders. The Government has shown a commitment in expanding the benefits of the digital economy to rural areas and bridging digital divides.

Armenia has relatively favourable conditions for the development of the digital economy. In terms of broadband connectivity, Armenia outperforms other countries with the same level of socioeconomic development (World Bank, 2019a). Affordable and high-quality digital infrastructure creates conditions for the development of e-commerce and for digitalization of the entire economy. Owing to the Soviet legacy of industrial development partly based on high precision technologies (e.g. aerospace industry, optics), Armenia has a considerable number of specialists with skills and competences for the growth of the digital economy, creating opportunities for leapfrogging to more advanced stages of economic and industrial development.

Thanks to the availability of a qualified workforce, relatively well-developed infrastructure and low costs, Armenia is witnessing the growth of information technology business process outsourcing. Emerging ecosystem of information technology enterprises and startups can become a considerable driver of economic development. Some international information and technology companies have located their offices in Armenia. One of the examples is Microsoft Innovation Center Armenia, jointly founded in 2011 by Microsoft Corporation and the United States Agency for International Development (USAID).

Armenia actively works on developing the national innovation ecosystem that would support the growth of the information technology sector. In 2002, the Government of Armenia and the World Bank founded the Enterprise Incubator Foundation, a major policy mechanism to support the ICT sector through the proliferation of best international practices in corporate governance, venture capital investments and business networking. The Foundation supported the establishment of Vanadzor and Gyumri Technology Centers, which have accelerated the growth of information technology companies in Armenia.

Digital government remains a strong priority for the long-term development of the public sector in Armenia. To align national development with the SDGs, the Government of Armenia established the SDG Innovation Lab jointly with the United Nations Development Programme. The SDG Innovation Lab is also active in disseminating data-driven approaches and digital tools for policymaking among government agencies. Some examples include Travelinsights.ai and EDU2WORK that support evidence-based policymaking through machine learning algorithms and web scraping software.

2.2 Azerbaijan

The digital transformation is a priority area in the National Strategy for the Development of Information Society in Azerbaijan 2014–2020. Digital technologies are largely seen as an important strategic vector in the national policy on economic diversification. The National Strategy outlines measures for fostering the scientific and technological potential of Azerbaijan, digital capacity-building and improvement of cybersecurity, among other things. In 2016, Azerbaijan adopted the Strategic

Roadmap for development of telecommunication and information technologies to support the development of the ICT sector, improve enterprise productivity and performance through the adoption of advanced digital tools and improve the quality of public services and evidence-based policymaking. It calls for the establishment of an independent agency in charge of developing favourable regulatory frameworks for the development of the digital economy.

Among government agencies in Azerbaijan, the State Agency for Public Service and Social Innovations has an important role in fostering the digital transformation of the country. It founded an E-government Development Centre to support digitalization of the public sector and launched the InnoLand Incubation and Acceleration Centre, that supports the development of ICT startups. The technological backbone of digital Government of Azerbaijan is G-cloud that provides a foundation for the development of various digital public services. The Small and Medium-sized Enterprise Development Agency (SMEDA) is another government agency supporting the digital transformation of the economy. It provides financial support and consulting services for domestic SMEs. One of the recent projects of SMEDA is focused on the proliferation of ERP systems among Azerbaijani enterprises. The National Innovation Agency of Azerbaijan offers targeted support for digital enterprises and helps to create the overarching conditions for the growth of innovation activities. The space industry in Azerbaijan is developing as well. Currently, the country owns three satellites, one provides remote earth observation services and two are used for telecommunications.

To support the digital transformation of the economy and the formation of the ICT sector, Azerbaijan founded the High-Tech Park in 2012. In addition to developing software applications, residents of High-Tech Park are involved in industrial activities producing electronic devices. One of the key priority areas of the Government of Azerbaijan is digital transformation of agriculture through the development of the following digital solutions: (1) a data portal on soil and environmental conditions; (2) an online portal for e-commerce of agriculture goods; and (3) an e-learning portal to offer capacity-building for farmers and SMEs.

Azerbaijan, like many North and Central Asian countries, serves as a connectivity node between the East and the West. Several projects regarding information transit have been implemented or are underway. Currently, Azerbaijan is part of the Europe-Persia Express Gateway, that aims to install a fibre-optic line stretching from Germany to Oman. Agreements with Kazakhstan and Turkmenistan have been signed to collaborate on a fibre-optic line along the bottom of the Caspian Sea. These projects are supposed to contribute substantially to the implementation of the Trans Eurasian Super Information Highway which aims at creating a transnational fibre-optic backbone and connecting the Eurasian continental area.³

In order to create favourable conditions for the development of the digital economy, the Government began to adjust its legal frameworks to digital economy needs, beginning with tax regulations. The Law of Azerbaijan “On Electronic Commerce” introduced the definition of e-commerce into national legal frameworks and reduced discrimination in the rights of residents and non-residents to take part in e-commerce activities in Azerbaijan. Amendments to the Tax Code (articles 16.1.11-1, 168.1.5, 169 and 169.1) made changes in the value added tax (VAT) collection procedures to reflect trends in digital trade of products, services and intangibles. New changes facilitate the collection of VAT on electronic transactions taking place on the territory of Azerbaijan. Moreover, the “Information Security and Cyber Security Strategy of the Republic of Azerbaijan” has been developed based on international experience and is at the approval stage.

³ See www.unescap.org/sites/default/files/Azerbaijan%2C%20item%203.pdf.

In response to the pandemic, Azerbaijan developed special websites and a mobile application to provide information about COVID-19 to the citizens. The application is also used now as an information notification system based on a tracking system for infected people.

2.3 Georgia

Unlike some other countries in North and Central Asia, Georgia does not have a separate national digitalization strategy. Instead, policy goals and objectives on digitalization are included in the 'Georgia 2020' Social Economic Development Strategy. The strategy outlines target areas for the digital transformation of economy, governance and society: (1) creation of a robust national innovation ecosystem; (2) proliferation of access to high-speed broadband Internet; (3) digitalization of education; (4) digital government; and (5) capacity-building for digital economy.

The digital ecosystem in Georgia is co-shaped by a variety of public institutions including, but not limited to the Georgian National Communications Commission (GNCC), Data Exchange Agency (DEA), Georgia's Innovation and Technology Agency and Enterprise Georgia. GNCC is a government entity responsible for development of regulatory frameworks for telecommunications and digital economy. An important role of GNCC is to enable creation of healthy competitive market environment that would spark accelerated growth of information technology companies.

Openness and transparency of data are among the priorities of the Government, as reflected in the Open Government Partnership 2014–2015 Action Plan. Data Exchange Agency was established by the Ministry of Justice in 2010 to improve cybersecurity arrangements of Georgian organizations, foster the development of digital government in Georgia and support creation of open public data infrastructure. Another area of competences is setting digital and data standards for the public sector and proliferation of best international practices in digitalization of public services.

The Innovation and Technology Agency and Enterprise Georgia support innovation economy and entrepreneurship through direct and indirect support measures. The information technology hub programme aims to facilitate the development of information technology businesses through investments into human capital and greater availability of financial instruments. Enterprise Georgia contributes to the growth of ICT startups and SMEs by providing direct financial support and co-financing mechanisms.

The Ministry of Education, Science, Culture and Sport made digitalization a key priority area in the Unified Strategy of Education and Science 2017–2021. The e-school initiative aims at creating the school management information system to improve the governance and the quality of educational institutions through data collection, processing and reporting. Within the initiative, electronic journal modules facilitate administrative workflows. Several areas of their applications include attendance control, monitoring of academic performance and automatic reporting. The Book (Buki) project offers interactive educational games for children. The project covers several scientific disciplines and contributes to improved skills and capabilities through the gamification of education. Through the Teachers Professional Development Centre, the Ministry of Education, Science, Culture and Sport promotes pedagogical competences relevant to the demands of the twenty-first century, including digital literacy and sustainable development.

In addition to national programmes, Georgian schools also participate in digitalization projects developed or co-created by international partners. The multinational corporation, Intel, launched a platform, schoool.ge, to improve science and math education in Georgia. Georgian schools also use the Chess in School platform, created by Kasparov Chess Foundation Europe, that provides complete

chess curriculum for all educational levels including video tutorials and textbooks for both teachers and students.

The COVID-19 pandemic has catalysed e-learning at all levels of education. The pandemic has pushed the entire educational system towards innovative solutions based on digital technologies. In 2020, the Georgian Government developed various online tools to facilitate the teaching and learning process in schools in the situation when a physical presence is no longer possible.

In order to support e-learning in vocational education, the Ministry of Education, Science, Culture and Sport set up 17 sectoral online networks (for agriculture, tourism, construction and so on) where teachers were gathered to discuss the formulation and implementation of measures to support online vocational education. The COVID-19 pandemic prompted amendments to the Law of Georgia on Higher Education related to distance learning. The amendments were adopted in June 2020 and establish legal frameworks for future digitalization of education in Georgia.

2.4 Kazakhstan

Digital Kazakhstan 2018–2022 aims to improve living standards of citizens and create foundations for the development of a new economy through the adoption of digital technologies. In addition to the transformation of the business sector, Kazakhstan outlined measures for digitalization of the public sector and development of ICT infrastructure. The programme offers policy initiatives on investments into skills and competences as well as a cultural shift towards creative and innovative mindsets. Another priority area is the creation of a favourable business ecosystem based on close cooperation among academia, industry and civil society. The key priority areas of the programme include the following:

- Digitalization of the economy – implementing ground-breaking technologies aimed at restructuring traditional industries and increasing labour productivity for increased capitalization.
- Transition to a digital government – developing state infrastructure to provide services for the population and business.
- Implementation of the digital Silk Road – developing high-speed and secure infrastructure for the transfer, storage and processing of data.
- Development of human capital – fostering structural changes, comprising creative society formation and transition to the new realities of a knowledge-based economy.
- Formation of an innovative ecosystem – creating conditions to develop technological entrepreneurship through active partnerships between business, academia and the State, as well as to diffuse innovative technologies in industry.

Kazakhstan is also initiating the project to secure fibre-optic broadband access in rural settlements of the country. This project is supposed to stimulate the proliferation of fibre-optic lines through the procurement of connection services for governmental use in 2018–2032. Greater connectivity will enhance efforts to expand the scope of e-governance. Another project is the construction of 3G/4G mobile networks in rural settlements, which aims to increase connectivity through collaboration between the Government and private providers. The project is funded by the private sector and is expected to be completed by the end of 2020.⁴

⁴ See www.unescap.org/sites/default/files/Kazakhstan%2C%20item%203.pdf.

Furthermore, government representatives highlighted the importance of adopting a national policy to monitor the e-resilience and sustainability of ICT infrastructure and networks. Enhanced efforts in the elaboration and implementation of national innovation and technology strategies for sustainable development in Central Asia are needed. Kazakhstan also supports the development of a single information portal based on ESCAP methodologies, data and tools in order to enable stakeholder information exchange.

Since 2018, Kazakhstan has used space monitoring technology that gathers data on agriculture, forest and water resources, soil use, national security, etc. The collection of this data is critical for monitoring climate change, supporting urban planning and detecting illegal deforestation.⁵ In addition to government agencies providing incentives for the digital transformation, other national actors are also actively involved in building the foundations of the digital economy. In 2019, Nazarbayev University established an artificial intelligence R&D fund to accelerate research on related topics and attract experts in the field to Kazakhstan.

2.5 Kyrgyzstan

The digital transformation in Kyrgyzstan is guided by the national programme, Taza Koom, adopted in 2017. As a part of the national sustainable development strategy, Taza Koom aims to lay foundations for long-term sustainable growth through investments in the knowledge-absorptive capacities of domestic enterprises, improvements in ICT infrastructure and digitalization of public services. In its digitalization policy, Kyrgyzstan pursues the principle of digital inclusiveness by ensuring that the entire population of the country, irrespective of age, gender and location, can have an equal access to the benefits of the digital transformation.

At the end of 2018, Kyrgyzstan approved the programme "Digital Kyrgyzstan 2019–2023". The main goal of the programme is to provide a structured approach to digital transformation in the sphere of society, governance and economy. This includes digital education, digital public services, international connectivity and exchange and combating the spread of COVID-19. For instance, the project "Sanatip Aimak" allows local authorities not only to provide digital services to citizens but also to collaborate with other departments. This and other platform solutions are based on the "Tunduk" interdepartmental interaction system, through which 64 state bodies and 34 private organizations (by the latest count) are exchanging data.⁶

The Government set a course for the digital transformation of public services and policymaking. Not only will that improve the efficiency and effectiveness of government agencies, but it will also create conditions for greater involvement of citizens in policymaking. Through the gradual improvement of the business environment and further development of digital infrastructure, Kyrgyzstan aims to become a regional hub of digital Silk Road initiative.

2.6 Russian Federation

The national programme for the development of the digital economy 2018–2024 entered into force on 7 May 2018 by presidential decree No. 204. The strategy aims to create favourable conditions for the development of the digital economy and for the growth of digital innovations across all industrial sectors. While the strategy is designed to support industrial applications of all recent advancements in digital technologies, it specifically targets the development of digital solutions based on big data,

⁵ See www.unescap.org/sites/default/files/Kazakstan%2C%20item%204.pdf.

⁶ See www.unescap.org/sites/default/files/Kyrgyzstan%2C%20item%203.pdf.

artificial intelligence, neurotechnologies, blockchain, quantum computing, Industrial Internet of Things, robotics, and virtual and augmented reality.

The programme consists of several federal projects that target the development of institutional frameworks, business ecosystems and improvement of ICT infrastructure:

1. **Skills for digital economy:** improving the supply of qualified workforce through reforms of secondary and higher education, enabling the transformation of the Russian job market to support the digital economy and create opportunities and incentives for life-long learning.
2. **Digital infrastructure:** introducing measures for the improvement and further development of ICT infrastructure and data centres.
3. **Cybersecurity:** enabling digital security and safety for Russian citizens and public and private organizations.
4. **Digital technologies:** setting out measures for the support of basic and applied research on digital technologies.
5. **Legal frameworks:** shaping laws and regulations supporting the development of digital technologies and their applications in public and private sectors.
6. **Digital government:** creating the vision and outlining measures for the digital transformation of the public sector based on novel technological approaches.

Each of the projects is based on public-private partnerships, and the novelty of the programme is its inclusiveness of both public and private stakeholders to policymaking. The Government of the Russian Federation, state-owned enterprises, private telecommunications companies and private technology and information companies founded a not-for-profit organization called Digital Economy, tasked with the formulation and design of policy measures for the support of the digital transformation.

The Government of the Russian Federation sees artificial intelligence as the most promising technology capable of raising innovation and productivity in the entire economy. In October 2019, the Russian Federation launched the National Strategy for the Development of Artificial Intelligence based on the Neurotechnologies and Artificial Intelligence road map under the federal project on Digital Technologies. The strategy for artificial intelligence development introduces related policy initiatives oriented to support of its development and the proliferation of solutions across public and private sectors. It introduces measures to enhance skills, support research and mathematics for artificial intelligence, and create favourable legal frameworks for the adoption of artificial intelligence solutions.

In response to the COVID-19 outbreak, the Russian Federation expanded e-government services for its citizens including the issuance of medical documents and paid leave as well as applications for material allowances. During the quarantine period, the Government introduced a digital pass system which enabled citizens to register and track their mobility during lockdown. The system helped to limit the spread of COVID-19 and was abolished on 8 June 2020. An initiative called “Affordable Internet” was launched by the five major fixed broadband access providers of the country in April 2020. The initiative aimed at maintaining limited Internet access for households that suffered financially from the containment measures and were not able to afford the rates for Internet access.⁷

⁷ See www.unescap.org/sites/default/files/Russian%20Federation%2C%20item%203.pdf.

2.7 Tajikistan

Policy priorities and measures for the digital transformation of the economy and society of Tajikistan are anchored in the National Development Strategy 2030. According to the strategy, the transition to innovation-led sustainable development will be implemented in three stages: (1) a transition period to a new model of economic growth; (2) a period of accelerated investment-based growth; and (3) accelerated industrialization. Within this programme, Tajikistan aims to improve the quality of legal and institutional frameworks for the development of technological industries and the innovative economy. The transition is to be based on stronger institutional development, and it aims to strengthen the network of national technology parks and diversify the economy through the development of R&D intensive industrial sectors.

According to the concept, Tajikistan is developing a road map for digitalization of the public sector. The Government wants to lead the digital transformation by example by enabling data-driven innovations and creating demand for digital solutions. For example, it is implementing digital government initiatives and a single window policy. An important strategic vector in the digitalization policy is increased investments in education and the introduction of life-long education and retraining opportunities.

The concept includes establishing the national council of the digital transformation to improve coordination among government agencies and align policy initiatives. The design and formulation of support measures will be based on close collaboration between public and private sectors. During 2026–2030, Tajikistan will continue improving the national ICT infrastructure by raising the quality and coverage of broadband connections and establishing data centres across the country. Significant attention will be given to promoting networking between academia and industry to support the growth of digital innovations.

In the long term (2031–2040), Tajikistan aims to contribute to high levels of digital intensity for priority industrial sectors: agriculture, energy production, telecommunication, transport, trade, manufacturing, education and health care. Through the digital transformation of the economy and society, Tajikistan wants to improve social welfare and contribute to long-term sustainable development.

2.8 Turkmenistan

In 2018, Turkmenistan adopted the digital economy concept 2019–2025 to support the digital transformation of all industrial sectors and public governance. The concept is complemented by the technology roadmap that aims to create a knowledge economy and increase economic productivity. The implementation of the government vision on the digital transformation is divided into three stages: (1) 2019; (2) 2020–2023; and (3) 2024–2025.

In order to create favourable conditions for the development of the digital economy, Turkmenistan made amendments into existing legal frameworks and adopted new laws. In 2019, examples of new laws and new amendments included the Law on Telecommunications, the Law on Cybersecurity and the Law on the Internet and Digital Services. Currently, Turkmenistan is working on developing a system of interdepartmental digital exchange to enable more effective communication across the Government. Turkmenistan created the portal of public services, e.gov.tm, to improve the quality of public services and better meet the needs of rural communities.

In order to accelerate the digital transformation, the Government founded an interdepartmental working group and the agency, Turkmen Aragatnasyk. The agency offers training opportunities in ICT skills and cybersecurity for specialists of all levels both from public and private sectors.

2.9 Uzbekistan

The programme, Digital Uzbekistan 2030, sets priorities and defines measures for digital transformation. It seeks to create favourable conditions for foreign direct investment, improve the quality of national ICT infrastructure, implement smart city concepts in urban areas and improve digital skills and competences. The creation of an enabling environment for digital innovations and entrepreneurship is steered by the National Innovation Development Strategy 2019–2021. Uzbekistan is also currently preparing the national artificial intelligence development strategy 2021–2022 to accelerate the pace and create foundations for the next production revolution.

To capture the benefits of the digital economy, Uzbekistan initiated changes in national legislation. Some examples include presidential decree No. UP-5099 of 30 June 2017 on comprehensive improvement of conditions for the development of the ICT sector, presidential order No. PP-3724 of 15 May 2018 on comprehensive improvement of e-commerce and presidential order No. PP-3832 of 3 July 2018 on the development of the digital economy.

The Government sees digitalization as a priority for the long-term development of public services and policymaking. The portal, my.gov.uz, offers public services to businesses and individuals. By September 2020, some 280,000 users have executed operations using this portal. The Government is also active in providing open access to government data to enable data-driven innovations and ensure higher levels of transparency and accountability of public administrations. The portal, data.gov.uz, provides access to data from 147 government agencies. The Government aims to increase participation of citizens in policymaking through the platform, regulation.gov.uz, where citizens can engage in discussions on topics related to regulations and legal norms.

In 2020, the Government founded an information technology park to stimulate the development of globally competitive software products and creation of a business outsourcing ICT cluster in Uzbekistan. It offers business acceleration and incubation services to support the transition of business ideas to commercialized products and services. In addition to the information technology park, Uzbekistan has a diverse system of innovation policy mechanisms that support the growth of digital businesses. Some examples include the CAT accelerator, IdeaLab, Start-up Factory and WomenTech.

The information technology park has the Information Technology Academy that offers training in digital skills. One of the main projects of the Academy is “One Million Uzbek Coders” that provides coding courses. Uzbekistan has founded 26 information technology training centres across the country to disseminate knowledge and competences and close the urban-rural divide in the digital economy. Jointly with the private sector, the Government launched the RoboTech 2020 competition to teach robotics in secondary schools.

During the SPECA Working Group on Innovation and Technology for Sustainable Development, building upon the work done on the SPECA Innovation Strategy, Uzbekistan proposed to integrate the national e-commerce platforms in Central Asia.⁸

⁸ The report and materials of the working group are available on the ESCAP website: www.unescap.org/events/speca-working-group-innovation-and-technology-sustainable-development.

3. Policy frameworks for digital transformation

The digital economy may undoubtedly develop organically in certain countries of North and Central Asia; however, for maximum efficiency, Government participation is vital to ensure that it does so in the right regulatory conditions. Moreover, the State can serve as a key participant in the digital transformation by leading the way on structural technological change. Comprehensive measures taken to facilitate the development of the digital economy are the most effective and could be a partial solution to resolve the issue of distrust towards new technologies.

Another outstanding issue prevailing in the subregion is the low participation in life-long learning and the low level of digital skills. To raise participation, Governments need to design training programmes to improve skills and capabilities of jobseekers to face the demands of the digital economy. Continuation of education to enhanced digital skills, especially for socioeconomically disadvantaged groups in society, needs to be encouraged.

3.1 The role of government for digital transformation

According to the Digital Adoption Index figures in the table, the digital transformation in Kazakhstan and the Russian Federation is spearheaded by the public sector (with 0.82 and 0.84 subindices, respectively). The comparison of these indicators with the data in figure 1 reveals that favourable conditions created by the State are essential for broader adoption of digital technology. It should be mentioned that, while the Governments of both countries have explicitly set the task of broadening the backbone of ICT infrastructure, there are a number of other initiatives that further stimulate the growth of the digital economy. These include the creation and constant revision of a legal framework for the digitalization of business and the adoption of new technologies by state bodies.

Key indicators of competitiveness in digitalization in selected North and Central Asian countries, 2019

Indicator	Armenia	Kazakhstan	Kyrgyzstan	Russian Federation	Tajikistan
E-Participation Index* (0–1)	0.57	0.84	0.69	0.92	0.39
Future orientation of government (1–7)**	3.84	4.13	3.16	3.87	4.46
Legal framework's adaptability to digital business models*** (1–7)	4.01	4.03	3.03	3.89	3.63
Mobile communication subscribers (per 100 pop.)	119.04	145.42	121.92	157.89	107.61
Mobile-broadband subscriptions (per 100 pop.)	75,87	77,57	94,03	87,28	22,83
Fixed-broadband internet subscriptions (per 100 pop.)	10.76	14.14	4.27	21.44	0.07
Fibre-to-the-home/building Internet subscriptions (per 100 pop.)	5,46	7,54	2,11	15,80	-
Internet users (percentage of individuals)	64,74	78,90	38,00	80,86	21,96

Digital skills among active population (1–7)	4,54	4,69	3,85	4,95	4,44
Growth of innovative companies (1–7)	4,25	3,58	3,27	3,74	4,16

Source: Prepared by the author using World Economic Forum data for 2019.

Notes: * The e-participation index (0 to 1) assesses the use of online services to assist the government in the provision of information to citizens (e-information sharing), interaction with stakeholders (e-consultation) and participation in the decision-making processes (e-decision making).

** The values are for 2018. Average value of the answers to the following four questions of the poll: ‘How quick is your country’s legal framework to adapt to digital business models (e.g. e-commerce, sharing economy, fintech, etc.)?’ [1 = not quick at all; 7 = very quick]; ‘To what extent does your government provide a stable political environment for doing business in your country?’; ‘To what extent does your country’s government effectively respond to changes (e.g. technological changes, social and demographic trends, and security and economic issues)?’; and, ‘To what extent does your government have a long-term vision in your country?’

*** The answer to the question of ‘How quick is your country’s legal framework to adapt to digital business models (e.g. e-commerce, sharing economy, fintech, etc.)?’ [1 = not quick at all; 7 = very quick].

According to the 2014 OECD report entitled ‘Strengthening Digital Government’, the changing global and technological realities cause drastic changes in the nature of the economy and in the channels for the interaction of individuals and businesses with the Government. It elaborated key recommendations on government measures and guidelines to institutionalize political will to develop the digital economy. Among others, useful measures and state initiatives should include a comprehensive and systematic approach to digitalization consisting of a digital government strategy supported by an action plan and an impact assessment tool; regular updates of legal and regulatory frameworks, financial support for capacity-building activities for digital and data-related skills in the public sector and explicit standards and guidelines for more coherent, interoperable and resilient digital government infrastructure. In addition, an open government data strategy plays a focal role to engage external stakeholders.

In terms of government digitalization in North and Central Asia, the government development index is the highest in Kazakhstan and the Russian Federation. In Kazakhstan e-government was established in 2006 as a platform to provide services to citizens. Since then over 6 million people have used the portal to access over 760 electronic services and other services.⁹ It should be noted that all the Governments of North and Central Asia are involved in shifting towards employing digital solutions in their work.

A survey carried out by the World Economic Forum found that the most flexible legislative frameworks exist in Armenia and Kazakhstan. In Armenia, this success is attributable to the relatively fast growth of innovative companies, largely promoted by the Armenian diaspora living in industrially developed countries who serve as conductors of best practices applied in their countries of residence as well as source of investment finance.

3.2 Reforms of national statistics

National statistics are indispensable to monitor and analyse the digital economy. Therefore, systems and methodologies need to be improved and aligned with international standards. The understanding of economic value in national statistics and accounting principles were conceptualized in the 1970s and have not changed much since then. International organizations such as the United Nations, the OECD and the World Bank initiated discussions on how to improve the measurement of gross domestic product (GDP) in the age of the digital economy. These discussions are at the initial stages and have not yet contributed to major changes in international standards on the collection and analysis of statistical data. For instance, the international community does not have robust mechanisms to identify the value of data for economic activities and social welfare. The ESCAP Committee on Statistics elaborated a framework for action on improving statistical practices throughout the Asia-Pacific region.

⁹ Digital Kazakhstan <https://digitalkz.kz/en/>.

The document, “Advancing official statistics for the 2030 Agenda for Sustainable Development: a collective vision and framework for action by the Asia-Pacific statistical community”, follows the objective to produce high-quality, timely, reliable and disaggregated statistics to fill data gaps and deliver on the region’s development commitments.¹⁰ Thus, mainstreaming SDG monitoring practices, even in collecting digitalization-related data, is critical for tracking and comparing SDG progress across North and Central Asia and for developing strategies to achieve the 2030 Agenda.

The North and Central Asian countries may want to consider strengthening their collaboration with the international community to keep up with recent developments in reforms of national statistics in the age of the digital economy. It is advisable for the North and Central Asian countries to harmonize their national statistical systems with international standards of Eurostat and OECD. National Governments should channel required resources for the improvement of research and analytical functions of the national statistical agencies, while increasing their autonomy vis-à-vis other public authorities. The increasing complexity of the digital economy and an exponential growth of data volumes call for the development of digital skills and competences in national Governments to apply recent advancements in digital technologies (e.g. big data, artificial intelligence) with utmost effectiveness for analytical purposes.

¹⁰ See

www.unescap.org/sites/default/files/ESCAP.CST_.2020.2_Progress_in_implementing_regional_initiatives_respect_to_the_collective_vision.pdf.

4. Focus areas for development of digital potential

National strategies and programmes aimed at developing the digital economy in North and Central Asian countries often take a sector-based approach. The main areas through which the digital economy is being developed are e-commerce, the financial sector, agriculture and logistics. The role of ICT infrastructure, its quality, capacity and speed of Internet, e-resilience of ICT infrastructure and networks, role of ICT in societal resilience are instrumental in this regard and were highlighted as key aspects that can facilitate the region's recovery from COVID-19 at the third session of the Committee on Information and Communications Technology, Science, Technology and Innovation. E-resilience is particularly important given that it is one of the four pillars of the Asia-Pacific Information Superhighway initiative.¹¹ These focus areas bear the potential to disseminate long-term benefits of the digital transformation to other areas of the economy and society.

4.1 E-commerce

E-commerce is a sale, purchase, order delivery or order commitment of products, goods and services via the Internet (OECD, 2019; Eurostat, 2017). Regulatory agencies and scholars use the term “digital trade” for Internet transactions of intangible digital solutions, whereas e-commerce operations involve traditional physical products (World Bank, 2019b). According to UNCTAD (2018) global e-commerce sales (business to business and business to consumer) reached \$26 trillion in 2018 contributing to 30 per cent of the world GDP. The development of e-commerce has the potential to substantially contribute to economic growth and social welfare through the increase of household consumption, enlargement of the retail sector and the decrease of transaction costs (Cardona and others, 2015). E-commerce can be instrumental for the support of SMEs and local employment.

At the same time, the development of e-commerce poses new challenges for policymakers. The cross-border nature of e-commerce transactions and the growing complexity of digital business models challenge the enforcement of consumer protection regulations, antitrust mechanisms and taxation of digital assets and solutions. The development of robust and up-to-date trade regulation is hindered by digital servitization, the blurring of boundaries between products and services. Policymakers should make substantial investments in the development of ICT and logistics infrastructure to enable the development of e-commerce and digital trade.

4.2 Financial sector

Another important prerequisite for developing the digital economy and increasing e-commerce is the development of inclusive financial services and more advanced, interoperable payment systems. Increased digitalization in the financial sector will inevitably have a direct effect on social well-being and businesses because of increased accessibility of financial services. The implementation of digital technology causes structural changes in the business environment by helping enterprises of any size integrate into the regional and global economy.

Realizing digital potential in the financial and banking sectors primarily leads to a higher degree of transparency, accessibility, integration and increased efficiency and flexibility. An analysis of the World Bank's Global Index for 2014–2017 shows that the development of the banking sector and the adoption of digital technologies have generally displayed positive trends in North and Central Asian countries.

¹¹ See www.unescap.org/commission/75/document/E75_INF5E.pdf.

The 'analog' banking sector is fairly accessible in most countries in the subregion, however the availability and level of inclusiveness of digital banking services varies widely by national income. The best regional performer is the Russian Federation, whose population is most active in using digital technology to access their bank accounts for making online payments and purchases.

Considerable efforts are being made in Armenia to digitalize the financial sector to increase financial literacy and increase economic well-being in the country. In the attempt to increase the inclusivity of the financial system, the Government launched the National Strategy for Financial Education and the National Steering Committee in 2014, charged with implementing the Strategy. In 2014, the Government formally adopted the Strategy to increase financial stability, financial inclusion and welfare for the people of Armenia through capacity-building and education.

Digital technology usually has a positive effect on banking sector inclusiveness, as it makes financial services readily available. As identified by the United Nations, digital financial inclusion can become an important catalyst for faster progress toward achieving the SDGs and creating long-lasting social and economic impact for millions of people worldwide. Broader access to financial services means growing demand for them, which drives further development of the banking sector. Demand from individuals promotes the digitalization of the financial sector, and this area of the digital economy has the potential for synergetic development.

The effects of the digitalization of the financial sector for Governments in the subregion will include more transparent cash flows in the economy and a broader area for cash-free payments. However, efficient digitalization of the banking sector requires appropriate policymaking and a flexible legal framework to enable and even encourage banks to apply breakthrough technology and develop their own innovative products and services.

In addition, Governments in the subregion can and should actively promote the digital culture among citizens, in particular, by switching to digital payments between the federal and municipal authorities and citizens. Such measures by Governments would increase confidence in digital banking and the transparency of the financial sector. Digital technologies enhance the stability of the banking sector. Commercial banks can assess their client risks more promptly and accurately using innovative technology and big data. A more transparent banking system will have a positive effect on a country's investment attractiveness and significantly expand financing opportunities.

4.3 Agriculture

In analysing the digital potential of North and Central Asia, it is essential to consider its economic structure and its dependence on the agriculture sector. Recent advancements in digital technologies may structurally transform agriculture and support more efficient management of agricultural resources and human capital. The agriculture sector has low productivity in all North and Central Asian countries except for the Russian Federation.

Digital agriculture (or e-agriculture) is based on a combination of advanced technologies that enable efficient resource management and yield increases through comprehensive monitoring and analysis of weather and soil conditions. In addition to having positive effects on enterprise productivity and employment, the introduction of digital technologies and data-driven approaches in agriculture safeguards national food security and increases quality of life in rural areas.

Currently, the Ministry of Agriculture of the Russian Federation is developing a project to support digital agriculture and adopt new technologies.¹² The smart planning system for agriculture will be introduced across the entire country to promote the cultivation of the most profitable crops and optimize supply chains. The project also envisages a complete switch to electronic contracting among recipients of state funding, so that all export products can be tracked using a paperless system ‘from source to port’.

Within the Digital Kazakhstan programme, the Government is launching policy initiatives to enhance the productivity of the agriculture sector through precision agriculture and e-commerce of agriculture goods. In 2018, 14 smart farms were created in Kazakhstan. Thanks to the adoption of data-driven approaches, these farms lowered their expenses and doubled their productivity compared to traditional farms. Their harvest increased two-fold and expenses were reduced by 15–20 per cent. In 2020, Kazakhstan is planning to introduce an agriculture e-commerce platform to increase food security and export potential.

In North and Central Asia, digital agriculture is still at an early stage of development. Most countries lack national strategies in this field, but they possess considerable potential. Given the significant share of the agriculture sector in GDP and its effects on job creation, North and Central Asian countries should establish legal and institutional frameworks and improve the quality of digital infrastructure. The proliferation and adoption of digital technologies in agriculture should be based on public-private partnerships and close academia-industry collaboration.

4.4 Supply chains and logistics

Most of the North and Central Asian countries are landlocked and face transport costs that can reach twice the global average. The manufacturing sector is highly dependent on affordable, well-organized and highly efficient logistics in order to compete in global markets. Moreover, resilient food supply is dependent on timely transportation and connectivity. Significant time and cost reductions for transport, improved access to information needed for lean inventories and just-in-time deliveries and low tariffs and border restrictions contributed substantially to the efficiency of global value chains (ESCAP, 2020). All of these factors can be improved by enhanced digitalization efforts.

For instance, artificial intelligence for manufacturing has the potential to improve the management of supply chains, logistics and process optimization (McKinsey Global Institute, 2018). By combining and analysing historical delivery data, feedback from customers and traffic data, artificial intelligence can provide precise delivery time forecasts and predict the need for restocking arrangements. Through a smart placement of goods in warehouses and optimization of delivery, companies can significantly decrease the costs of stock-keeping and improve their responsiveness to new orders.

The application of machine learning and natural language processing to sensor data can provide granular information about parts of products in real time. As data on parts provided by suppliers are also often captured and analysed by assemblers, they may have the opportunity to strengthen their negotiation powers in supply chains as they acquire deeper knowledge on the performance and operations of different parts of a final product (OECD, 2017).

Digital transformation can contribute to resilient supply chains since harmonized plant technology and digitalization across the network can shorten the chain’s recovery period. Investing in digital solutions

¹² Information about the project is available in Russian at <http://mcx.ru/ministry/departments/dit/news/minselkhoz-rossii-predstavil-proekt-tsifrovoye-selskoye-khozyaystvo/>.

for supply chains increasingly contributed to supply-chain resilience. If supply chain data are updated frequently, there is less need for holding safety stocks. Therefore, real time data-sharing and an advanced ICT sector enhance resilience (ESCAP, 2020).

COVID-19 posed a threat to the subregion's integration into the global economy. Supply chain disruptions were caused by virus containment measures, including border closing, shutdowns of production sites and movement restrictions, while networks and infrastructure remained intact. These effects were expected to be temporary but still left their marks on the world economy. The Governments of North and Central Asian countries can tap into the opportunities present by the post-pandemic climate to reinvigorate digital transformation and incentivize companies to enhance their digitalization efforts.

5. Recommendations to realize digital potential

The national initiatives in North and Central Asian countries listed in section 2 revealed promising digitalization activities but also showed that several obstacles remain to fully realize the digital potential in the subregion. These hurdles need to be mastered by goal-oriented and issue-tailored policy responses to ensure digitalization efforts complement the longer-term objectives of economic transformation and sustainable development.

Over the past decades, the pace of digital transformation in the economy has been limited in most North and Central Asian countries. To solve this issue, Governments need to **design clear national policies and action plans for the development of the digital economy**. Governments can lead this initiative in consultation with private industry players and civil society, in alignment with initiatives proposed by the SPECA Working Group on Innovation Technology for Sustainable Development and recommendations of the Committee on Information and Communications Technology, Science, Technology and Innovation. Collaboration between academia and industry could be encouraged through direct and indirect forms of investments, through reforms of governance in higher education institutions and through the development of public-private partnerships in this field. Moreover, it is indispensable to introduce supporting mechanisms by redesigning tax regulations and public procurement. These initiatives can be effectively harnessed to contribute to the achievement of the SDGs while creating policy environments and infrastructure foundations for an inclusive digital economy.

Linked to the above recommendation on developing national policies for the development of the digital economy, countries need to ensure that the legal and governance aspects keep up with the evolving socioeconomic landscape caused by digitalization. Currently, many of the existing legal frameworks in North and Central Asia do not reflect the demands and needs of the digital economy. Therefore, countries in the subregion need to adopt global best practices concerning legal frameworks focusing on competition, consumer protection and taxation. National Governments can **consider implementing regulatory sandboxes to test the effects of new legal acts concerning digital technologies** in a controlled environment. Countries with effective regulatory sandboxes will attract high potential startups and talent, which will encourage the development of a dynamic digital ecosystem that can yield long-term benefits. These sandboxes may also attract strategic investment into countries to fund targeted sectors for potential development.

Countries in the subregion need to also **increase investments for science, technology and innovation** activities in order for the sector to more significantly contribute to the creation of high-skilled jobs and an increase in income levels. Data showed that countries in North and Central Asia are significantly lagging behind OECD countries in the share of ICT exports and have uneven levels of digital adoption. As countries seek to diversify their economy to decrease reliance on the mining industry, investments into the field of digitalization will facilitate sustainable economic transformation. This also indirectly tackles the issue of brain drain in the subregion, as the investments can stimulate the creation of opportunities and a robust environment for science, technology and innovation which can attract experts and talent to pursue careers in the subregion.

The development of intraregional content exchange faces many barriers but can also generate gains that can benefit from regional cooperation. **Improving data exchanges within countries and within the subregion** can be facilitated by the establishment of carrier-neutral internal exchange points. Although digital government is very nascent in North and Central Asian countries, Governments can play a model role by improving data exchanges among their databases and designing user-friendly digital public services. Standardization of data and statistics according to internationally agreed

standards is a step in the right direction to facilitate data exchanges. Additionally, this can complement efforts to monitor the implementation of action plans on digital transformation.

Another major obstacle to digital transformation in the subregion is the poor ICT infrastructure in some countries. In order to develop it further, Governments should **strengthen regional cooperation in digital infrastructure development**, and they should implement direct and indirect incentives for the use of shared ICT infrastructure by several operators to support the development of the digital economy. This was recognized at the third session of the Committee on Information and Communications Technology, Science, Technology and Innovation as one of the important facets for digital connectivity and e-resilience, especially in response to COVID-19. Specific examples include recommendations during expert group meetings to support Kazakhstan, Kyrgyzstan and Mongolia in their efforts to develop a shared and co-deployed ICT infrastructure.¹³ In planning the deployment of digital infrastructure, policymakers must also keep in mind the growing digital divide, especially between rural and urban areas, to ensure that digitalization efforts do not exacerbate inequality in the subregion.

¹³ See www.unescap.org/events/e-resilience-pandemic-recovery-intercountry-consultations-preparation-cictsti.

6. Conclusion

North and Central Asian countries are very heterogeneous in their degree of digitalization. With the exception of Armenia, Azerbaijan, Kazakhstan and the Russian Federation, the countries of the subregion have considerable constraints on the availability of reliable communications infrastructure. The key role of regional cooperation was highlighted at the SPECA Working Group on Innovation and Technology for Sustainable Development, where areas of collaboration were defined within its strategy on innovation and technology. Specifically, countries committed to facilitate the diffusion of innovations and the transfer of technologies to address sustainable development challenges in the subregion.

Overall, the low share of R&D expenditures in GDP, weak linkages among businesses, higher education institutions and research organizations, and the low availability of venture capital investments negatively affect the pace of the digital transformation in North and Central Asian countries. Despite relatively high levels of education attainment, North and Central Asian countries do not have sufficient digital skills to fully benefit from the digital transformation. The situation is aggravated by the scarcity of life-long learning opportunities and digital divides based on gender, age and location. While the success of the digital transformation depends on the availability of ICT and data specialists, the knowledge diffusion mechanisms also play a crucial role in realizing the potential of digital technologies for the economy and society.

National policies and legal frameworks were developed in a pre-digital era and should be updated to reflect the realities of the digital economy. North and Central Asian countries have already begun amending existing laws and regulations. Owing to the increasing complexity of digital technologies and socioeconomic volatility, it is essential to foster international collaboration to identify technological challenges and propose new legal solutions. The major objectives of legal reforms should be to improve the well-being of citizens and protect their constitutional rights. The creation of rigid legal barriers should be avoided to support innovation and business dynamism.

The next production revolution and digitalization of government promise to increase productivity and the efficiency of the public sector. To realize this vision, North and Central Asian countries need to improve their legal and institutional frameworks, make investments into digital skills and improve ICT infrastructure. Policy initiatives should be based on well-defined priorities and contribute to knowledge sharing and collaboration between business and academia.

The COVID-19 pandemic highlighted the potential of digital applications and the overdue necessity of intensifying digitalization efforts. It also showed how the lack of digital inclusion and poor ICT infrastructure had rampant effects on the lives of the most vulnerable groups of society. Prioritising inclusive and sustainable digital transformation will help countries build back better and ensure that no one is left behind.

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