

A **digital path** for sustainable development in Latin America and the Caribbean



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Digital agenda for Latin America and the Caribbean

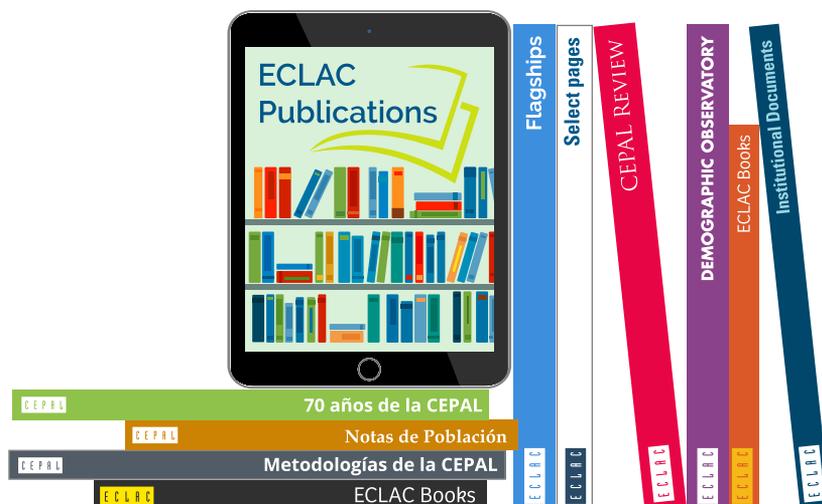


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Digital agenda for
Latin America
and the Caribbean



European Union regional
facility for Latin America
and the Caribbean

José Manuel Salazar-Xirinachs
Executive Secretary

Raúl García-Buchaca
Deputy Executive Secretary for Management and Programme Analysis

Mario Castillo
Officer in Charge, Division of Production, Productivity and Management

Sally Shaw
Chief, Documents and Publications Division

Work on this document was coordinated by Álvaro Calderón, Chief of the Innovation and New Technologies Unit of the Division of Production, Productivity and Management of the Economic Commission for Latin America and the Caribbean (ECLAC), with the collaboration of Filipe Da Silva, Valeria Jordán, Valeria Lobos, Georgina Núñez, Alejandro Patiño, Laura Poveda, Fernando Rojas and Sebastián Rovira of the same Division.

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Contents

| | |
|--|----|
| Foreword | 7 |
| Chapter I | |
| Global change driven by digitalization | 11 |
| A. The multiple dimensions of digital transformation | 13 |
| B. Value creation and competitiveness in the digital era | 15 |
| C. The growing importance of digitalization in the global economy | 17 |
| D. A new world order? | 20 |
| E. Digitalization at the heart of productive development policies | 23 |
| Bibliography | 26 |
| Chapter II | |
| Infrastructure, connectivity and skills: the foundations for a sustainable and inclusive digital transformation | 27 |
| A. Digital infrastructure and connectivity in Latin America and the Caribbean | 29 |
| 1. The digital and connectivity divides are increasingly decisive for development | 30 |
| 2. Connectivity gaps in Latin American and Caribbean households remain factors of social exclusion and require a comprehensive approach | 31 |
| 3. Connection quality affects the use of data-intensive solutions and hinders the development of new productive capacities | 33 |
| 4. The challenge of deploying fifth generation (5G) mobile networks | 35 |
| 5. Proposals for closing access and quality gaps | 37 |
| B. Digital skills for today and tomorrow | 39 |
| 1. What are digital skills? | 41 |
| 2. Skills for the adoption of digital technologies | 42 |
| 3. The need to strengthen actions to increase and enhance digital skills | 45 |
| Bibliography | 46 |
| Chapter III | |
| Key factors for accelerating digitalization in Latin America and the Caribbean | 47 |
| A. Digital transformation in the productive sector | 49 |
| 1. Innovation and entrepreneurship: the foundation of the digital economy | 50 |
| 2. The digitalization of traditional sectors | 52 |
| 3. Sectoral digital transformation | 53 |
| B. The future of the labour market | 58 |
| 1. Uneven risk of technological substitution of labour | 59 |
| 2. The potential of digitalization to generate new jobs and occupations | 60 |
| 3. The new challenges of the digital transformation of jobs and occupations | 62 |
| 4. Progressing towards a fair labour market and decent jobs in the future | 64 |

| | |
|--|-----|
| C. Digital transformation of government | 64 |
| D. Digitalization and the green transition: the importance of an integrated approach | 68 |
| E. Boosting innovation at the local level: smart cities | 72 |
| 1. Advances in connectivity and opportunities for the deployment of advanced digital technologies | 72 |
| 2. Institutional frameworks: an enabling condition for smart cities | 74 |
| Bibliography..... | 75 |
| Chapter IV | |
| Agendas, institutional framework and new partnerships for the digital transformation | 77 |
| A. Tools to address the challenges of the digital age | 79 |
| 1. Digital agendas as an organizing element | 79 |
| 2. Emerging issues for a new generation of digital agendas..... | 82 |
| B. Towards greater digital integration and cooperation..... | 87 |
| 1. Critical factors for driving regional integration in the digital age..... | 87 |
| 2. New digital partnerships and the strengthening of regional cooperation..... | 93 |
| Bibliography..... | 95 |
| Chapter V | |
| Policy recommendations | 97 |
| A. Creating enabling conditions for a digital society for all | 100 |
| B. Developing inclusive, smart digital solutions for well-being..... | 101 |
| C. Fostering a sustainable digital transformation in the production sector..... | 102 |
| D. Establishing appropriate governance for the digital age | 102 |
| E. Strengthening regional digital cooperation and integration | 103 |
| Tables | |
| Table II.1 Connection speed requirements by type of use | 34 |
| Table II.2 Active commercial networks worldwide, by technology, March 2022 | 37 |
| Table III.1 Latin America and the Caribbean (12 countries): risk of technological substitution of employment, by sex, education level and age, simple averages, around 2015 | 60 |
| Table III.2 Global trends in digital and energy indicators, 2015 and 2021 | 70 |
| Table III.3 Buenos Aires, Mexico City, São Paulo and Bogotá: connectivity infrastructure, public and private networks, 2022 | 73 |
| Table III.4 Buenos Aires, Mexico City, São Paulo and Bogotá: most-used advanced technologies, 2022..... | 73 |
| Table III.5 Buenos Aires, Mexico City, São Paulo and Bogotá: digital institutional frameworks, 2022..... | 74 |
| Table IV.1 Institutional considerations in the digital agenda..... | 81 |
| Table IV.2 Latin America and the Caribbean (14 countries): adoption of sectoral digital agendas, 2022..... | 83 |
| Table IV.3 Latin America (10 countries): instruments for the adoption of digital technologies in smaller firms, 2022 | 85 |
| Table IV.4 Latin America and the Caribbean: progress on selected issues in the main economic integration mechanisms, 2022 | 88 |
| Table IV.5 Considerations for a new institutional framework on data governance..... | 93 |
| Table IV.6 Critical areas for digital cooperation..... | 94 |
| Table IV.7 The “Europe fit for the digital age” strategy: spaces for cooperation..... | 95 |
| Figures | |
| Figure I.1 Internet users, connected Internet of things devices, and amount of data created and consumed in the world, 2010–2021 | 17 |
| Figure I.2 Market values of the digital technology industry and of traditional industries, by segment, March 2010 and March 2022..... | 18 |
| Figure I.3 Internet of things platforms | 19 |

| | | |
|---------------|---|----|
| Figure I.4 | Market capitalization of publicly traded companies that operate Internet services and e-commerce platforms, by selected countries and regions, March 2010 and March 2022..... | 21 |
| Figure I.5 | Selected countries and regions: share of manufacturing value added in the world, 1990–2020 | 22 |
| Figure I.6 | Selected countries: patents for advanced digital technologies in the world, by segment, 2021 | 22 |
| Figure II.1 | Global broadband subscriptions, by region, 2010 and 2021 | 30 |
| Figure II.2 | Latin America (12 countries): households with Internet connection in the highest (Quintile V) and lowest (Quintile I) income quintiles, latest available year | 32 |
| Figure II.3 | Latin America (15 countries): households with Internet connection, by place of residence (urban or rural), latest available year | 32 |
| Figure II.4 | Connection quality: effective fixed broadband download speed, monthly average, June 2022..... | 33 |
| Figure II.5 | Connection quality: effective mobile broadband download speed, monthly average, May 2022 | 34 |
| Figure II.6 | Latin America (9 countries): price-quality ratio of post-paid plans for entry into the fixed broadband market, September 2022 | 35 |
| Figure II.7 | Market share of mobile technologies, 2020–2025 | 36 |
| Figure II.8 | Latin America (6 countries): monthly cost of the basic digital basket relative to the average monthly income of households in the lowest income quintile, September 2022..... | 38 |
| Figure II.9 | Internet exchange points (IXPs), by region, August 2022..... | 38 |
| Figure II.10 | Selected countries: human capital and GDP per capita, 2020 or latest available year..... | 40 |
| Figure II.11 | Latin America and the Caribbean and advanced economies (selected countries): main digital skills of the population over 15 years of age, 2020 | 42 |
| Figure II.12 | Latin America (5 countries): youth and adults with programming skills, by sex, 2019 or latest year available | 44 |
| Figure II.13 | Relative penetration of artificial intelligence skills, 2015–2021 | 45 |
| Figure III.1 | Latin America and the Caribbean: monthly visits to websites and mobile applications, by category, January 2020–August 2022 | 49 |
| Figure III.2 | Latin America and the Caribbean: value of the digital industry compared with traditional industries, by segment, March 2010–March 2022 | 50 |
| Figure III.3 | Latin America and the Caribbean: unicorn companies, number of companies and market value, by industry, July 2022..... | 51 |
| Figure III.4 | World: unicorn companies, number of companies and market value, by country and selected regions, July 2022 | 51 |
| Figure III.5 | Argentina, Brazil, Chile, Colombia and Mexico: technology use in 2020 | 52 |
| Figure III.6 | Latin America and advanced countries: proportion of direct intermediate digital inputs, by economic sector | 53 |
| Figure III.7 | Brazil, Chile, Colombia and Mexico: new commercial websites, by category, 2019–2021 | 54 |
| Figure III.8 | Latin America: e-commerce, 2019–2021..... | 54 |
| Figure III.9 | Latin America: traffic to local and cross-border e-commerce websites, by major platform, 2021 | 55 |
| Figure III.10 | World: share of trade in services provided in digital format in total international trade in services, by region, 2005–2020..... | 55 |
| Figure III.11 | Brazil: main uses of digital technologies in the agriculture sector, 2020 | 57 |
| Figure III.12 | Argentina and Costa Rica: distribution of home-based work and telework, by labour income quintile, first quarter of 2020 | 63 |
| Figure III.13 | Latin America and the Caribbean: United Nations e-Government Development Index (EGDI), 2014, 2016, 2018 and 2020..... | 65 |

| | | |
|---------------|---|----|
| Figure III.14 | Latin America and the Caribbean (29 countries): digital governance ranking, 2021 | 66 |
| Figure III.15 | Latin America and the Caribbean (29 countries): projects for digitalization of procedures, 2021 | 67 |
| Figure III.16 | Latin America and the Caribbean (29 countries): existence and status of digital projects in key areas, 2021 | 68 |
| Figure IV.1 | Existence of a national policy or master plan for information and communications technology (ICT) in 129 countries of the world..... | 80 |
| Figure IV.2 | Latin America and the Caribbean (16 countries): status of the national digital agenda, 2022 | 80 |
| Figure IV.3 | Latin America and the Caribbean (15 countries): institutional characteristics of the national digital agenda, 2022..... | 82 |
| Figure IV.4 | Latin America and the Caribbean (33 countries): Global Cybersecurity Index, 2020 | 86 |
| Figure IV.5 | Number of countries with cybersecurity awareness campaigns targeting small businesses, the private sector and government agencies, 2020 | 87 |
| Figure IV.6 | Latin America (15 countries): domestic and cross-border e-commerce, 2021 | 89 |
| Figure IV.7 | Latin America and the Caribbean (selected countries) and Europe (28 countries): Internet users who shop online, 2019 | 90 |
| Figure IV.8 | Digital Trade Restrictions Index, selected countries, 2014–2021 | 90 |

Diagrams

| | | |
|---------------|--|----|
| Diagram I.1 | Dimensions of digital development and their disruptive effects on society, the productive sector and the State | 14 |
| Diagram I.2 | Digitalization and transformation of means of value creation..... | 15 |
| Diagram I.3 | Industry 4.0..... | 16 |
| Diagram I.4 | A systemic approach to digital policies for productive development | 25 |
| Diagram III.1 | Digitalization and employment trends..... | 59 |
| Diagram III.2 | Categories of digital platforms for goods and services, by type and scope of task | 61 |
| Diagram III.3 | The roles of digital technologies in the green transition | 69 |
| Diagram III.4 | Components and priorities of an action plan | 71 |

Maps

| | | |
|----------|--|----|
| Map I.1 | Digital industrial policies and artificial intelligence strategies, May 2022 | 24 |
| Map II.1 | Number of data centres, by country, 2022 | 39 |



Foreword

Over the two years that have elapsed since the Seventh Ministerial Conference on the Information Society in Latin America and the Caribbean, which was held in virtual format in November 2020, major transformations in the digital sphere have gathered speed and become consolidated. The coronavirus disease (COVID-19) pandemic generated a quantitative and qualitative leap, albeit a very uneven one, in the use of digital technologies by all actors: governments, businesses of all sizes, education systems, households and individuals. It also showed how important digitalization has become for ensuring the continuity of all types of economic and social activity and enabling people not only to connect with family and friends, but also to exercise fundamental rights such as work, education and health.

The digital transformation transcends the current juncture and is generating new consumption and production models that are redefining the paradigms of growth and development. Much of humanity is connected today thanks to the rollout of network infrastructure, the mass take-up of smartphones and the consequent access to information, social networks and audiovisual entertainment. The acceleration of technical progress in the digital realm has brought cloud computing, big data analytics, blockchain and artificial intelligence into people's everyday use of devices and applications.

It has become increasingly evident that a digital society is not only more dynamic and productive but also more resilient, because it is more capable and flexible in its response to different kinds of shocks and crises. However, getting to this point requires building digital infrastructure for the twenty-first century, reducing inequalities in access and levelling the playing field.

The technological revolution poses challenges and risks. The shift in the strategies of leading companies in the response to the advance of digital technologies has led to the rise of global platforms, producing a strong concentration of economic and political power. This, together with the greater relevance of the elements that make up the digital economy —microprocessors, fifth generation (5G) mobile networks, artificial intelligence algorithms, and so on— has generated new sources of geopolitical tension amid rivalry for position in the techno-economic sphere, mainly around issues relating to patents, standards, regulation and production. This competition for technological dominance and the resulting geopolitical tensions have demonstrated the need to strengthen collective and multilateral actions to respond to the common challenges we face.

In recent years, the countries of Latin America and the Caribbean have pursued policies that have underpinned significant advances in connectivity, as well as programmes for the digitalization of education, health and e-government services, with adjustments to the corresponding regulatory frameworks. However, significant digital gaps persist in access and use, both within and between countries in the region, as well as with respect to the more advanced economies.

It is essential to advance in the application of coordinated measures to address the challenges of digital transformation. In this regard, in his report "Road map for digital cooperation" (29 May 2020), the Secretary-General of the United Nations, António Guterres, highlighted the need to strengthen global digital cooperation in the face of the enormous outstanding challenges in the areas of digital inclusion, capacity-building, protection of rights and trust and security. The region is no stranger to these challenges, which have taken on a new urgency given the importance that digital technologies have been shown to have in addressing major challenges such as the COVID-19 pandemic.

Multilateral cooperation spaces are —and will be increasingly— important to build a coherent framework for global governance of the digital economy to ensure that no one is left out of its potential benefits. Today, the region is at a turning point that requires renewed digital cooperation extending beyond individual projects, with shared and collaborative vision and leadership. A collective strategy will help leverage the opportunities offered by digital technologies to drive a transformative recovery and achieve the Sustainable Development Goals.

The Economic Commission for Latin America and the Caribbean (ECLAC) has supported the countries of the region in managing rapid technological change. Since 2005, unremitting support has been provided to strengthen regional cooperation spaces in the digital sphere, coordinated through the Digital Agenda for

Latin America and the Caribbean (eLAC), which is renewed every two years. This mechanism has served to share experiences and best practices and, from a systemic and multidimensional perspective, to promote digitalization as a powerful tool for overcoming the region's structural problems and managing the multiple sources of uncertainty presented by the global environment.

Thus, the Eighth Ministerial Conference on the Information Society in Latin America and the Caribbean, under the chairship of Uruguay, aims to take stock of the agreements established and renew this policy dialogue, as well as to promote innovative policies and measures, with greater participation by private actors and civil society, that can drive greater access to and use of digital technologies to close the inclusion, productivity and sustainability gaps that hold back development in Latin America and the Caribbean.

The present document contributes to the debate and to action for the uptake and use of digital technologies at the national and regional levels, in order to support inclusive and sustainable development. The contents are organized into five chapters. The first reviews the main global changes driven by digitalization. The second assesses the enabling conditions for infrastructure development and the skills that are available in the region to promote a sustainable and inclusive digital transformation. The third chapter analyses progress and challenges in key areas for accelerating digitalization, such as the productive sector, government, the green transition, employment and the labour market, and smart cities. The fourth chapter looks at the state of digital agendas in the region, in particular with regard to emerging issues, and presents recommendations to improve governance and partnerships and to strengthen regional cooperation and the move towards a regional digital market. The fifth and final chapter puts forth a number of policy recommendations, under five lines of action, to advance an inclusive and sustainable digital transformation. We trust that this document, prepared for the Eighth Ministerial Conference on the Information Society in Latin America and the Caribbean, will contribute to the updating and fine-tuning of national and regional strategies, both in terms of public policies and in terms of partnerships and cooperation with private and civil society actors, to accelerate progress towards a digital transformation that will underpin the productive, educational, social and environmental transformation of our countries.

José Manuel Salazar-Xirinachs

Executive Secretary

Economic Commission for Latin America
and the Caribbean (ECLAC)



CHAPTER

I

Global change driven by digitalization

- A. The multiple dimensions of digital transformation
- B. Value creation and competitiveness in the digital era
- C. The growing importance of digitalization in the global economy
- D. A new world order?
- E. Digitalization at the heart of productive development policies

Bibliography

In recent years, advances in development of digital technologies and their cross-cutting applications have driven transformations that are affecting the entire economy and all of society. It is a global trend, and one that was accelerated by the coronavirus disease (COVID-19) pandemic, as digital technologies became resilience tools for maintaining social and productive activities under restrictions on face-to-face activities and movement in the health emergency.

The increased adoption of digital technologies, especially the most advanced ones, tied to intensive use of data and smart solutions, is disrupting consumption, business and production models, enabling new forms of value creation that have the potential to affect the well-being of people and the competitiveness of the economy. Today, digitalization is seen as a tool to transition to a new, more inclusive and sustainable development model.

The most advanced economies have accepted that these changes are irreversible and have begun to apply measures to retain their leading positions in the new context. The countries of Latin America and the Caribbean need to move more quickly in this direction, appreciating the new forms of value creation offered by digital transformation, and thus seizing the opportunities for social inclusion and sustainable economic growth that they create. Action is urgently needed to develop capacities that will enable countries to ensure that digitalization is virtuous; if countries do not, there is a risk they may lag further behind in terms of development.

A. The multiple dimensions of digital transformation

The digital revolution is giving rise to a new age characterized by the transformation of consumption, business and production models through adoption of advanced digital technologies, namely fifth-generation (5G) mobile networks, the Internet of things (IoT), cloud computing, artificial intelligence, big data analytics and robotics, among others. The current situation is one of transition from a hyperconnected society to a world whose economic and social dimensions are digitalized, in which organizational, production and governance methods of the traditional economy coexist with the business, production and governance models arising from the new technological paradigm and incorporate their innovations. This is leading to formation of a new, digitally interwoven system in which models from the two spheres are integrated and interact, giving rise to more complex ecosystems that are currently in the throes of organizational, institutional and regulatory transformation, and in which digital data, produced by people and machines, become a strategic source of economic, social and environmental value creation (ECLAC, 2018).

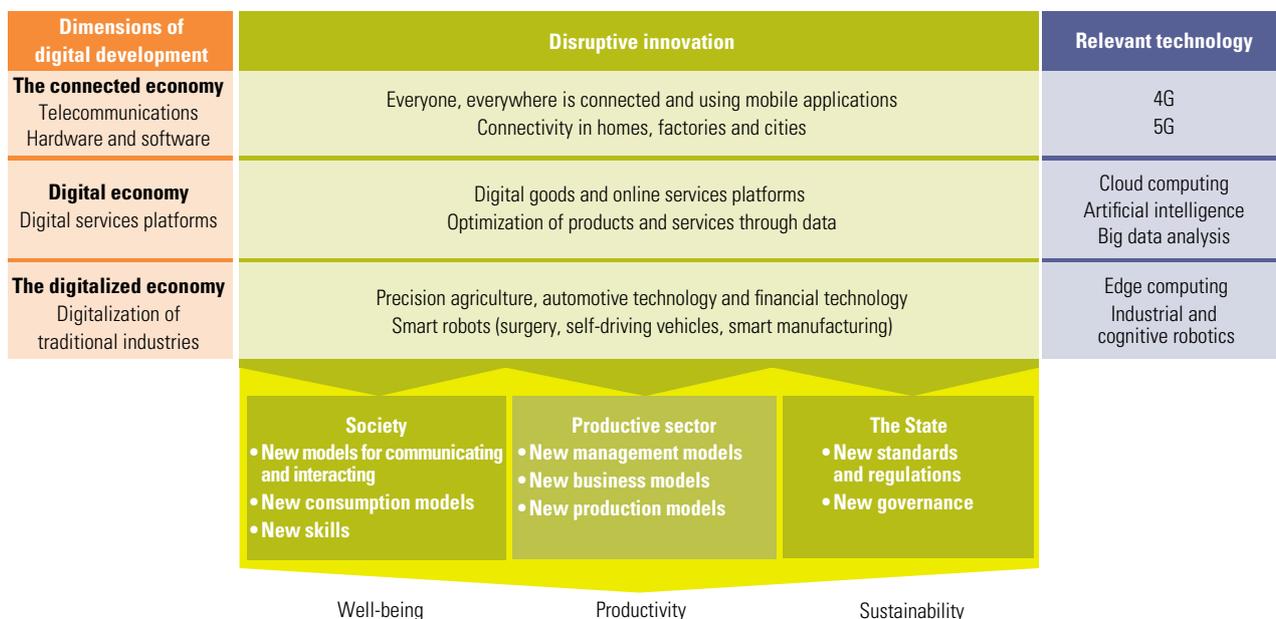
This trend is evolving at the same pace as technological progress. It is a synergetic process, in which advances in one area influence changes in another, and a systemic one, because of its impact on society, production and government, as well as its potential to improve well-being, productivity and environmental sustainability. There are three clear dimensions of this process: (i) the connected economy; (ii) the digital economy; and (iii) the digitalized economy (ECLAC, 2021a) (see diagram I.1).

- Connected economy: the deployment of digital infrastructure (such as fixed and mobile broadband Internet networks, Internet exchange points (IXP) and data centres) and pervasive use of devices with Internet access (desktop or laptop computers, tablets and smartphones). Sensor networks also reflect growth in connections of people with machines through IoT.
- Digital economy: the part of economic output based on business models enabled by use of digital technologies (Bukht and Heeks, 2017). These digital platform models drive data generation and collection, with a view to offering new value propositions when supplying goods and services in various economic sectors.¹
- Digitalized economy: transformation of the business and production models of companies in traditional sectors into connected smart systems, through adoption of advanced technologies such as 5G mobile networks, IoT, cloud computing, artificial intelligence (AI), virtual and augmented reality (VR and AR), big data analytics and cognitive robotics. The aim is to make operations more competitive, productive and sustainable.

¹ At present, digital platforms operate in multiple economic sectors and facilitate, among others things, online purchases and sales (Amazon, Alibaba and Mercado Libre), financial services (Ant Group, Avant, Mercado Pago and Nubank), communications and social networks (Facebook, Instagram and WhatsApp), tourism and hospitality (Despegar, Booking and Airbnb), the development of applications (for the Apple iOS and Google Android operating systems) and matching supply and demand in employment (Laborum, LinkedIn, Workana and Freelancer).

Diagram I.1

Dimensions of digital development and their disruptive effects on society, the productive sector and the State



Source: Economic Commission for Latin America and the Caribbean (ECLAC), Towards transformation of the development model in Latin America and the Caribbean: production, inclusion and sustainability (LC/SES.39/3-P), Santiago, 2022.

Social value is derived from people's well-being, which depends on quality of life, income level and working conditions. Digitalization can improve these areas by enabling changes in consumption, work, communication and social interaction models. The rise of the digital economy has improved access to all kinds of information and knowledge, as well as to digital goods and services, which, by being provided solely online save costs and travel time. Digital solutions can also enhance delivery and coverage of public services in the health, education and government management, improving quality of life and social inclusion.

In the world of work, digitalization can create opportunities by facilitating entrepreneurship or professional development, as well as providing mechanisms for a better work-life balance, such as teleworking tools. The social and entertainment activities provided by social networks, messaging services, websites and audiovisual service platforms also lead to improved well-being.

The transition to an increasingly digitalized economy is expected to enable consumption of smart products linked with advanced services with a higher degree of personalization, resulting in a higher level of consumer satisfaction. New forms of consumption also have potential benefits in terms of use of less material and could facilitate more sustainable consumption by providing more information for related decisions. For example, data related to a product's environmental footprint or rewards for more environmentally friendly consumption could reshape people's preferences.

In the productive sector, digital transformation is creating new management, business and production models that favour innovation and access to new markets, often causing disruptions in traditional industries. Development of the digital economy is resulting in a radical change in the value proposition of goods and services, by exploiting information from data produced and shared on digital platforms, as well as reducing transaction and intermediation costs. Increasingly widespread adoption of advanced digital technologies in the different productive sectors is also leading to new stage, that of the digitalized economy. The incorporation of industrial Internet of things, smart systems, virtual value chains and AI into production processes is accelerating innovations, resulting in productivity gains and more sustainable production processes. However, digitalization of production is more than just process optimization. In fact, value chains are undergoing a transformation, reshaping markets and industries.

In order to properly meet citizens' demands and improve government action, a similar digital transformation should take place in State bodies' public management models. Adoption of these technologies by the State could increase efficiency and effectiveness of tax collection and in the provision of services (health, education, transportation, among others), as well as improving citizen participation in democratic processes and transparency in government activities, in addition to promoting more sustainable practices. Smart city solutions in particular are transformative owing to their potential social, economic and environmental effects.

Although this cross-cutting process has been taking place since the start of the twenty-first century, in recent years some of its most evident impacts, which are often disruptive, have been seen in the productive sphere, enabled by new forms of value creation. This is directly related to the ability to compete of companies and therefore also of the ability of countries' productive fabric to do so, making it a key element for national development agendas.

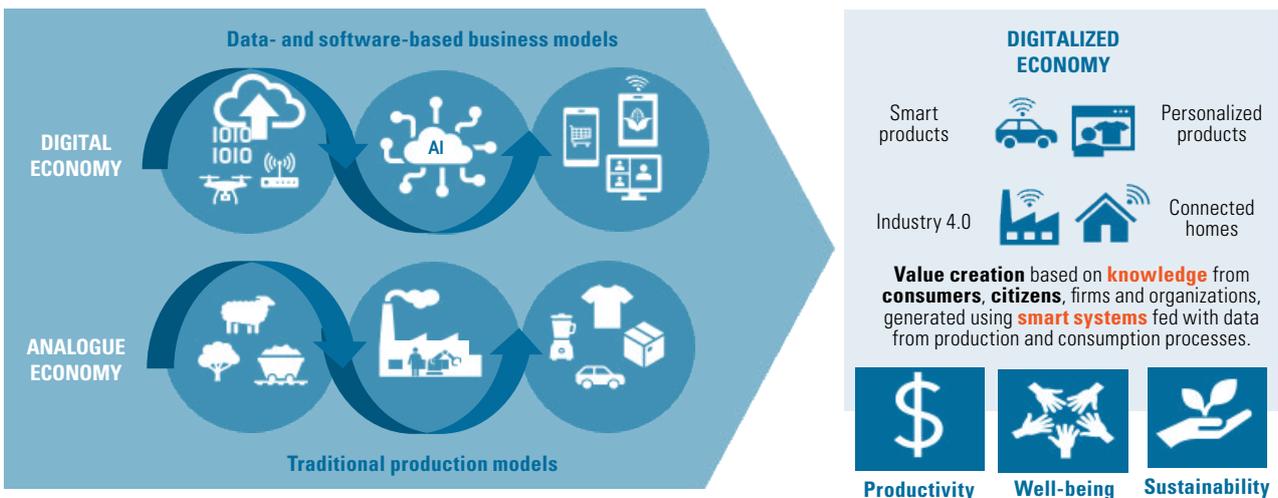
B. Value creation and competitiveness in the digital era

Digitalization engenders new forms of value creation, with the potential to increase competitiveness, productivity, social well-being and environmental sustainability. This value creation is based on the knowledge generated from digital data extracted from production and consumption processes by means of smart systems based on advanced digital technologies. This is ushering in a fourth industrial revolution (Industry 4.0), characterized by the digitalization of all sectors of the economy.

As use of these technologies intensifies in productive sectors, traditional business and production models will be transformed into Industry 4.0 models. In this environment, data-driven business models and software platform systems are merged with traditional operation and production mechanisms. The result of this is integration of the entire production chain, including product development and manufacturing and distribution assets, through continuous autonomous data and information flows that trigger decisions and actions, thus enabling smarter and more flexible processes (see diagram I.2). This transformation not only makes it possible to optimize processes, but also entails reconfiguration of chains and transformation of products and services. Incorporation of digital technologies therefore enables value creation in terms of products, manufacturing processes and business management, translating into improved customer satisfaction, productivity gains and more sustainable operations.

Diagram I.2

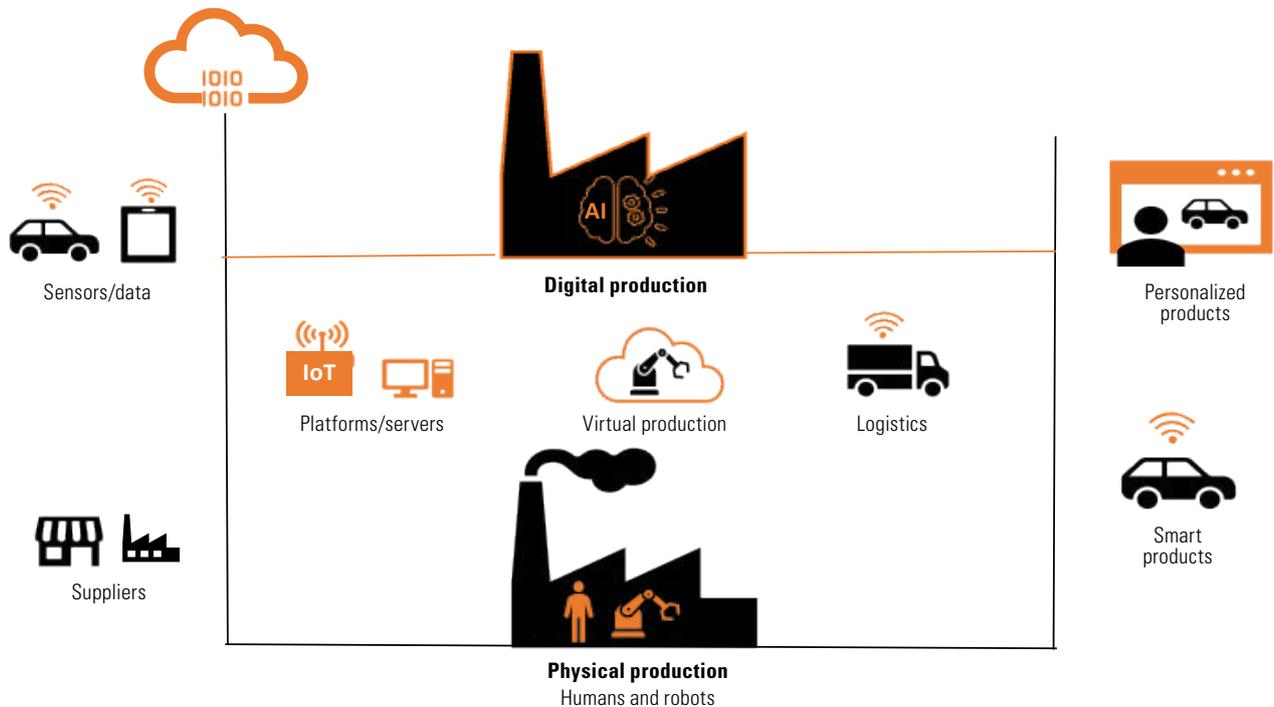
Digitalization and transformation of means of value creation



Source: Economic Commission for Latin America and the Caribbean (ECLAC).

As part of the fourth industrial revolution, smart factories are appearing, with processes that adapt dynamically and rapidly to market demand (see diagram I.3). Having real-time access to information for decision-making along an entire value chain is a key competitive advantage when it comes to making efficient use of resources and better meeting demand. Solutions based on cloud computing enable better integration of the various stages of the production chain. This makes it possible to optimize processes within the chain (maintenance, manufacturing or stock management) and reduce costs, as well as to improve management of logistics and distribution, reducing time to market and providing better insight into consumer needs.

Diagram I.3
Industry 4.0



Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of Lasinskas, "Industry 4.0: penetrating digital technologies reshape global manufacturing sector", January 2017 [online] <https://www.euromonitor.com/article/industry-4-0-penetrating-digital-technologies-reshape-global-manufacturing-sector>.

In addition to improving productivity, the use of digital technologies is expected to have an impact on sustainability, as data could be used to apply methods and algorithms to optimize operations, thus reducing their environmental impact, and to create circular models that contribute to cutting waste.

Smart and more personalized products are also emerging, whose value lies not only in their physical features and functionalities, but also in optimization of the user experience, through integration of services in different links of the value chain. Products may be mass-customized and will increasingly incorporate services into their value proposition (such as goods packaged with after-sales services or subscriptions to regular delivery of supplies, such as car subscription services). In these new models, services will account for an increasing proportion of value added.

Competitiveness will depend on the capability of traditional companies to incorporate software into their core businesses, build new digital platforms within the confines of their usual activities or transform production chains into digitally enabled ecosystems, with interconnected services that meet a variety of cross-sectoral user needs in one integrated experience (Blackburn and others, 2021). The latter can enable creation of smart clusters of local small and medium-sized enterprises (SMEs) that provide a variety of services at different stages of the chain. This productive transformation has implications at the national and local levels.

Thus, in the digital era, competitive advantages will increasingly depend on the capacity of countries to adapt and develop digital technologies and solutions—a core component of the new landscape—and incorporate them into their productive fabric. This trend is increasingly incontrovertible, given the rapid pace of digital transformation worldwide.

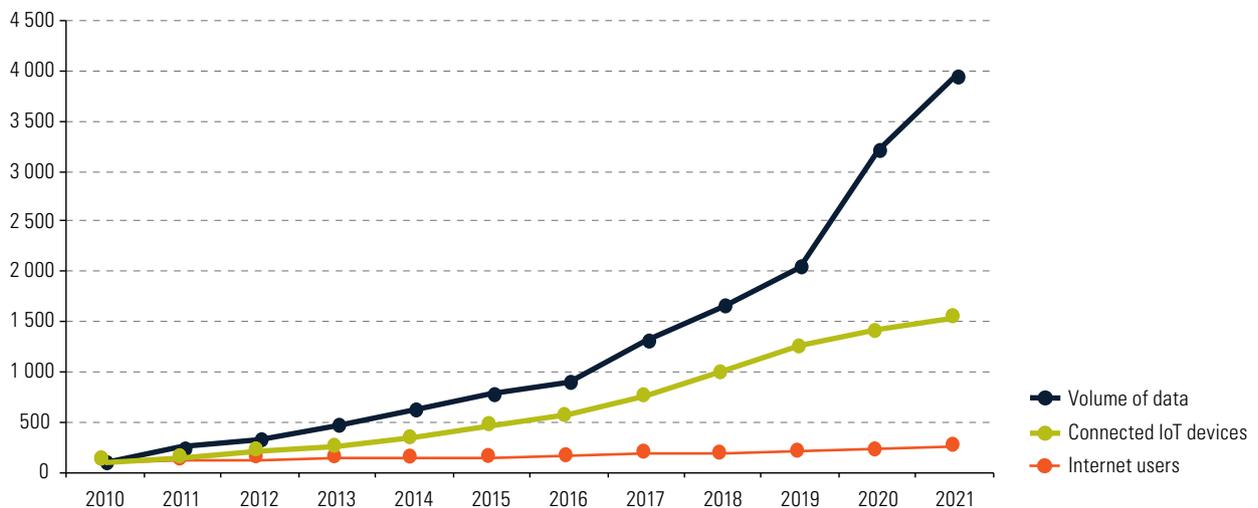
C. The growing importance of digitalization in the global economy

The ongoing datafication of the economy is unmistakable. Between 2011 and 2021, the percentage of Internet users doubled to 63% of the global population, which is to say 4.9 billion people. Over the same period, the number of connected IoT devices increased elevenfold to 12.2 billion, while the volume of data generated and consumed increased sixteenfold from 5 zettabytes to 80 zettabytes (see figure I.2).² In 2020 alone, the volume of data grew by 57%, owing to increased use of online solutions for work, study, entertainment or communication during the COVID-19 pandemic. It is estimated that by 2025, IoT devices alone—of which there are expected to be over 55 billion—will have generated 79.4 zettabytes of data (IDC, 2019).

Figure I.1

Internet users, connected Internet of things devices, and amount of data created and consumed in the world, 2010–2021

(Base year 2010=100)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), Regional observatory for digital development, on the basis of data from IDC-Statista June 2021 [online] <https://www.statista.com/statistics/871513/worldwide-data-created/>; Statista, November 2020 [online] <https://www.statista.com/statistics/1101442/iot-number-of-connected-devices-worldwide/> and International Telecommunication Union (ITU), *World Telecommunications/ICT Indicators Database*, December 2021.

Digital expansion seems immune to economic fluctuations and crises. The growth in digital technology has been both rapid and sustained for more than a decade, as opposed to traditional yardsticks of economic performance, such as foreign direct investment or international trade, which have fluctuated considerably. This pattern of growth has enabled the emergence of players that have dominated the economic landscape to an unprecedented extent.

² For reference, 1 zettabyte is equivalent to about 250 billion digital video discs (DVDs).

Today, technology giants such as Apple, Microsoft, Alphabet (whose main subsidiary is Google), Amazon and Meta (parent company of Facebook, Instagram, WhatsApp and other subsidiaries) have some of the highest market capitalizations in the world. In March 2022, the global digital industry was worth more than US\$ 25 trillion, accounting for more than a quarter of the global economy (27%). This represents growth of 330% between 2010 and 2022 in market value of companies in the sector, four times more than the growth in traditional industries (see figure I.2).

Figure I.2

Market values of the digital technology industry and of traditional industries, by segment, March 2010 and March 2022
(Trillions of dollars)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), Regional observatory for digital development, on the basis of data from Bloomberg on the 5,000 companies with the highest market values worldwide and the 500 companies with the highest market values in Latin America.

The strong momentum of the digital industry is largely a result of explosive growth in e-commerce platforms and in Internet and software services over the period, which increased in value by more than 1,400% and 945%, respectively. The software and hardware segments grew by 440% and 390%, respectively, while the telecommunications segment recorded the least growth, at 103% (see figure I.2).

This increase in value is being accompanied by extensive consumption of the online products and services offered by firms in the digital economy, as illustrated by these figures:

- In April 2022, people spent a global average of seven hours online, mainly searching for information and news, using social networks and messaging services to communicate with friends and family, streaming music and videos, making online purchases, performing education- and work-related activities, managing their finances and playing online games.
- Today, 80% of people in Europe, North America and Latin America and the Caribbean are users of social networks, and 59% of the global population (twice the proportion recorded in 2015).
- It is forecast that by the end of 2022, 21% of retail sales will be online, and around 60% of Internet users will purchase goods or services through e-commerce channels (Statista, 2022a).
- In 2021, 64% of consumers used a financial technology (fintech) tool, mainly for cash transfers and payments.
- Today, more than 80% of professionals report using a combination of email, messaging services, video calls, office software and collaborative solutions on a daily basis.
- In the first quarter of 2022, there were 37 billion downloads of mobile applications (Data.ai, 2022).

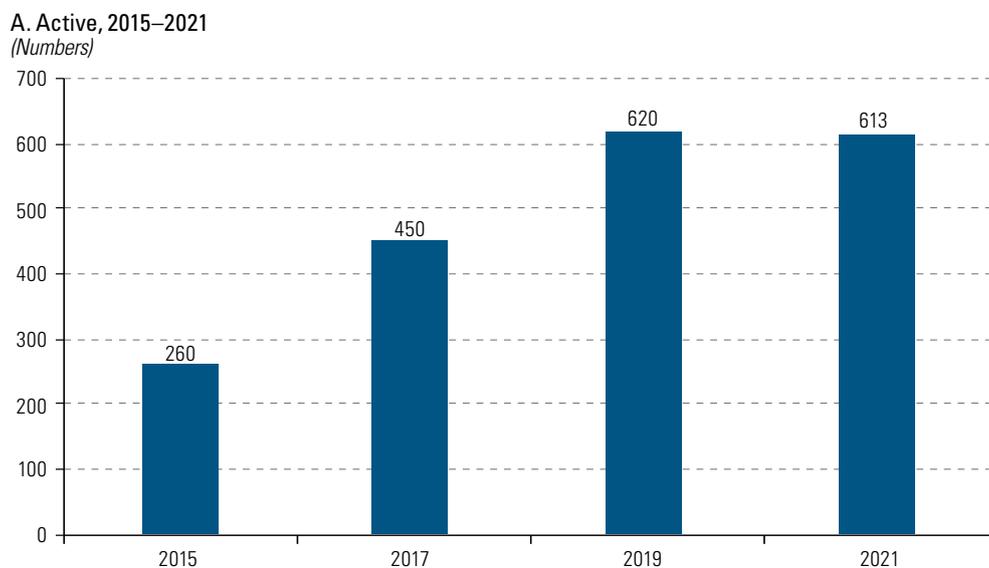
The datafication of socioeconomic activities is spreading beyond supply of goods and services within the digital economy, permeating the business and production models of companies in traditional industries, transforming them and enabling them to leverage new sources of value creation, as part of the fourth industrial revolution. The challenge for these firms is to incorporate digital technologies into their products, to develop digital services that leverage generated data and to introduce smart systems into innovation, production, logistics and marketing processes.

This entire process entails taking advantage of advances that are unrelated to the core business. As a result, many leading firms in traditional industries are turning to alliances, joint ventures and acquisitions as transformation and survival strategies, while digital companies are expanding into traditional industries (ECLAC, 2021b). Over the last five years, the big technology companies (Amazon, Apple, Alphabet, Meta and Microsoft) have collectively made more than 200 acquisitions and large investments in other companies, at a pace that showed no signs of slowing during the COVID-19 crisis. These deals focused on technological ventures to strengthen their capabilities in artificial intelligence and virtual reality, among other areas, and on development of solutions for collaborative work, cybersecurity and industrial productivity, as well as in the areas of mobility and health (CB Insights, 2022).

The digital transformation of industrial sectors requires network infrastructure, access terminals and applications to capture, store and analyse data to make production and business processes smart. IoT platforms³ offer such features, so their roll-out in recent years is a reflection of digital transformation in various industries. Walmart, for example, is building its global IoT platform on Microsoft's Azure cloud computing service to connect its heating, ventilation and air conditioning (HVAC) units to reduce energy use and to use machine learning to optimize truck routes and improve its supply chain. Volkswagen, meanwhile, has partnered with Amazon Web Services and MindSphere to develop its industrial cloud to connect all components of its value chain and enhance it with a marketplace and an app store.

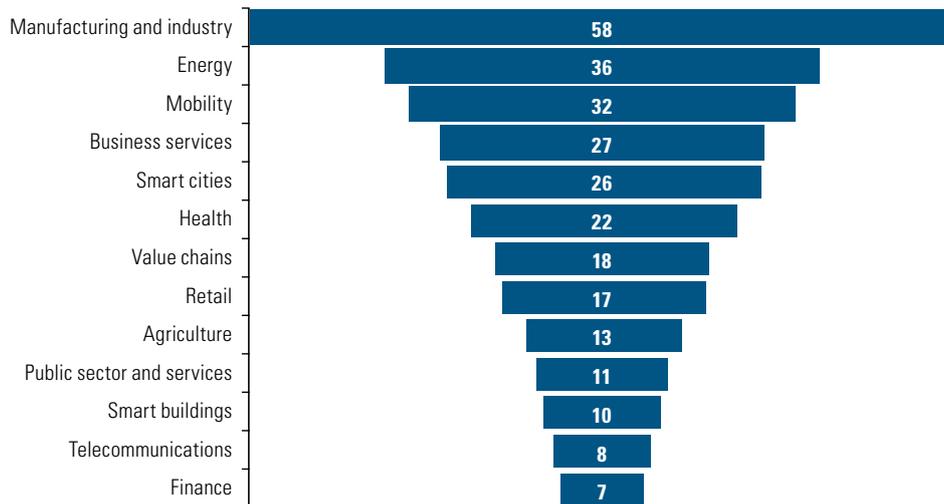
The number of companies operating IoT platforms globally rose from 260 in 2015 to 613 in 2021, with 44% of those firms headquartered in the United States or Canada (see figure I.3). These platforms are expected to serve a market worth around US\$ 9 billion by 2020, with solutions focused on the manufacturing and industrial, energy and mobility sectors, followed by enterprise tools, smart cities and health care. The market is expected to grow to US\$ 28 billion by 2026 (IoT Analytics, 2021).

Figure I.3
Internet of things platforms



³ An IoT platform is a local software package or cloud service (IoT platform as a service (PaaS)) “that monitors and may manage and control various types of endpoints, often via applications business units deploy on the platform. The IoT platform usually provides (or provisions) web-scale infrastructure capabilities to support basic and advanced IoT solutions and digital business operations” (Gartner, 2022).

B. Distributed by industry segment, 2021 (Percentages)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of IoT Analytics, “IoT Platforms Competitive Landscape 2021”, December 2021.

Note: Percentages do not add up to 100%, as most companies focus on several segments at the same time.

Smart automation using industrial robots in factories around the world is also gathering pace, rising from 66 units per 10,000 employees in 2015 to 126 today, driven by strong momentum in automation of the electronics, automotive and metalworking industries. As part of this trend, collaborative robots (cobots) are increasingly being installed, with adoption doubling between 2017 and 2020 to 6% of annual installations of robots (IFR, 2021a). Cobots are expected to significantly improve productivity by tackling new applications and have the potential to improve safety for workers, for example, when performing dangerous maintenance and repair tasks. However, this new form of automation has implications for the labour market, in terms of both job destruction and demand for new worker skills.

These transformations bring with them technological challenges, such as the need for interoperability standards to enable different systems to be integrated, as well as security standards to protect consumers and organizations from cyberattacks. In 2021, there were 50% more average weekly attacks on corporate networks than in 2020, and Latin America and the Caribbean was the third most prone region to such attacks after Africa and Asia-Pacific (Check Point Research, 2022). During the same year, attacks on supply chains grew by 100%.⁴

The new global landscape thus reflects cultural changes, as well as changes in consumption, business and production models, to leverage the new forms of value creation linked to digital transformation. Countries need to prepare for the future by understanding these patterns and the extent of the related changes, which appear to be shaping a new world order.

D. A new world order?

Today, we are facing a global scenario of different coexisting economic systems, whose performance varies. The digital economy works very differently from the traditional economy: while the latter is based on diminishing returns in production, the former is characterized by its ability to generate increasing returns, typical of the network effects of digital ecosystems, and then use that advantage to dominate a market in which the winners (dominant firms) are left with extraordinary income and can influence the conditions for competition and market entry (Arthur, 1996).

⁴ This type of crime comprises an attack on an external supplier that has legitimate access to its clients' systems, thus compromising the data belonging to a company. To carry out such attacks, hackers insert malicious code into trusted hardware or software that enables them to expose the data of customers, and of their customers in turn, throughout the chain. This can affect a whole network of suppliers and cause serious damage to those affected, as well as severe disruption to business continuity. The rise in such crimes is therefore cause for alarm.

As a result, the two economies differ in behaviour, culture and performance, and require different management techniques, strategies and regulatory frameworks. In this new economy, it is not so much about production efficiency, but about improving redistribution mechanisms (Arthur, 2017), which requires internationally coordinated actions to address challenges arising from the digital economy, especially in terms of market concentration.

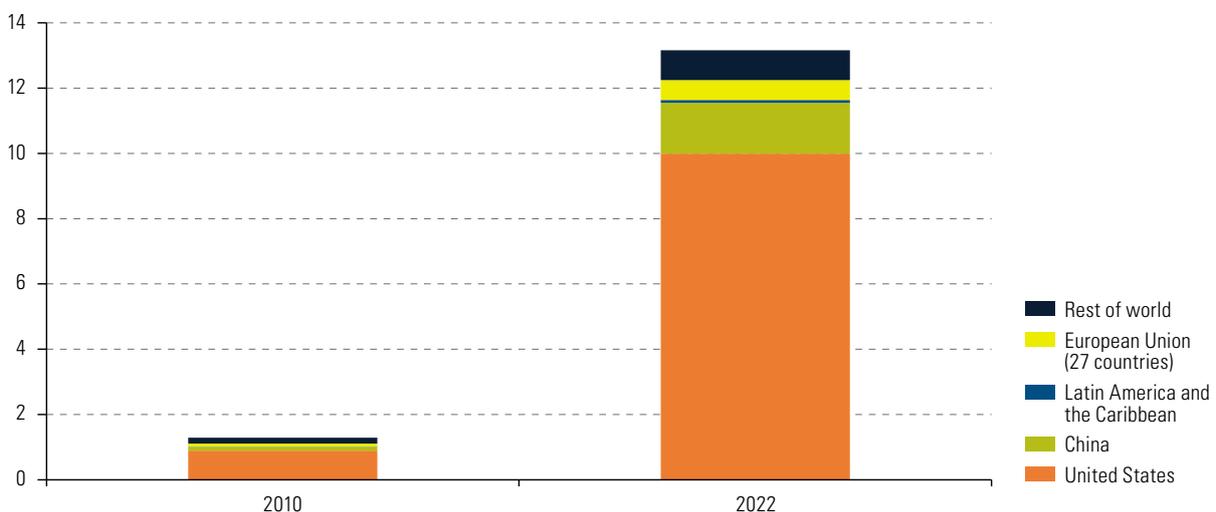
Over the past decade, technological giants have dominated their respective market segments worldwide. Meta, through Facebook and Instagram, accounts for 80% of social network users (StatCounter Global Stats, 2022). Google has a share of over 85% in the search engine market (Statista, 2022b) and its smartphone operating system, Android, has a share of more than 70% in that market (StatCounter Global Stats, 2022). Apple has 28% share of the mobile handset market and 51% of the smartphone market in the United States. Microsoft's share of the desktop operating system market, with Windows, is 76%, while Amazon manages a third of cloud services through Amazon Web Services.

This economic power is the result of the business model for digital platforms, which connects groups of economic agents (for example, suppliers with consumers or advertisers with search engines), leveraging the data that agents exchange on the platforms, their networking effects and their global reach. In addition, information asymmetries arise because the platforms have large volumes of data on their users, but users have no insight into how the platforms operate or the data they use for training their algorithms. As a result, technology giants have the power to set operating standards and rules. Thus, as their services permeate economic sectors, these companies have the ability to set operating conditions in their ecosystem for other economic agents, thus exercising some monopolistic power (Dijk, Nieborg and Poell, 2019).

In the digital age, this economic power reaches beyond companies. Gains at the microeconomic level are transferred to the country where their headquarters are located, affecting the development of economies and creating geopolitical tension at the global level. This is particularly relevant if one considers that 88% of the large technology platforms for Internet services and software, together with those for e-commerce, are headquartered in the United States (76%) and China (12%) (see figure I.4).

Figure I.4

Market capitalization of publicly traded companies that operate Internet services and e-commerce platforms, by selected countries and regions, March 2010 and March 2022
(Trillions of dollars)

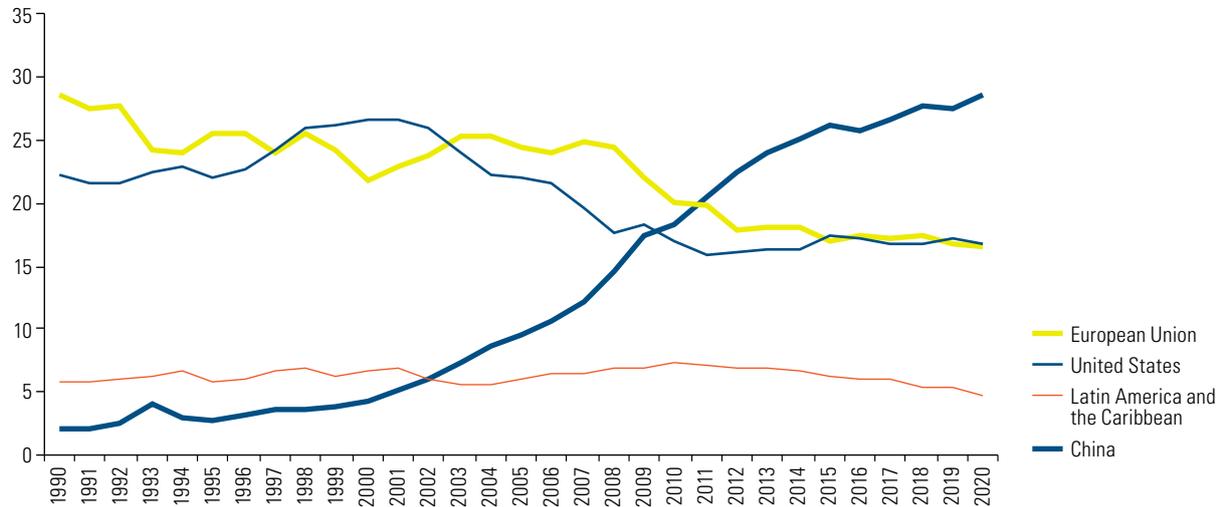


Source: Economic Commission for Latin America and the Caribbean (ECLAC), Regional observatory for digital development, on the basis of data from Bloomberg.

In this context, the performance of China is particularly noteworthy. In recent decades, the country has positioned itself as a major player in both new technologies, with the value of its digital platforms increasing fifteenfold between 15 2010 and 2022, and in traditional industry, and its contribution to global value added has grown, surpassing those of the United States and Europe in 2020 (see figure I.5).

Figure I.5

Selected countries and regions: share of manufacturing value added in the world, 1990–2020
(Percentages)



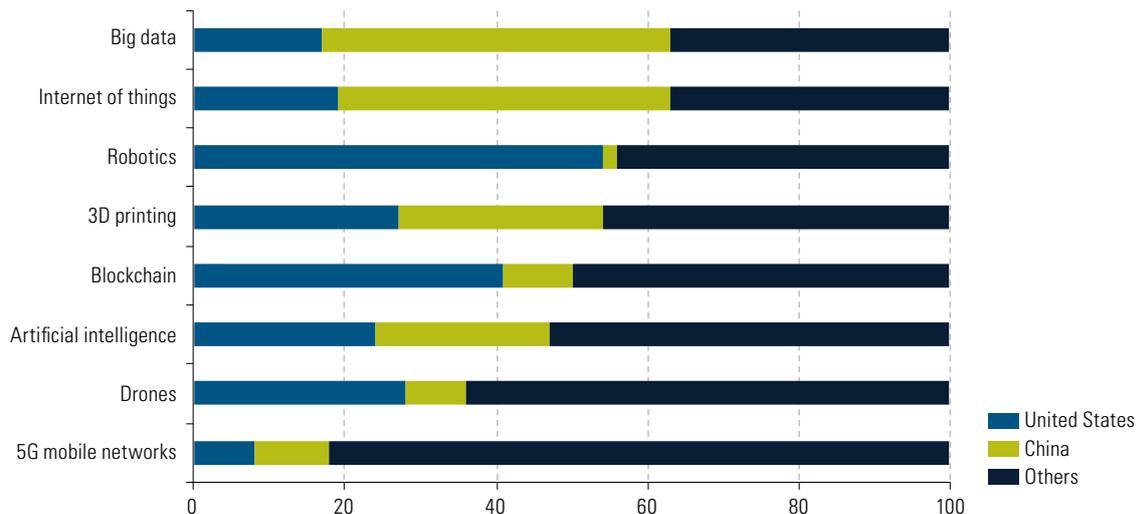
Source: Economic Commission for Latin America and the Caribbean (ECLAC), Regional observatory for digital development, on the basis of data from Bloomberg and United Nations Industrial Development Organization (UNIDO), Manufacturing Value Added Database 2022 [online] <https://www.unido.org/researchers/statistical-databases>.

In the 1990s, the main manufacturing powers were the United States and Europe, which together accounted for around 50% of global manufacturing value added. From 2000 onward, the distribution of global manufacturing shifted, especially towards China, whose share rose from 2% in 1990 to 29% in 2020. In contrast, the combined share of the United States and Europe fell sharply to around 17% in 2020, while Latin America and the Caribbean's remained at around 5% (see figure I.5).

The strong position of China and the United States with regard to the fourth industrial revolution is also reflected in a concentration of patents for advanced technologies in these countries. China dominates patents relating to big data and IoT, while the United States leads in robotics and blockchain. The situation is more balanced with regard to development of AI (see figure I.6).

Figure I.6

Selected countries: patents for advanced digital technologies in the world, by segment, 2021
(Percentages)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of United Nations Conference on Trade and Development (UNCTAD), *Technology and Innovation Report 2021. Catching technological waves. Innovation with equity* [online] https://unctad.org/system/files/official-document/tir2020_en.pdf.

The strong position of the United States and China in manufacturing and the digital economy puts them at the forefront of this new industrial era. This enables them to better withstand new waves of innovation based on digital data and the use of AI in their mature manufacturing sectors. Both countries have been gradually implementing strategies and actions to strengthen their current leading position, giving them an advantage in the economy of the future. This behaviour is being mirrored, to varying degrees, by several of the world's other leading advanced economies, which are placing digital technologies at the heart of their development strategies.

E. Digitalization at the heart of productive development policies

The emergence of a fourth industrial era spurred by the digital revolution, together with other factors linked to climate change, the vulnerability of an international production system based on global value chains, the COVID-19 pandemic and the growing geopolitical tension among some of the world's major economies has led to implementation of ambitious new productive development policies.

These policies are key to economic development, as they improve competitiveness and increase the share of more technology- and knowledge-intensive activities, with a significant impact on creation of high-quality jobs and higher wages. However, it is not a case of returning to traditional industrial policies, but of adopting new approaches that leverage technological progress and take into account the needs of environmental sustainability and social cohesion (Aiginger and Rodrik, 2020). These factors are even more important for countries in transition to development, such as those in Latin America and the Caribbean, which are suffering the consequences of decades of deindustrialization and environmental degradation caused by strategies of development and spurious growth based on exploitation of natural resources.

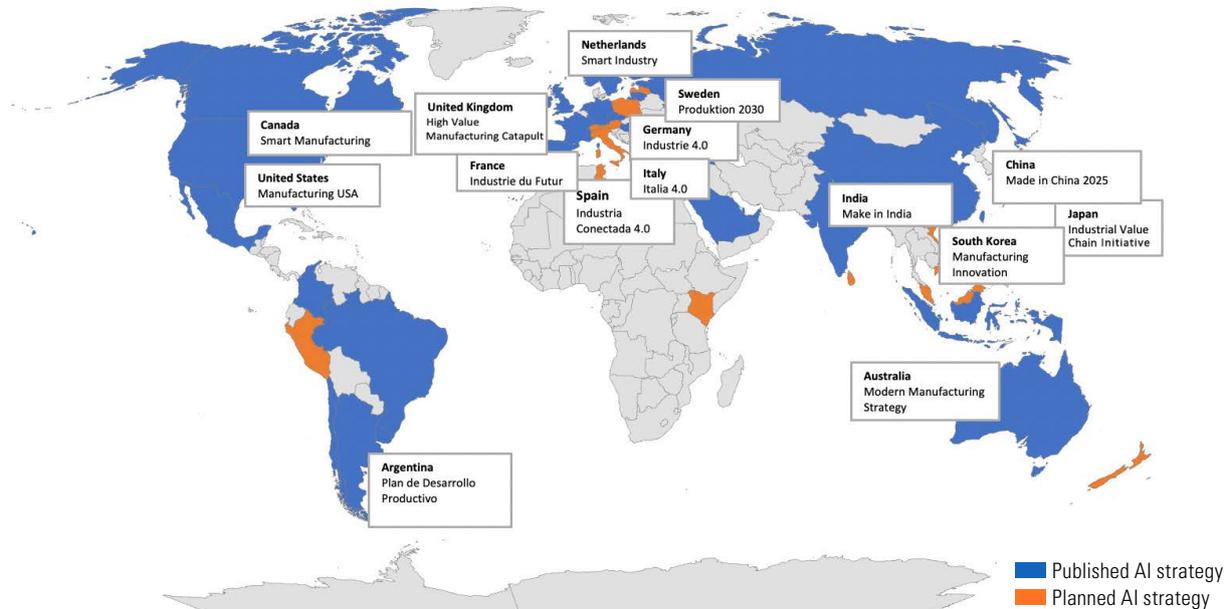
Productive development policies in the digital era are more complex and cannot be restricted to manufacturing and processes of structural change. Their scope should be broadened to include new matters related to data flows, such as technical standards, cybersecurity and specific regulations. Because it is a cross-border issue, data governance should be aligned with international guidelines. Likewise, new industrial policies should foster integrated digital ecosystems and prioritize development of innovation-intensive, export-oriented strategic sectors that play a central role in supply chains and in creation of value networks, as well as contributing significantly to employment, productivity and sustainability. In addition, efforts must be made to boost technological activities that facilitate digital ecosystems to support development of strategic sectors.

The most advanced countries face this new industrial era having reached a mature point in previous eras and have therefore quickly begun to implement policies to accelerate dissemination of digital technologies and their inclusion in production systems. In 2011, the United States launched a set of measures, discussions and recommendations at the national level called the Advanced Manufacturing Partnership (AMP), to ready its industries to make major investments in advanced technology. In 2013, Germany launched the Plattform Industrie 4.0 programme to develop smart networks of machines and processes for industry and maintain the country's advantages in the global manufacturing sector. In 2015, China launched the first national ten-year plan to transform manufacturing, called Made in China 2025. Austria, France, Italy, Japan, the Republic of Korea, the Russian Federation, Switzerland and the United Kingdom have implemented similar measures. More recently, and with varying intensity and complexity, Argentina, Brazil, Chile, India, Indonesia, Malaysia, Mexico and Singapore have followed in their footsteps (see map I.1).

At the same time, countries are moving forward with strategies for safe and transparent development of AI, given its potential applications with social, economic and environmental effects. AI is expected to help governments and organizations apply innovations to optimize decision-making processes, leading to efficiency gains, better resource use and improved energy management, and the development of new skills among the population. It could also have a positive impact on citizens' well-being through the provision of efficient and effective services, promoting accountability and transparency.

Map I.1

Digital industrial policies and artificial intelligence strategies, May 2022



Source: Economic Commission for Latin America and the Caribbean (ECLAC).

Strategies on AI have largely focused on creating talent and strengthening education systems with a view to developing this technology and its uses, as well as promoting research, development and innovation, government investment and international cooperation, particularly with regard to ethical principles for development of algorithms. Around 65 countries have already formulated AI strategies or are in the process of doing so (Oxford Insights, 2022).

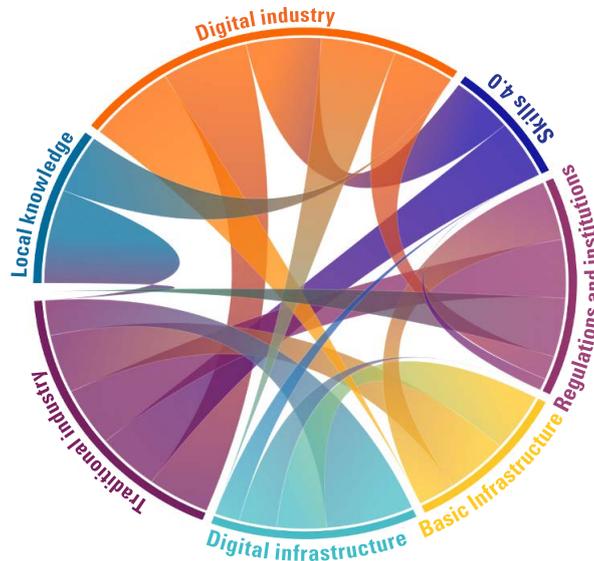
In general, countries with lower levels of development are lagging behind in terms of industry, meaning they face a twofold challenge of continuing to diversify their production while creating the right conditions for a fourth industrial revolution to occur and spread through the productive fabric. Digitalization of the economy is a complex process that requires substantial investment in various areas and creation of a foundation that enables comprehensive adoption of digital technologies, to unlock their transformative potential.

The impact of digitalization is neither automatic nor uniform across countries, companies or individuals, and depends on interplay with other economic, social and institutional factors (Peres and Hilbert, 2009). The potential benefits of digitalization in terms of growth, well-being and sustainability will depend on systemic factors such as the level of adoption of technologies, skills of human resources, productive structures, infrastructure (such as electricity and transportation systems), innovation systems and governance that addresses emerging challenges: market concentration, cybersecurity, employment and automation, privacy, personal data security and digital taxation (see diagram I.4). In short, countries must target a virtuous digital transformation that enables development of new and improved productive, technological and business capabilities linked to advanced technologies, while simultaneously modernizing and strengthening the traditional productive fabric. Digital transformation is not limited to the industry that gives rise to it; it has the greatest impact when it is adopted across the whole economy.

Without a systemic approach to digitalization, its benefits could become drawbacks in terms of concentration and inequality, especially for developing countries that are far from the technological frontier, whose competitive advantages are based on abundant natural resources and low labour costs, with significant structural heterogeneities in terms of sectors, territories and business size (ECLAC, 2012). As developed economies make rapid progress with policymaking on these issues, there is a growing risk that less developed countries will lag further behind, as they will find themselves competing under less favourable conditions, given the capacities needed to take part in the new environment.

Diagram I.4

A systemic approach to digital policies for productive development



Source: Economic Commission for Latin America and the Caribbean (ECLAC).

Technological innovations, especially advances in AI and robotics, have the potential to reduce required labour, which carries the risk of driving up inequality. Technological progress linked to information and communications technology (ICT) seems to be biased towards labour involving non-routine cognitive tasks, to the detriment of workers with less schooling who perform routine tasks (Autor, Levy and Murnane, 2003). Even in Latin American countries, demand has grown over the past two decades for workers in occupations that require intensive use of cognitive skills. Such positions offer higher pay than jobs that are intensive in manual tasks. The result is polarization of the labour market, considerably fuelling informality and inequity (Apella and Zunino, 2022).

The main challenge in this new environment comes from some countries potentially obtaining substantial gains and others having a lot to lose through worse terms of trade and weaker demand for unskilled labour, and even possibly less demand for natural resources as a result of production savings from using new technologies. Developing countries must therefore set out industrialization strategies that go beyond manufacturing to encompass other sectors, such as agriculture and knowledge-based services. In parallel, countries should engage in reforms of the global governance system that include a global tax regime for the digital age, competition policies that extend beyond national borders, adjustments to intellectual property frameworks and data regulation (Korinek, Schindler and Stiglitz, 2021).

In this context, the countries of Latin America and the Caribbean have significant opportunities but also face complex challenges. The future is digital, and the longer it takes for countries to increase not only access to the new digital economy, but also intelligent and widespread leveraging of its potential, the longer it will take for them to benefit from its enormous advantages, including the possibility of escaping the development traps that affect the region: high levels of social inequality, low productivity, institutional weakness and environmental vulnerability (Salazar-Xirinachs, 2021). Faced with this challenging and complex panorama, and in order to remain competitive and avoid deepening structural inequalities, the countries of the region should accelerate their digital transformation with three main goals: (i) achieving universal access to digital technologies, promoting development of improved skills to increase adoption; (ii) fostering innovation and digital transformation of the productive sector; and (iii) promoting public-private cooperation and regional digital cooperation.

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CHAPTER



Infrastructure, connectivity and skills: the foundations for a sustainable and inclusive digital transformation

- A. Digital infrastructure and connectivity in Latin America and the Caribbean
 - B. Digital skills for today and tomorrow
- Bibliography

As has become clear in recent years, and especially since the crisis caused by the coronavirus disease (COVID-19) pandemic, the Latin America and the Caribbean region still face a series of structural challenges that need to be addressed in order to advance the development process. These include inequality and low productivity, which are interrelated and linked to a highly heterogeneous and poorly diversified production structure, compounded by fragmented societies, high levels of informality, difficulties in accessing basic services and institutions that enjoy low levels of approval and credibility.

Today, more than ever before, improvements in inclusion, equality and productivity are associated with the accumulation of new capacities in the area of digital technologies. As noted in the previous chapter, in a world in which technological progress has accelerated sharply, there is less room for competition based solely on static comparative advantages, such as abundant natural resources or low-skilled labour. To boost economic development, resources need to be reallocated toward innovation- and knowledge-intensive activities; and economies need to diversify into sectors in which both domestic and external demand are growing rapidly.

It is undeniable that the digital transformation entails major disruptions that could promote greater inclusion and equality and also foster diversification of the production structure and sustainable productivity growth. Digitalization is affecting all sectors of the economy and society, adding value along the production chain; but the magnitude of the change will depend, largely, on enabling factors such as skills and infrastructure.

These technologies have expanded possibilities for advancing towards progressive and inclusive structural change. However, it is also true that the corresponding opportunities are not open to all countries or sectors alike. In fact, rapid digital transformation can become an additional source of social and productive segregation, both within and between countries, if the infrastructure and basic capacities needed to use the technologies appropriately and effectively are not in place. Moreover, success in harnessing the digital revolution depends increasingly on how economies, production sectors, institutions and societies position themselves to absorb and adapt to these changes.

A. Digital infrastructure and connectivity in Latin America and the Caribbean

The relationship between digitalization, inclusion and productivity is highly complex and depends on many factors. However, digital infrastructure is a central element in supporting value creation and generating an effective impact on competitiveness, social well-being and environmental sustainability.

Internet access is a key factor in people's quality of life, since it is a crucial factor not only for the adoption of digital solutions and technologies, but also for access to basic goods and services, and for connection with government institutions, businesses and society as a whole.

Effective connectivity involves a series of elements such as Internet access, the availability of devices and basic skills for using them. Despite having made great progress in this area in recent years, the countries of Latin America and the Caribbean still have to overcome significant access disparities associated with economic situation, social status, geographic location, gender or age range.

Achieving effective connectivity for people therefore requires mass deployment of both services and access devices, and the skills to use them. Failure to make progress along these lines could give rise to erroneous conclusions regarding access to and use of these technologies, and result in digitalization being concentrated in certain segments of the population only, which would generate greater social and economic divides between people. Targeted policies and public-private partnerships are key to solving the connectivity problems of the most disadvantaged people and the most remote sectors, thereby facilitating access to connection devices and making it possible to develop the skills needed to use them effectively.

1. The digital and connectivity divides are increasingly decisive for development

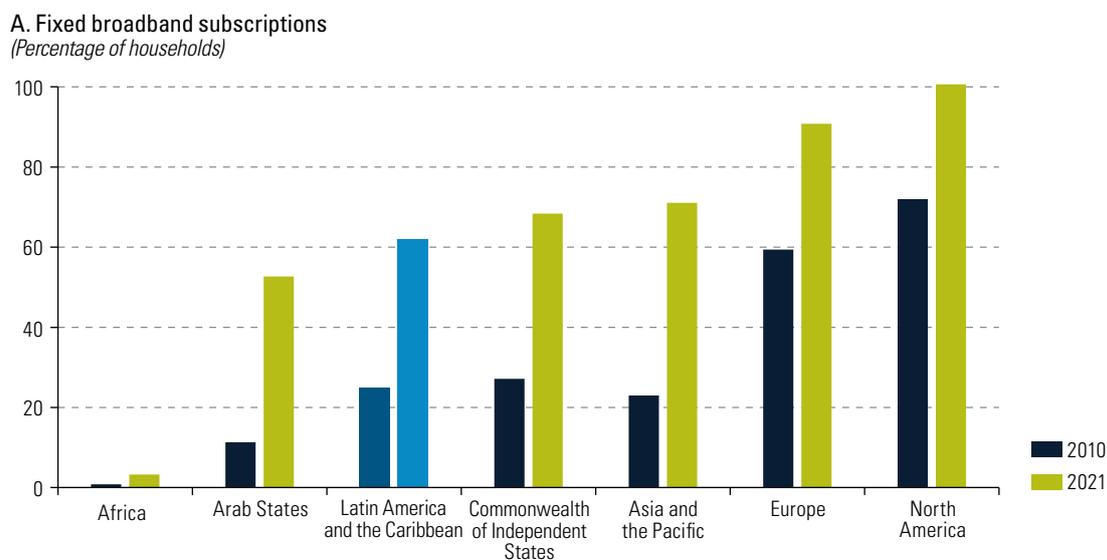
As noted above, in a hyperconnected world, connectivity and access to broadband services condition the current and future options facing individuals and firms in accessing goods, services and new markets and processes, as well as the possibility of engaging in work, education and leisure activities. Accordingly, Internet penetration should be considered a basic universal service.

The data available on Internet penetration in Latin American and Caribbean countries reveal a challenging panorama. During the last decade, several countries in the region have made great efforts to universalize Internet access; and some have made notable progress. In other economies, however, there are still large gaps in access to connectivity that exclude a substantial portion of the population from the benefits of digital services; in addition, suitable terminals and the skills to use them are also lacking.

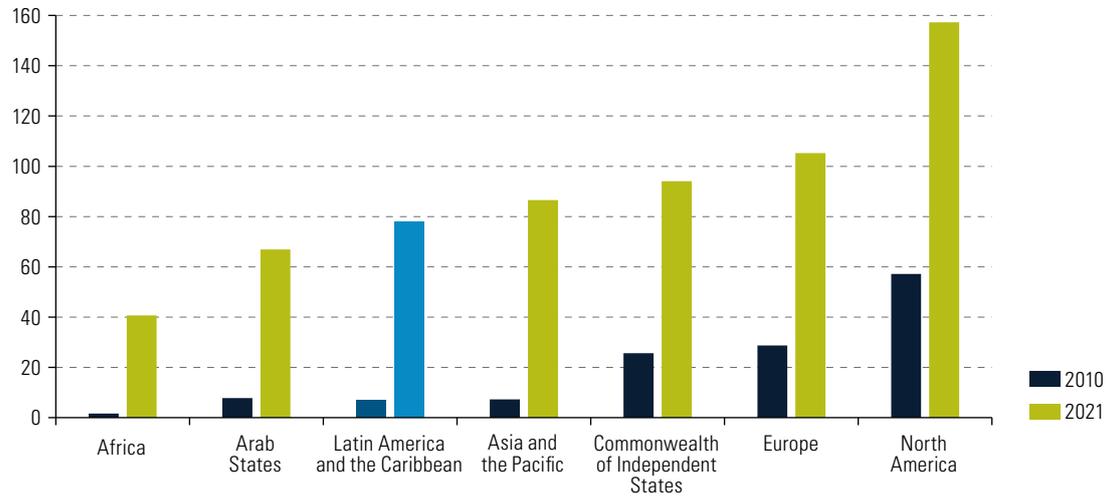
Between 2010 and 2021, mobile broadband penetration in the region grew by more than tenfold, on average, which is a much greater increase than that observed in North America and Europe. The situation is very different for fixed broadband, however, where penetration in the region barely doubled and remained well below that of Asia and the Pacific, Europe and North America (see figure II.1).

Figure II.1

Global broadband subscriptions, by region, 2010 and 2021



B. Mobile broadband subscriptions (Percentage of the population)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), Regional observatory for digital development, on the basis of data from the International Telecommunication Union (ITU).

Note: In the case of mobile broadband, the values refer to the total number of subscriptions and not to individual subscribers.

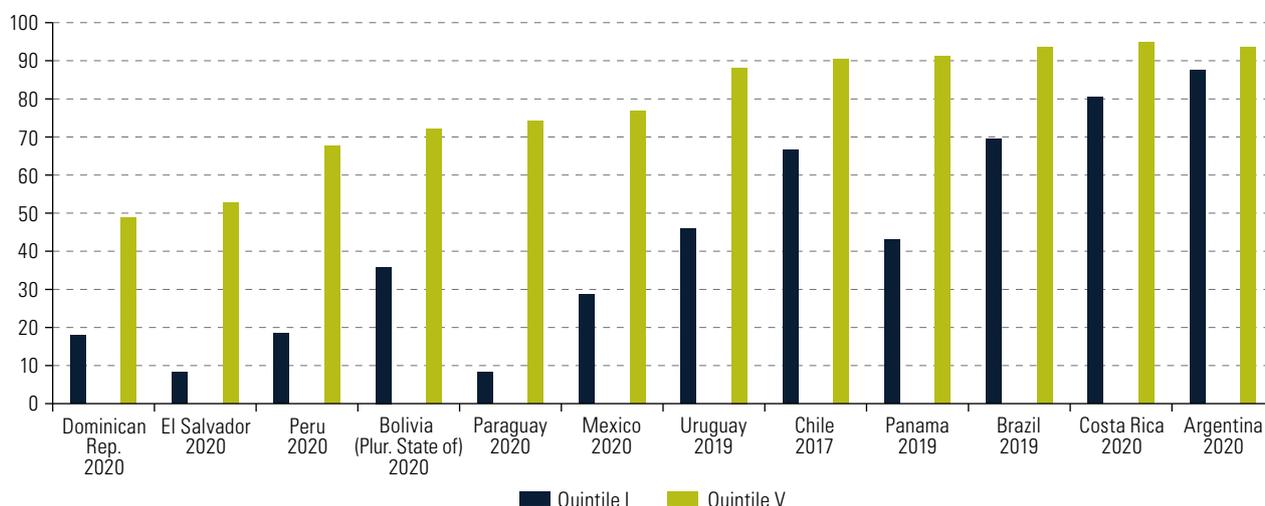
In 2021, fixed broadband reached almost 62% of Latin American and Caribbean households which, as noted, places the region well below other parts of the world, such as North America and Europe where penetration rates are close to 100% and 90%, respectively. The differences are also significant in the case of mobile broadband, which reaches 78% of the population in the region, and of 105% and close to 150% in the cases of Europe and North America, respectively, although situations differ widely between countries.

2. Connectivity gaps in Latin American and Caribbean households remain factors of social exclusion and require a comprehensive approach

Connectivity gaps are associated with a variety of supply and demand factors. The former include those related to service coverage, while the latter are associated mainly with the affordability of the service and of the necessary terminals, and also with digital skills. As noted above, demand factors are related to people's income levels, area of residence, education levels, gender and age, among other factors. One of the main demand-side determinants of the connectivity gap is the cost of access. An analysis of disparities by income level is highly relevant, because it makes it possible to take steps to achieve mass access. In Latin America and the Caribbean, there is a significant digital divide according to household income level; in some cases, there can be a difference of more than 50 percentage points between the highest- and lowest-income households. In general, the differences between the first and the last quintile are more than double, sometimes as much as nine times. Moreover, this is not always just a problem of differential access by income level, since in the worst-positioned countries, households in the highest income quintiles have very low penetration rates, close to 50% (see figure II.2).

Figure II.2

Latin America (12 countries): households with Internet connection in the highest (Quintile V) and lowest (Quintile I) income quintiles, latest available year
(Percentage of total households in each quintile)

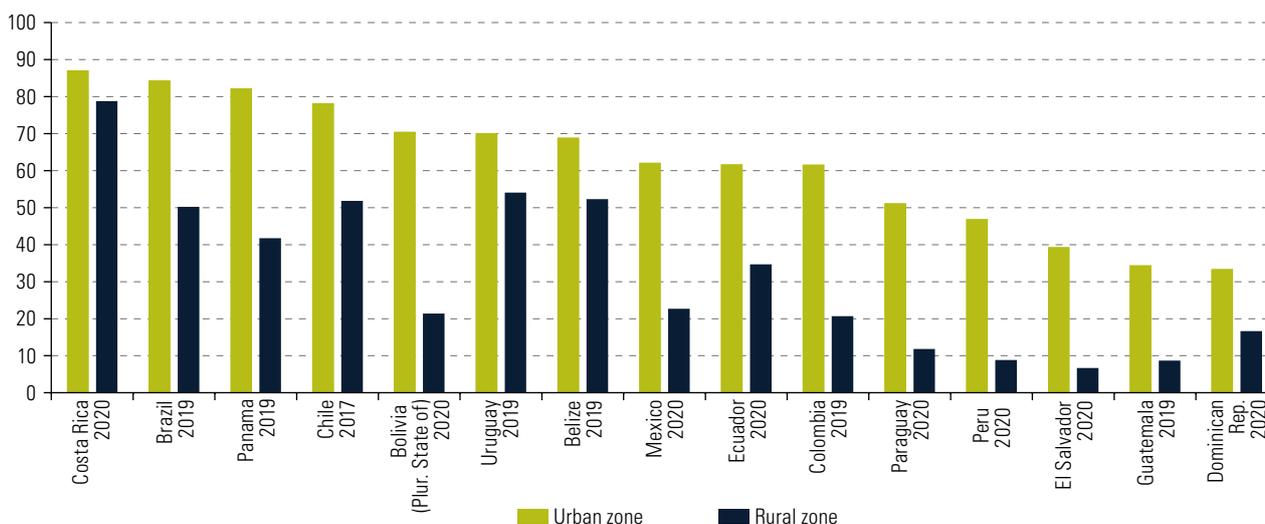


Source: Economic Commission for Latin America and the Caribbean (ECLAC), Regional observatory for digital development, on the basis of National Administrative Department of Statistics (DANE), “Encuesta nacional de calidad de vida (ECV) 2018” [online] <https://www.dane.gov.co/index.php/estadisticas-por-tema/salud/calidad-de-vida-ecv/encuesta-nacional-de-calidad-de-vida-ecv-2018> for Colombia, and information from the Household Survey Data Bank (BADEHOG) for the rest of countries.

Place of residence is another relevant dimension that explains disparities in connectivity and in its quality, since there are marked differences in access between urban and rural households. The situation varies greatly between the different countries of the region. While penetration exceeds 80% in urban areas in some countries, in others it is less than 40%; and the difference in penetration between urban and rural areas ranges from more than 50% to less than 10% (see figure II.3).

Figure II.3

Latin America (15 countries): households with Internet connection, by place of residence (urban or rural), latest available year
(Percentages)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), Regional observatory for digital development, on the basis of National Administrative Department of Statistics (DANE), “Encuesta nacional de calidad de vida (ECV) 2018” [online] <https://www.dane.gov.co/index.php/estadisticas-por-tema/salud/calidad-de-vida-ecv/encuesta-nacional-de-calidad-de-vida-ecv-2018> for Colombia, and information from the Household Survey Data Bank (BADEHOG) for the rest of countries.

Connectivity gaps are evidence of the exclusion of large segments of the population, especially the most vulnerable. This situation not only limits access to the potential benefits of digitalization, but also restricts access to some basic services, such as information, education and health. Therefore, as income is one of the main constraints on access to certain basic services, it is important to consider different ways of financing initiatives to close this type of gap, such as the implementation of demand subsidies (see section II. A. 5).

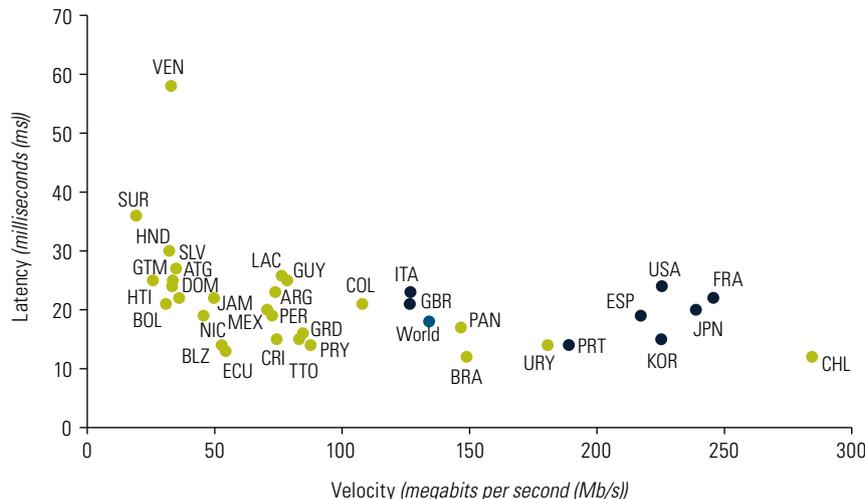
3. Connection quality affects the use of data-intensive solutions and hinders the development of new productive capacities

The quality of the connection determines the type of services that can be used, and the possibility of using more than one device simultaneously. Fixed broadband provided through fibre optic connections allows for high connection speeds with low latency,¹ which would make this technology the best option for home connectivity. However, despite its longer useful life, its costs limit the geographical reach and speed of deployment. As a result, universalization solutions are tending towards fifth generation (5G) mobile networks, through fixed connections (fixed wireless access), which provide high connection speeds with faster deployment and lower costs. The use of these technologies to universalize connectivity has also been boosted by the fact that they allow for a gradual increase in access speeds, in line with progress in the development of digital skills (ECLAC, 2022).

The fixed broadband panorama varies widely between countries in the region. Brazil, Chile, Colombia, Panama and Uruguay have high average download speeds (over 100 megabits per second (Mb/s) and low latency. These countries surpass the global average and even attain values comparable to some advanced economies, such as the United States, Japan and the Republic of Korea. Chile stands out in this group, with an average effective download speed of close to 280 Mb/s, which is better than any of the three advanced countries mentioned (see figure II.4).

Figure II.4

Connection quality: effective fixed broadband download speed, monthly average, June 2022



Source: Economic Commission for Latin America and the Caribbean (ECLAC), Regional observatory for digital development, on the basis of Speedtest, "Speedtest Global Index" [online] <http://www.speedtest.net/global-index>.

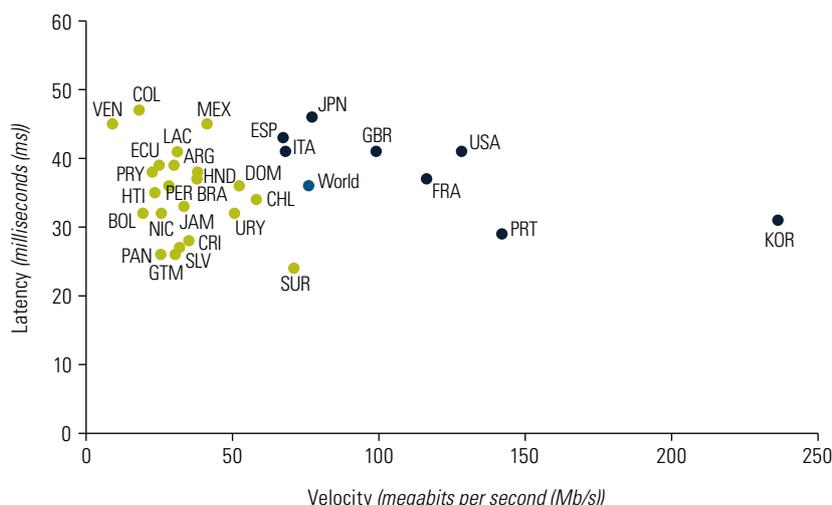
Argentina, Costa Rica, Mexico, Paraguay and Peru are in an intermediate situation, with speeds of over 50 Mb/s (equivalent to the regional average), while El Salvador, Guatemala, Haiti, Honduras and the Plurinational State of Bolivia are relative laggards (see figure II.4).

¹ Latency is the sum of time delays in a computer data network. A delay is produced by the time it takes to propagate and transmit data packets in the network.

In the case of mobile broadband, there is greater homogeneity between countries in terms of average speeds and latencies. However, the region's countries clearly lag behind more advanced ones such as the United States and the Republic of Korea (see figure II.5). As the most widely used mode of broadband access in Latin America is mobile, the quality of this service could have a major impact.

Figure II.5

Connection quality: effective mobile broadband download speed, monthly average, May 2022



Source: Economic Commission for Latin America and the Caribbean (ECLAC), Regional observatory for digital development, on the basis of Speedtest, "Speedtest Global Index" [online] <http://www.speedtest.net/global-index>.

In recent years, the quality of broadband, both fixed and mobile, has been improving constantly, despite the fact that the technologies used to provide both services condition the speed and degree of these improvements. Thus, in order to enhance the quality of services and catch up with the most advanced countries, the mass deployment of fibre optic infrastructure and mobile technologies such as 5G in their different radio spectrum bands needs to be accelerated. Some countries in the region, such as Brazil and Chile, are moving in this direction.

Table II.1 shows some of the relationships that exist between the types of services and applications that can be accessed, depending on broadband connection speeds. Although the download speeds for the different types of use are indicative and may vary according to additional factors—such as the content hosting site, categorization and associated uses—connection speed requirements can be identified according to the needs of different uses. As can be seen in table II.1, by way of example, to provide a household with an effective connection that allows several members to connect simultaneously to data-intensive services, requires connection speeds of over 25 Mb/s.

Table II.1

Connection speed requirements by type of use

| | Light use (basic functions: e-mail, navigation, Internet radio) | Moderate use (basic functions plus a data-intensive application) | High usage (basic functions plus several data intensive applications simultaneously) |
|------------------------------|---|--|--|
| One user on one device | Basic | Basic | Basic |
| Two users or two devices | Basic | Medium | Medium/advanced |
| Three users or three devices | Medium | Medium | Advanced |
| Four users or four devices | Medium | Advanced | Advanced |

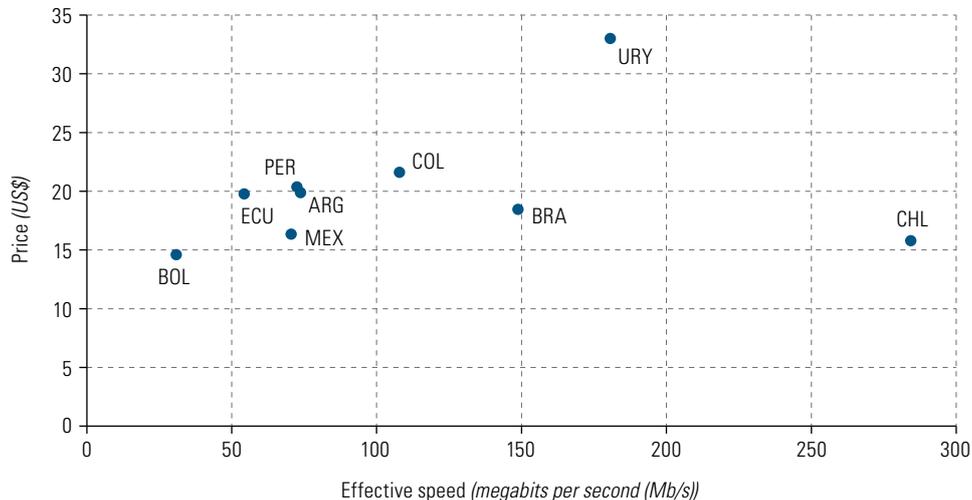
Source: Economic Commission for Latin America and the Caribbean (ECLAC), Regional observatory for digital development, on the basis of Federal Communications Commission (FCC), "Household Broadband Guide" [online] <https://www.fcc.gov/consumers/guides/household-broadband-guide> [accessed on 10 August 2022].

Note: Speed requirements are divided into the following usage categories: basic (3–8 Mb/s), medium (12–25 Mb/s) and advanced (more than 25 Mb/s).

The cost of high-speed connections is another decisive factor, along with technological issues and the availability of coverage and services, since it can be a binding constraint on access to data-intensive services. In the case of fixed broadband, the relationship between price and the quality received varies greatly in Latin American countries. For broadband plans with tariffs close to US\$ 20, the speed received can vary by as much as ten times depending on the country. In most of the countries for which information is available, the aforementioned tariff affords plans that provide speeds of less than 100 Mb/s, while in Chile the same price buys more than 280 Mb/s (see figure II.6).

Figure II.6

Latin America (9 countries): price-quality ratio of post-paid plans for entry into the fixed broadband market, September 2022



Source: Economic Commission for Latin America and the Caribbean (ECLAC), Regional observatory for digital development, on the basis of information available at operators' websites.

In short, high-speed connection costs vary greatly between countries in the region. This can also be a constraint when accessing and making proper use of services that require high speeds, especially when there are several users connected simultaneously.

In general, the changes that have occurred in the quality-price ratio correspond mainly to changes in the characteristics of the service and not to changes in tariffs. In other words, for similar tariffs, the speed or the data caps have increased. In fact, changes are constantly occurring, and the comparison between countries can vary significantly over the course of a few months.

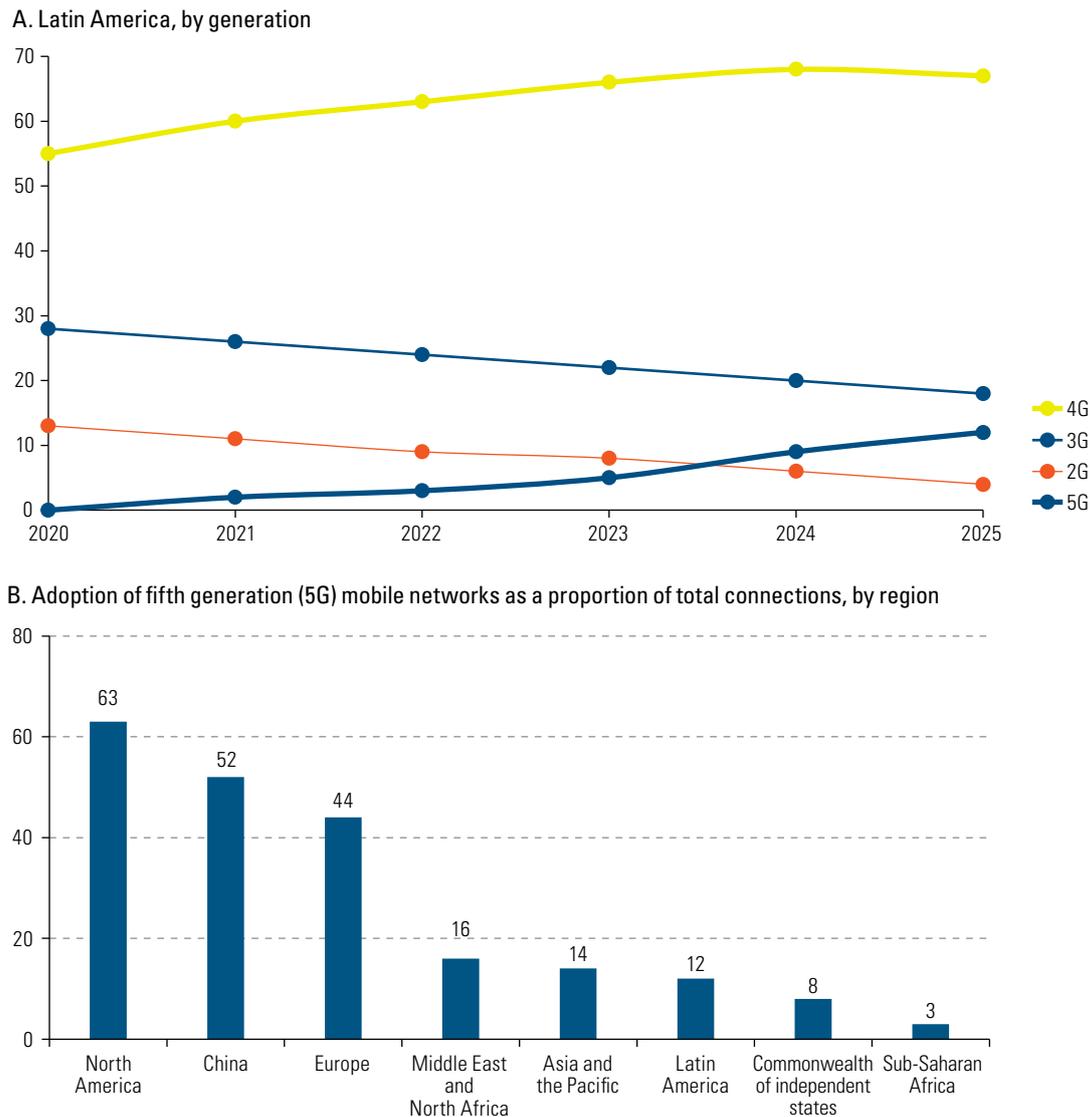
4. The challenge of deploying fifth generation (5G) mobile networks

As noted above, the countries of Latin America and the Caribbean still face the challenge of improving connectivity, in terms of both coverage and quality. Fifth generation (5G) mobile networks can make a significant contribution to closing both gaps. In addition to representing an evolution of the infrastructure that allows for higher connection speeds, this technology transcends previous generations of mobile networks, since it meets the requirements of the Internet of things (IoT) and the digitalization of different areas of society.

Enhanced mobile broadband (eMBB) is likely to be one of the first usage categories to be launched on 5G networks. This technology enables the introduction of new mobile services and provides high speeds that are competitive with fibre optics, but with lower infrastructure deployment costs. As it involves fixed wireless access, it is not necessary to incur large sunk costs to develop network infrastructure, and it is sufficient to provide coverage through base stations. These features reduce the initial investment substantially. Thus, 5G mobile networks are an appropriate technology for reducing access disparities in medium or low-density areas in large cities and small towns or villages. It is also a type of deployment that can improve access speeds progressively.

In addition, 5G technology could be a factor enabling digital transformation in the production sector; and it could become a fundamental means of boosting productivity and driving structural change in the region. However, GSMA projections show that the region is lagging behind in its deployment, with a penetration rate of just 12% projected for 2025, while the global average will be more than double that, and in North America and China it is likely to be five and four times higher, respectively (see figure II.7).

Figure II.7
Market share of mobile technologies, 2020–2025
(Percentages)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), Regional observatory for digital development, on the basis of data from GSMA Intelligence.

At present, Latin America has a lower degree of 5G network deployment than more advanced countries, particularly in relation to long-term evolution (LTE) broadband technologies (see table II.2).² In this regard, as yet there is no disaggregated data available on planned networks, spectrum investment and other intermediate stages of deployment.

² LTE (long term evolution) is a standard for high-speed wireless data communications for cell phones and data terminals.

Table II.2

Active commercial networks worldwide, by technology, March 2022

| |  |  | 5G/LTE ^a (Percentages) |
|--------------------------|---|---|--------------------------------------|
| Africa | 157 | 8 | 5 |
| Asia | 139 | 44 | 32 |
| Europe | 172 | 100 | 58 |
| Latin America | 127 | 22 | 17 |
| Middle East | 46 | 22 | 48 |
| Oceania | 38 | 8 | 21 |
| United States and Canada | 19 | 12 | 63 |
| Total | 698 | 216 | 31 |

Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of ECLAC, “Estado de situación sobre el desarrollo de redes 5G en América Latina y el Caribe”, 2022, unpublished.

^a 5G = fifth-generation mobile networks; LTE = long-term evolution broadband technologies.

5. Proposals for closing access and quality gaps

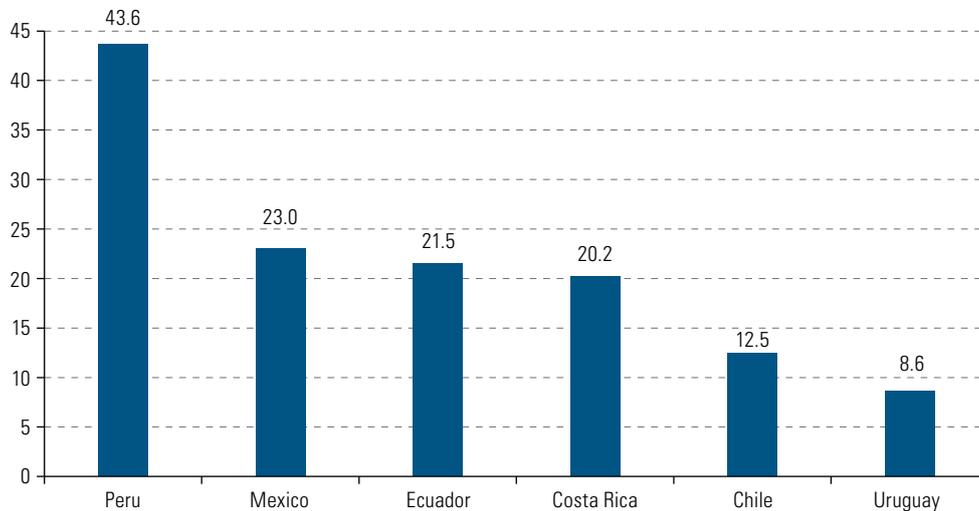
(a) Basic digital basket: devices and broadband

The number of unconnected households and the price of devices and services vary widely between the countries of Latin America and the Caribbean; and various solutions have been put forward to address this. The Economic Commission for Latin America and the Caribbean (ECLAC) has developed a proposal for a basic digital basket, consisting of a laptop, a smartphone and a tablet, in addition to fixed and mobile broadband services, as an alternative to provide an effective connection to households that cannot access such services. This is a comprehensive proposal that seeks to provide connectivity to households, and not just to individuals. It is also a modular tool, since it can be adjusted to different contexts and needs. As a third component, it also provides for the inclusion of content aimed at developing basic digital skills.

The basic digital basket is intended to reduce access gaps and can be used as a central tool in a policy of demand subsidies to improve effective connectivity. The cost of the services included in the basket can represent a large fraction of household income, particularly for those in the most vulnerable quintiles—in some cases as much as 44%. This reveals the great difficulty that the poorest households would have in gaining access to adequate connectivity, and it underscores the need to support this type of initiative with subsidies and appropriate public-private collaboration (see figure II.8).

Figure II.8

Latin America (6 countries): monthly cost of the basic digital basket relative to the average monthly income of households in the lowest income quintile, September 2022
(Percentages)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), Regional observatory for digital development.

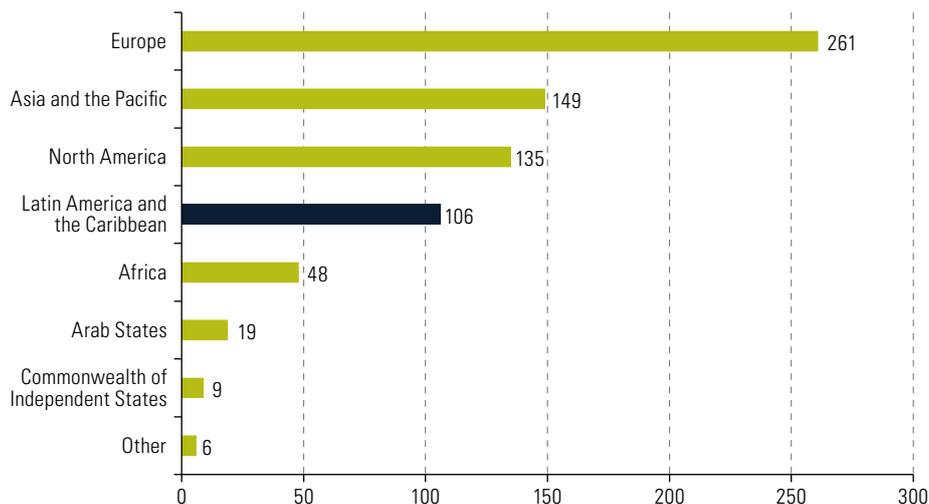
(b) Expansion of Internet exchange points and data centres to bring content and services closer to users

To enhance Internet quality, it is essential to manage traffic efficiently; this is achieved with an appropriate interconnection infrastructure that includes *Internet exchange points* (IXPs) and data centres that form part of *content delivery networks* (CDNs).

This type of infrastructure has developed significantly in recent years in Latin America and the Caribbean, where a good foundation has been laid to meet future challenges. There are currently some 106 IXPs in the region (60% of them are in Argentina and Brazil); and, in December 2020, aggregate traffic averaged 26 terabits per second (Tb/s) (see figure II.9).

Figure II.9

Internet exchange points (IXPs), by region, August 2022
(Number)



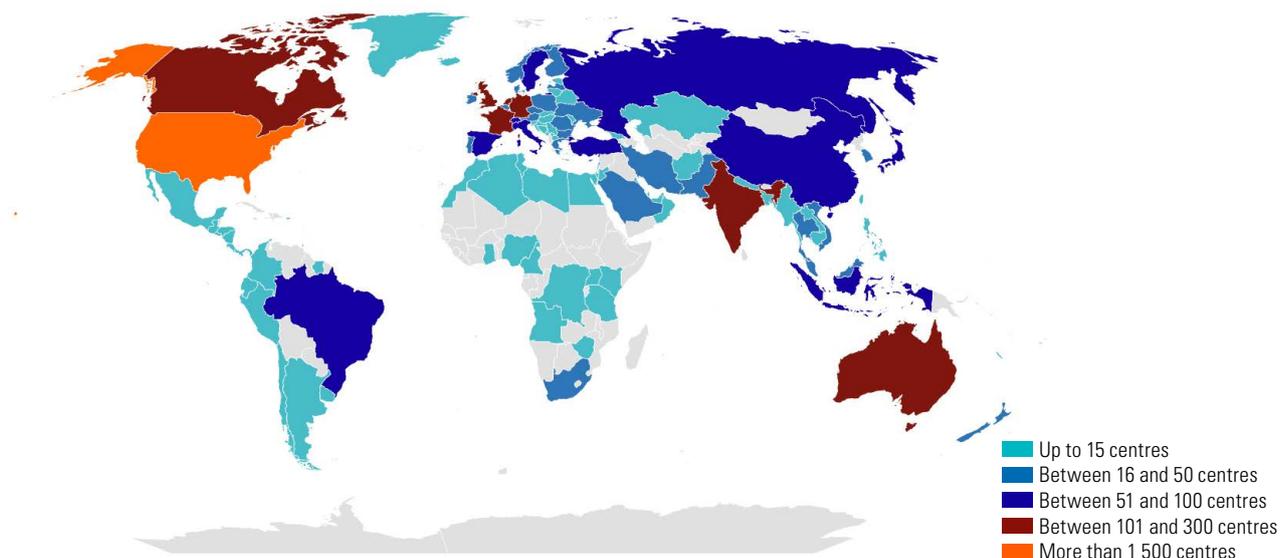
Source: Economic Commission for Latin America and the Caribbean (ECLAC), Regional observatory for digital development, on the basis of Packet Clearing House (PCH), "Internet exchange point directory reports" [online] https://www.pch.net/ixp/summary_growth_by_country [accessed on 7 August 2022].

Internet exchange points enable more efficient traffic exchange by connecting multiple service providers directly and simultaneously. IXP infrastructure is responsible for a large portion of traffic, in some cases close to 20%. It allows service providers to access up to 80% of the content they use, while also providing other value-added services such as resilience, security and technical cooperation.

In addition, content distribution networks continue to expand in the region. In several cases, CDNs operate their own data centres or have their own equipment in third-party data centres, as well as other content storage capacities installed in IXPs and in the networks of *Internet service providers* (ISPs). There are currently around 4,870 data centres in the world, 157 of which are located in the region, mainly in Brazil (41%), followed by Argentina, Chile and Mexico (9% each). With 38% of the global total, the United States has the largest number of data centres (1,828) (see map II.1). Content distribution has changed considerably over the last decade. The strategy now consists in locating content as close as possible to the user, with 90% being located no more than two queries away from the ISP's server. This reality has major implications for the deployment of new data centres in the region.

Map II.1

Number of data centres, by country, 2022



Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of Data Centre Map, “Colocation Data Centres” [online] <https://www.datacentremap.com/datacentres.html> [accessed on 7 August 2022].

Note: Grey shading indicates countries for which there is no information.

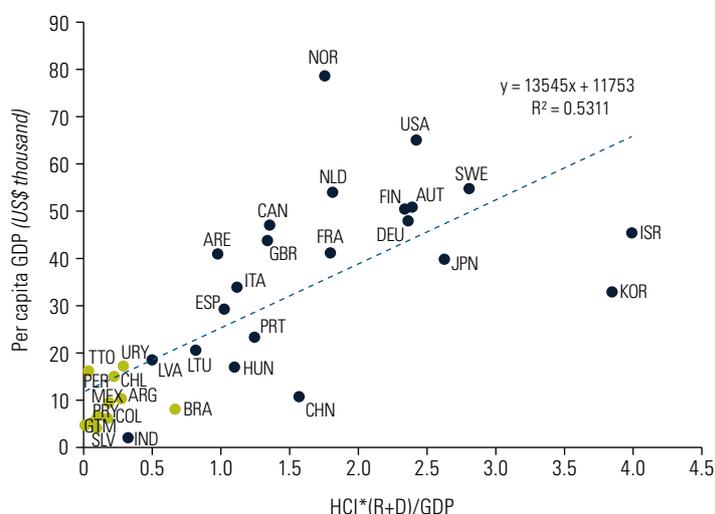
B. Digital skills for today and tomorrow

A society's endowment of skills and capacities plays a fundamental role in increasing the potential benefits of innovation and technologies, which has important consequences for countries, production sectors and firms. This is relevant, not only in terms of adding value or creating jobs, but also for the development of new activities, and for the generation of solutions and services that support personal well-being in all of its dimensions. These potential impacts open up significant opportunities for the design and implementation of policies in countries that are in a process of transition to development. Such is the case of many Latin American and Caribbean economies, where the structure and complexity of the production sector make technology adoption and dissemination processes more difficult.

Although the region's countries have experienced significant improvements in human capital and capacities in recent years, these are still substantially inferior to those of advanced economies. For this reason, the strides that have been made in science, technology and innovation (which, however, are still much less than those made in developed economies) have failed to translate into substantial improvements in productivity and personal income. In fact, an indicator that combines a human capital index with research and development (R&D) efforts relative to per capita GDP shows a positive and significant relationship between these variables (see figure II.10). Thus, Latin American and Caribbean countries are located in the lower left quadrant, with low values for both per capita GDP and the combined indicator of human capital and R&D investment. The remainder of the countries, although distributed unevenly because of other factors that also affect the economic and social situation—such as the production structure, informality or levels of poverty or inequality—clearly perform better than those of the region.

Figure II.10

Selected countries: human capital and GDP per capita, 2020 or latest available year



Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of World Bank, “Human Capital Index”, Data Bank [online] <https://databank.worldbank.org/source/human-capital-index#> [accessed on 26 September 2022].

Note: The Human Capital Index, developed by the World Bank, measures the level of human capital that a child can accumulate from birth to age 18 years. Health and good education are the fundamental factors underlying the logic of this indicator.

Improving growth and productivity levels is an essential task facing the region's countries. This entails developing a productive and digital ecosystem in which the strengthening of infrastructure and human capabilities is one of the essential components. As is the case with other technological changes, digital transformation is not just a matter of disseminating technology, but also of making complementary investments in skills and process innovation, and in new management systems and models.

To address human capital gaps, it is important to consider both the demands of the economy's production structure and its expected or desired development pathway. For example, the inadequate training of researchers involved in the creation of new products and services affects the capacity to develop new technologies and industries; and the inability of firms to assimilate technologies hinders their adoption and, hence, their potential impact on productivity, wages and well-being.

Skills and educational requirements differ according to the functions performed in the production environment. Researchers involved in developing digital technologies must generally obtain a graduate degree (at least a master's degree and often a doctorate). In contrast, a professional involved in the incorporation of digital technology in production processes needs a bachelor's degree and perhaps a master's, although a short-course qualification (such as a technical-vocational training or a certificate) may also be admissible. Moreover, the skills that comprise each of these professions differ greatly. Those needed to assimilate mature technologies require training in basic areas of management information technology, while the incorporation of advanced technologies into the production chain requires training in areas such as artificial intelligence and robotics.

Nonetheless, aside from the levels of sophistication of the different skills, the basic digital skills of persons who do not work in the information and communications technology (ICT) sector are also crucial for the deployment and better use of these technologies. To this end, a comparative analysis of the progress of digital skills in the countries of the region is presented below. This will make it possible to gauge the relevance of the different skills and the need to generate and promote mechanisms for public and private action to enhance their development and thus enable more effective technology use.

1. What are digital skills?

As mentioned in previous sections, the COVID-19 pandemic further hastened the digital transformation process. The old ways of doing things, from buying basic necessities to working, changed irreversibly. This dynamic has had a significant impact on the demand for current and future digital skills. For example, in the space of just a few months many firms transitioned from face-to-face activities in a physical location to new organizational models with a strong virtual component, intensive in digital technologies. In this new reality, digital skills have become more critical than ever for firms and the workforce, as evidenced by the widespread shift towards digital interactions such as remote working, online commerce and virtual collaboration. While these transformations are producing many benefits —such as greater flexibility for workers and the elimination of the geographic barrier to hiring new talent— they can also impact the labour market adversely, by widening the skills gap. This is especially true for developing countries, and for the most vulnerable of their populations.

Broadly defined, digital skills are the set of skills needed to use digital devices, communication applications and networks to access and manage information, together with those that contribute to the digital transformation. They range from basic online search and emailing to programming and more specialized tasks. For years now, and especially in recent months, these skills have proven essential for people to be able to communicate, collaborate, develop and share digital content, as well as solve problems in the production, work and business spheres, anytime, anywhere. According to the International Telecommunication Union (ITU), digital skills can be divided into three broad categories: basic, generic or intermediate, and advanced or higher level.

- (i) Basic digital skills: these are relatively simple skills that enable users to access and execute basic digital operations. They involve operating devices and range from using keyboards and touch screens to connecting to the Internet, setting up accounts and profiles, and accessing information and resources.
- (ii) Generic or intermediate digital skills: these skills involve the meaningful use of digital technologies. There are various analytical frameworks, but five areas of generic digital skills are present in all of them, associated with the following: (i) digital literacy and information management (basic data storage, management and organization issues, which encompass the skills needed to manage digital data generated as a result of technology use); (ii) digital communication and collaboration (participation in groups and communities in a spirit of active collaboration and awareness of belonging to a broader and diverse community); (iii) digital content creation (the ability to edit, enhance and integrate information and content into an existing body of knowledge); (iv) digital security and privacy (skills to ensure data protection and privacy); and (v) management and awareness of digital rights (capacities to understand the rights of individuals in a digital world) (Bércovich and Muñoz, 2022).
- (iii) Advanced or higher-level digital skills: these are the specific skills that specialized ICT professionals have. They require specialized high-level capabilities that are developed not through daily technology use but in advanced educational and training contexts. They include mainly the following: mastery of programming languages, data analysis, processing and modelling skills, large database management, software development, and the ability to program or develop applications and manage networks.

In addition to the technical skills described above, there is another set of skills traditionally related to the academic and training world, which are becoming increasingly relevant in other environments in which digital capabilities need to be developed. “These twenty-first century skills” include areas such as communication, collaboration and critical thinking, along with problem solving, creativity, innovation and entrepreneurship. They are associated with abilities to process complex information, communicate with co-workers and customers, solve problems, plan ahead and adapt quickly.

2. Skills for the adoption of digital technologies

The information compiled by ITU provides an overview of the status of digital skills in Latin America and the Caribbean. The data show the proportion of young people and adults (individuals over 15 years of age) with ICT skills by skill category (basic, generic or advanced). The data consider the use made of these technologies by individuals over 15 years of age who have performed certain computer-related activities (differentiated by type of technology, application or solution) in a given period of time (for example, during the last three months) (ITU, 2020).

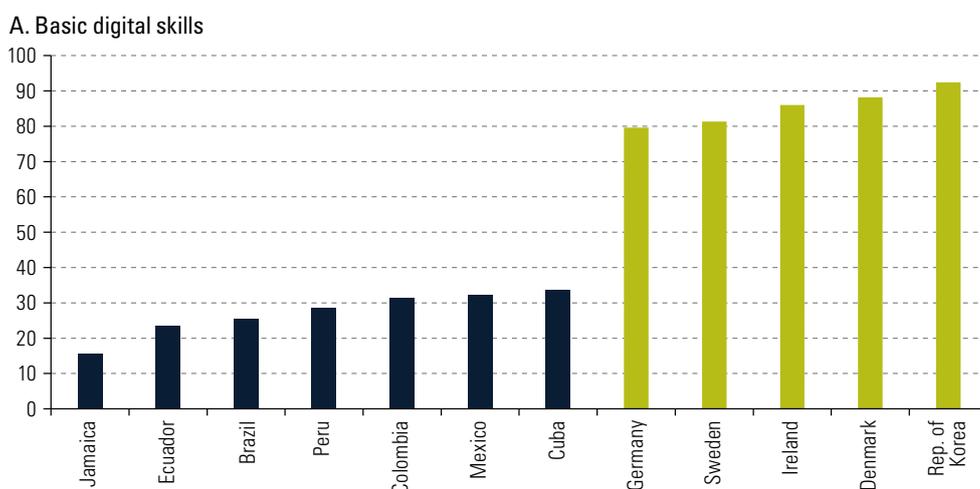
The available background information allows for a stylized, but not exhaustive, diagnostic assessment to be made of the digital-skill status of the region's countries, since only a few indicators are available, and they are often not fully comparable. However, it is clear that digital skills development in the countries of the region lags behind that of other economies around the world (see figure II.11). In 2020, about 30% of the adult population over 15 years of age in Latin America and the Caribbean had basic digital skills, compared to around 80% in developed countries (see figure II.11.A). This situation undoubtedly poses major challenges, especially for the general population, which could benefit more from digital technologies, but is not doing so for various reasons (lack of access or skills, or ignorance of their usefulness).

A similar situation can be discerned with respect to intermediate digital skills: working with spreadsheets, creating electronic presentations or installing and configuring software and applications. Less than 20% of the adult population in the countries of the region uses these tools, compared to over 60% in the advanced economies (see figure II.11.B). The low level of intermediate digital skills also reduces possibilities for continuing education and training during the course of a person's working life. Free online courses, available for anyone to join, along with open education platforms, make it possible to obtain training throughout the different stages of life, and to adapt content to specific personal or occupational needs. They also make it possible to provide more affordable training opportunities at times that are compatible with the working day. However, for this to be feasible, it is essential to have basic and generic or intermediate digital skills. The reasons given for the lack of basic digital skills are compounded by the characteristics of the countries' production structures and the skill demands that derive from them.

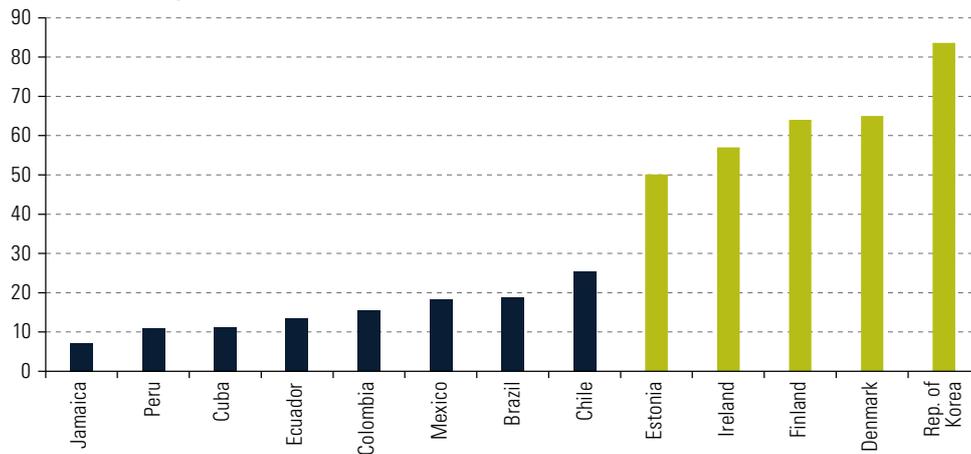
Figure II.11

Latin America and the Caribbean and advanced economies (selected countries): main digital skills of the population over 15 years of age, 2020

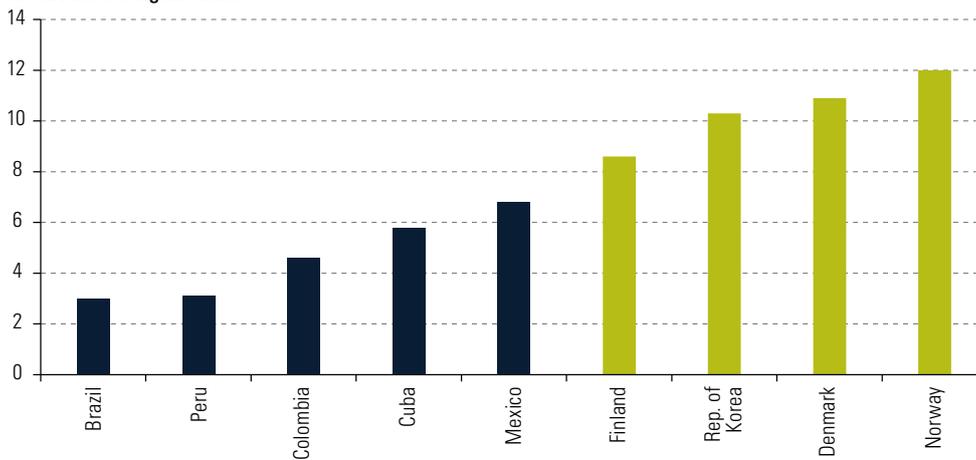
(Percentages)



B. Intermediate digital skills



C. Advanced digital skills



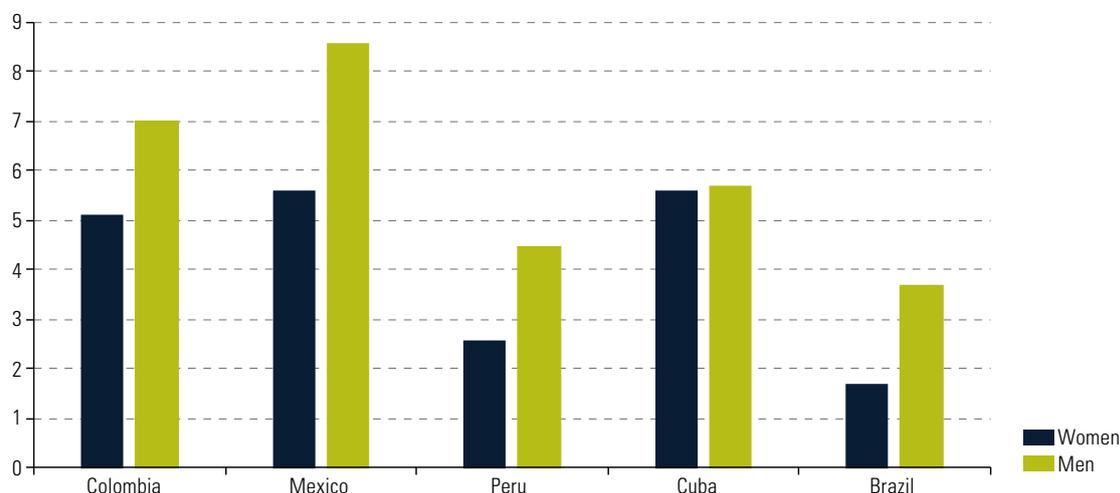
Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of information from the International Telecommunication Union (ITU).

Lastly, in the case of advanced digital skills, the differences between the countries of the region and the group of advanced economies considered appear less significant (see figure II.11.C). This might reflect the fact that the countries of the region also have a sector devoted to the development of digital solutions—small perhaps, but promising and globally competitive nonetheless.

Another element worth highlighting concerns the relation between digital skills and gender. While, at the primary and lower secondary school levels, the gender gap in digital skills is practically non-existent, greater differences start to emerge as skills become more complex. In general, secondary school girls tend to opt out of science, technology, engineering and mathematics (STEM) subjects earlier than boys. This means that they are increasingly less likely to pursue technology-related studies as they transition from secondary school to higher education (OECD and others, 2021). In fact, the proportion of youth and adults with programming skills is substantially higher among males except in Cuba (see figure II.12).

Figure II.12

Latin America (5 countries): youth and adults with programming skills, by sex, 2019 or latest year available (Percentages)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of information from the International Telecommunication Union (ITU).

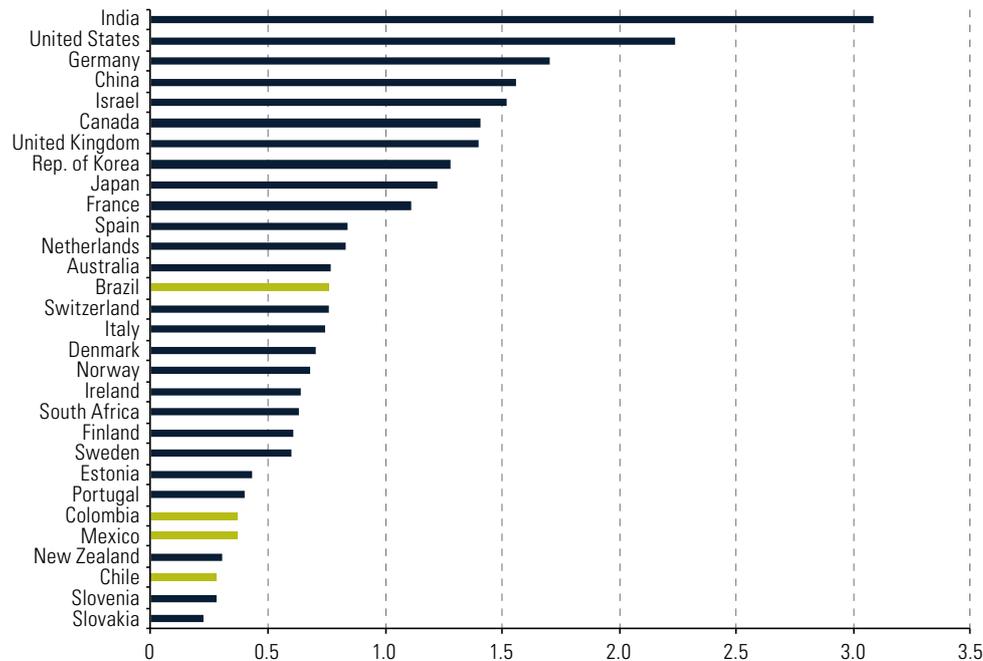
Skills, and digital skills in particular, are permanently in flux, as they have to adapt quickly to the needs of rapid technological transformation. Driven by this dynamic, new and more complex skills are emerging, associated with specific production sectors and various areas of development. Nowadays, it is not sufficient to know people's level of training, particularly in terms of advanced digital skills, to determine the capabilities needed for the development of the ICT sector. It is necessary to identify the specific type of skills, such as those needed for the development of artificial intelligence or Industry 4.0, or those associated with the health-care industry, among many others. The prospects for advancing the productive and social transformation needed by the countries of the region will depend on these specific skills.

In the case of artificial intelligence skills for example, the best prepared countries are India, the United States and Germany, in that order. In Latin America, Brazil displays the highest level of development, with a value close to the Organisation for Economic Co-operation and Development (OECD) average, followed at some distance by Colombia, Mexico and Chile (see figure II.13). Similarly, the complexity of the level of digital skills related to artificial intelligence is evident when considering the main subcategories associated with this technology: software development, research and methodology, machine learning tools, data management and development of Internet websites. Each of these categories, in turn, comprises a series of more specific subcategories.

The ranking of Latin American and Caribbean countries in terms of advanced digital skills in the last two decades reflects the development of a wide range of training programmes in digital technologies. It is currently estimated that there are over 1,600 higher education institutions offering more than 7,000 undergraduate and graduate training programmes in digital technologies in Argentina, Brazil, Chile, Colombia, Mexico, Peru and Uruguay. These represent 52% of all higher education institutions in the seven countries mentioned.

Figure II.13

Relative penetration of artificial intelligence skills, 2015–2021



Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of Organisation for Economic Co-operation and Development (OECD), OECD AI Policy Observatory (OECD.AI) [online] <https://oecd.ai/en/>.

Note: This chart shows the prevalence of workers with AI skills as reported by LinkedIn members from 2015 to 2021, by country and compared to a benchmark (the OECD average corresponding to a value of 1). For example, a country's AI skills penetration of 1.5 means that workers in that country are 1.5 times more likely to report AI skills than workers in the benchmark (in this case, the OECD average).

3. The need to strengthen actions to increase and enhance digital skills

This stylized overview of digital skills in Latin America and the Caribbean makes it possible to identify elements on which action is needed to strengthen skill development, not only in the present, but also with a view to the future. The actions in question should be duly harmonized with a national and, as far as possible, a regional production development strategy.

To achieve a high level of digital literacy, it is necessary to eliminate, or at least reduce, the gaps between different segments of the population, mainly in the area of basic skills. The necessary measures, whether public policies, private sector initiatives or public-private partnerships, should target specific groups, such as women, older adults, children and adolescents or vulnerable populations. To this end, it would be advisable to coordinate actions with foundations or other institutions, such as business and sector chambers, in order to expand the scope of the initiatives and reach a larger number of people. An interesting example of this is Uruguay's Plan Ceibal, which installed Internet connection networks in schools throughout the country, supported by professional development of the teaching staff and the incorporation of management platforms to support children's learning in various areas of knowledge. This initiative improved and equalized opportunities of access to information and knowledge for children from underprivileged families and promoted educational transformation processes. At the same time, it also succeeded in fostering the creation of new job opportunities and the development of new sectors of production.

In the labour domain, in order to advance the adoption of digital technologies, intermediate digital skills should be developed and strengthened first and foremost, by implementing digital skill technical training plans. These actions should primarily target reskilling and upgrading among micro, small and medium-sized enterprises (MSMEs) and self-employed workers, in order to stimulate and foster better inclusion in the labour market. This type of initiative, which can be supplemented by certification processes, could form part of a nationwide labour reskilling strategy, in which firms adopt a more participatory and active role in a continuous training process.

To boost development of the most advanced digital skills, it is essential to improve the quality of education by incorporating computer sciences into school curricula. A stimulus plan is also needed, to increase the number of professionals in science, technology, engineering and mathematics (STEM) disciplines, and in other areas that respond to the demands of the labour market, with a gender perspective. It is also important to stimulate the supply of short and long training courses in areas related to new technologies, such as artificial intelligence, the Internet of things, robotics and big data analysis, among others.

Lastly, policies should generally seek to create higher education systems that can absorb rapid changes in disciplines, maintain their orientation towards knowledge production, and foster socioeconomic development, without slipping into technological determinism. This requires flexible programs that make it possible to adapt curricula, formats and contents, and generate demand to keep knowledge continuously up to date. Programme reforms should be used to include basic knowledge that stimulates creativity and critical and logical thinking, and foster teamwork skills along with the learning and use of technological tools during the initial years of higher education. Specialization should also be encouraged in later years. Computer sciences are allied to this reform, because they align with the pedagogic and productive sense of teaching, while allowing students to create models and to formulate and test highly theoretical and practical hypotheses.

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CHAPTER



Key factors for accelerating digitalization in Latin America and the Caribbean

- A. Digital transformation in the productive sector
- B. The future of the labour market
- C. Digital transformation of government
- D. Digitalization and the green transition: the importance of an integrated approach
- E. Boosting innovation at the local level: smart cities

Bibliography

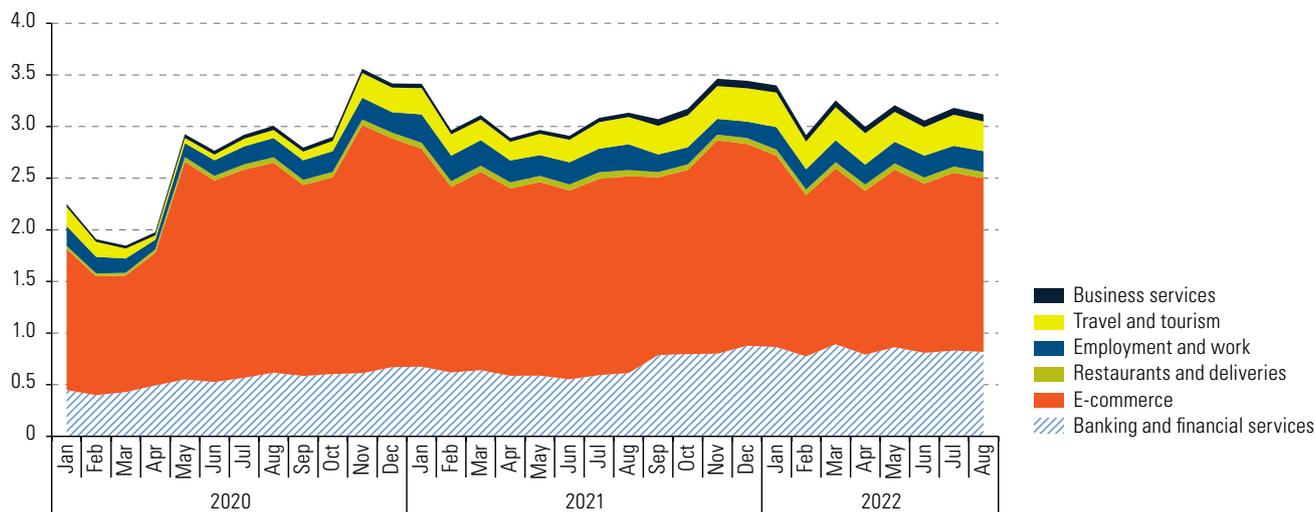
The coronavirus disease (COVID-19) pandemic marked a turning point in the use of digital solutions for all kinds of activities. Various online services were quickly enabled or enhanced to facilitate communication with family and friends, work, learning, shopping, bank transfers, medical appointments, administrative procedures and other tasks. Globally, the accelerated process of digitalization showed that connectivity was crucial and could boost people’s well-being and enhance productivity in the business world.

In Latin America and the Caribbean, the onset of the pandemic in March 2020 meant that social media and entertainment, the main uses of the Internet, made way for activities that went beyond leisure, including e-commerce, financial services, education and job searches, along with management and commercial services for businesses. Between March and May 2020, web traffic and the use of applications in these areas was up by 58% in the region, totalling nearly 3 billion views per month. The use of these solutions hit a peak of nearly 3.5 billion visits in 2021, then settled at around 3.1 billion visits in mid-2022, above the level seen prior to the pandemic (see figure III.1). As of August 2022, most traffic was in e-commerce (54%), followed by banking and financial services (26%), travel and tourism (9%) and employment and work (7%). This marked a change in consumer behaviour, with greater use of digital solutions and services, which in turn enabled greater economic and social participation.

Figure III.1

Latin America and the Caribbean: monthly visits to websites and mobile applications, by category, January 2020–August 2022

(Billions of visits)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), Regional observatory for digital development, on the basis of information from SimilarWeb.com [online] <https://www.similarweb.com/>.

This transformation transcends the current juncture and is configuring new models of consumption and production, based on data and digitalization, that will define new paradigms for growth and development. This leap forward is triggering social, economic and political changes that call for an urgent response, taking countries’ structural characteristics into consideration so that the benefits extend to all segments of society and the economy.

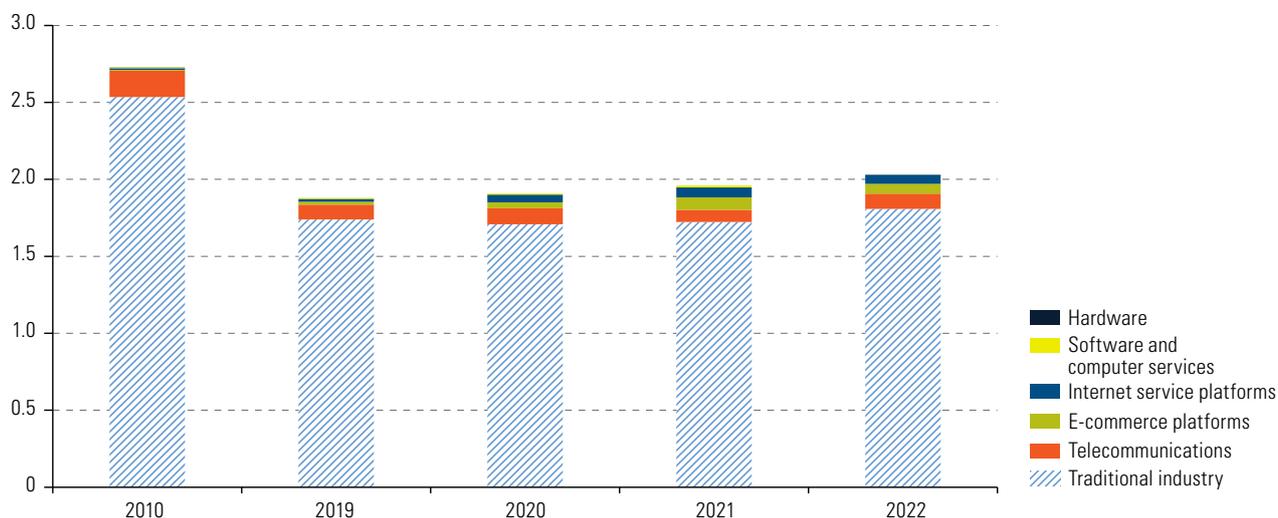
A. Digital transformation in the productive sector

As discussed in previous chapters, the digitalization of the economy and society is playing an increasingly significant role in economic and social development. In Latin America and the Caribbean, as in the rest of the world, the growing importance of digital segments of the economy signals that a digital transformation is under way.

In particular, the pandemic boosted the use of online channels, leading to a significant expansion of digital platforms. In March 2022, the market value of digital technology companies in the region amounted to US\$ 221 billion, nearly 11% of the total value of the 500 largest companies. The value of the digital industry grew by 14% between 2010 and 2022, which, although more modest than the global growth observed (329%), is significant in light of the 29% drop in traditional sectors over the same period. The larger digital economy has been attributed to strong growth in e-commerce platforms and Internet services, up by 248% and 200%, respectively, between March 2019 and March 2022 (see figure III.2).

Figure III.2

Latin America and the Caribbean: value of the digital industry compared with traditional industries, by segment, March 2010–March 2022
(Trillions of dollars)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), Regional observatory for digital development, on the basis of data from Bloomberg on the 500 companies in Latin America and the Caribbean with the highest market value.

1. Innovation and entrepreneurship: the foundation of the digital economy

Start-ups based on advanced technologies are a key driver of digital development. Over the last decade, they have grown significantly in the region: out of every 10 start-ups, almost 9 are based on digital technologies or are in that sector (86%). Most digital start-ups are concentrated in Brazil (57%) and Mexico (13%) (ECLAC, 2022). At the regional level, these companies mainly focus on information technology and software, which represent 22% of the total. Innovation in artificial intelligence solutions (7%), financial services technology (fintech), education (edtech) and agriculture (agritech) stand out.

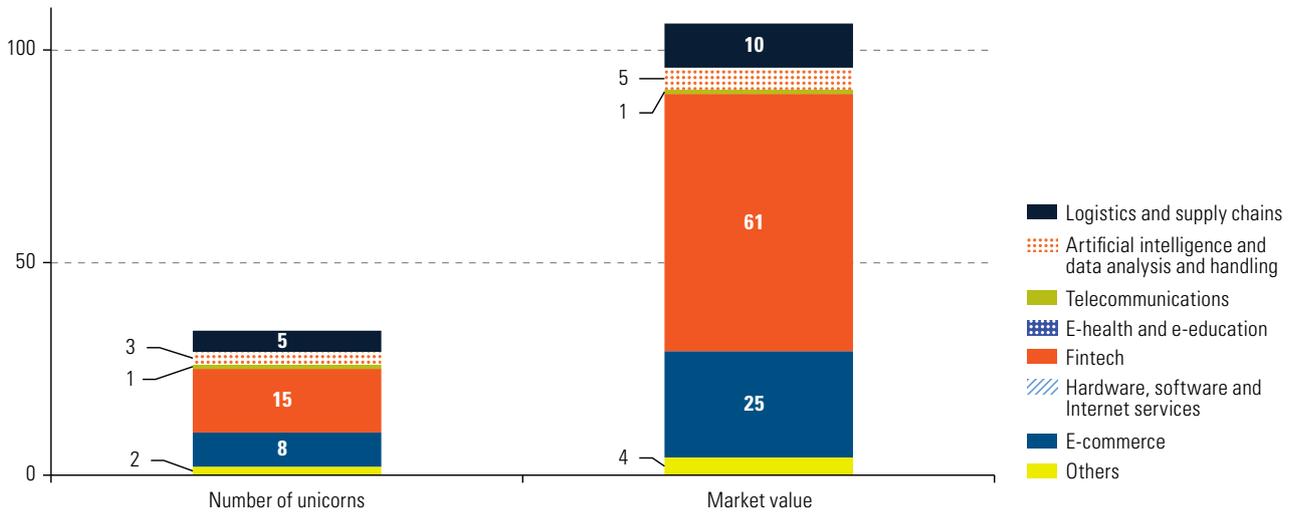
Uneven demand and lower levels of seed funding caused by the pandemic curtailed the emergence of digital start-ups (down 73% between 2019 and 2021). Despite this drop, start-ups attracted nearly US\$ 7.2 billion in capital investment in the first half of 2021, more than triple the figure in previous years. A significant part of this funding went to start-ups in the early phases of development. However, the bulk of it went to more mature start-ups, driving the emergence of “unicorn” firms.¹ As of July 2022, there were 34 unicorn companies with a combined market value of US\$ 106 billion, focused in fintech (57%), e-commerce and related solutions (24%), logistics and supply chains (10%), and artificial intelligence, data management and cybersecurity (5%) (see figure III.3). Despite these advances, Latin America and the Caribbean is lagging in comparison with other regions and countries that are closer to the technological frontier (see figure III.4).²

¹ A unicorn is a start-up company with a value of over US\$ 1 billion.

² Most unicorns are located in the United States (633 companies for a total value of over US\$ 2 trillion), followed by Europe (180 companies for a total value of US\$ 543 billion), China (173 companies for a total value of US\$ 673 billion) and the rest of the Asia-Pacific region (131 companies for a total value of US\$ 372 billion).

Figure III.3

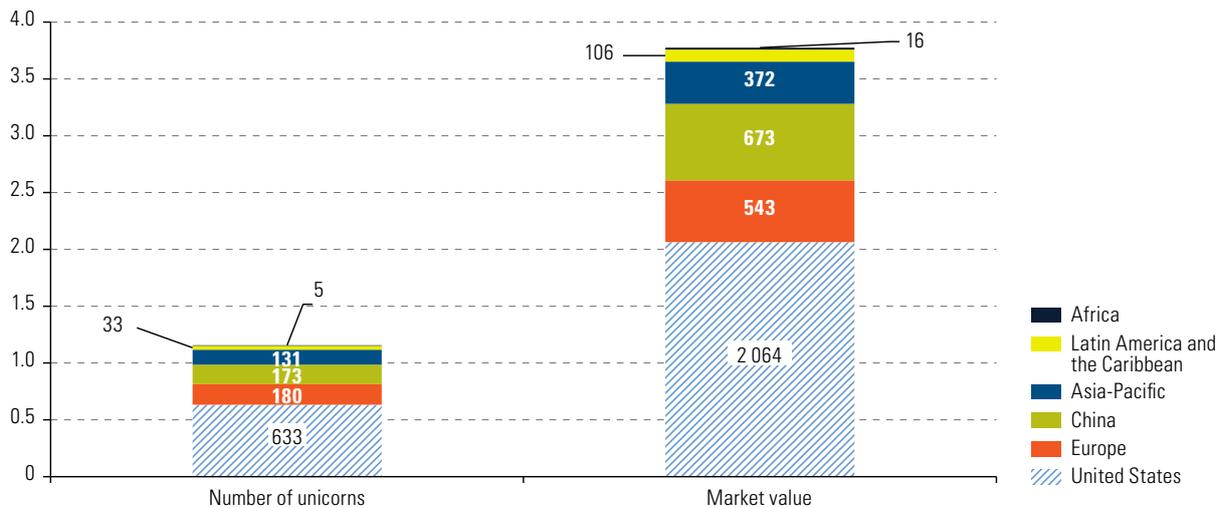
Latin America and the Caribbean: unicorn companies, number of companies and market value, by industry, July 2022
(Number of companies and billions of dollars)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), Regional observatory for digital development, on the basis of information from CBInsights, "Research Briefs" [online] <https://www.cbinsights.com/research/unicorn-startup-market-map/>.

Figure III.4

World: unicorn companies, number of companies and market value, by country and selected regions, July 2022
(Number of companies and billions of dollars)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), Regional observatory for digital development, on the basis of information from CBInsights, "Research Briefs" [online] <https://www.cbinsights.com/research/unicorn-startup-market-map/>.

In the region, fintech and e-commerce start-ups are playing an important role in inclusion. In 2021, 73% of people managed to obtain some kind of financial account, which represents the strongest progress among all regions of the developing world. The transformation has meant that people can send and receive payments, obtain loans and manage their savings using digital means. In addition, 40% of people used digital methods to pay retailers (with 14% having done so for the first time during the pandemic) and 24% received a government payment through direct deposit (Demirgüç-Kunt and others, 2022). E-commerce platforms have also enabled market access and fostered the digitalization of micro-, small and medium-sized enterprises (MSMEs). For example, growth in the number of new, active vendors on MercadoLibre.com went from 2% per month before the pandemic to 24% per month in the months following the emergence of the health crisis in March 2020. By the end of 2021, approximately 500,000 SMEs were selling products or services using this digital platform (Mercado Libre, 2021).

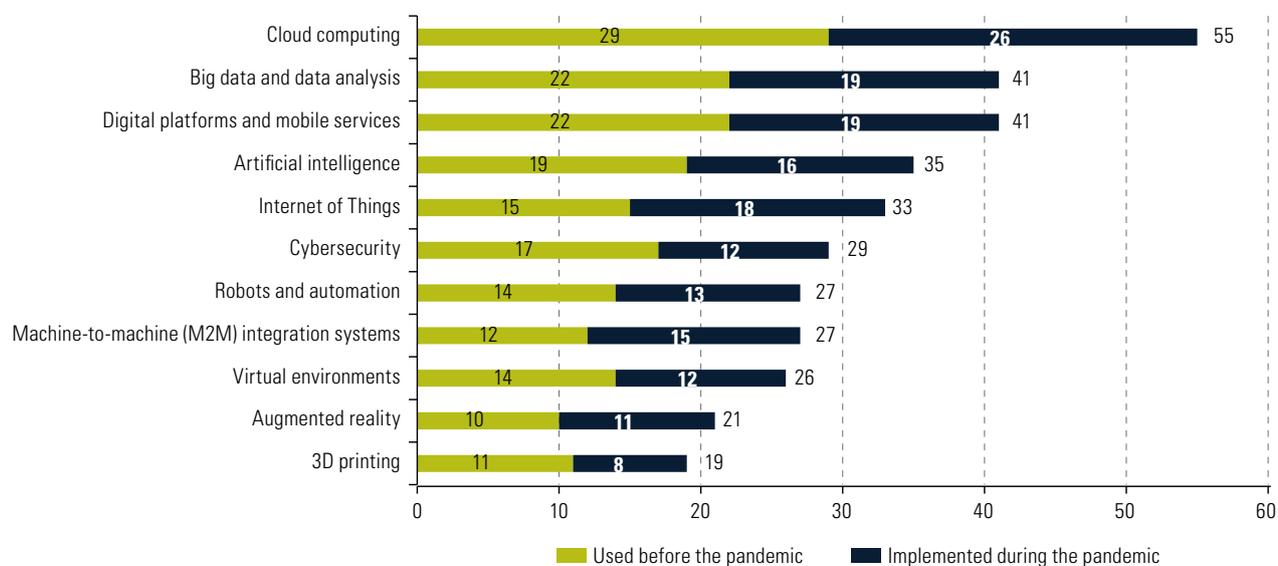
2. The digitalization of traditional sectors

The digital transformation of productive sectors goes beyond optimizing current production and management processes. This trend is accelerating innovation in products and services as well as in business and production models, which is reshaping value chains and transforming markets. In the current scenario, players in traditional industries must incorporate digital technologies into their products, develop services based on the use of data and introduce intelligent systems into innovation, production, logistics and marketing processes. This trend has obliged companies to enter areas and use technologies that are often completely outside their area of expertise. Similarly, the increasingly urgent need to strengthen digital capacities has boosted mergers and acquisitions (ECLAC, 2021c).

Companies in the countries of Latin America and the Caribbean generally have very good connectivity, over 90% in the case of larger firms. Despite this, the use of digital technologies in supply, manufacturing and distribution processes lags far behind that of more developed countries.³

Recently, in the wake of the pandemic, supply chain problems and the need for production scalability have seen companies rush to adopt advanced digital technologies. As an example, in 2020, cloud computing was the technology that companies used the most (55%) in Argentina, Brazil, Chile, Colombia and Mexico; it also grew the fastest during the pandemic (26%). Other technologies, such as big data and digital platforms, also saw significantly higher adoption (19% in each case), followed by the Internet of things (IoT) (18%) and artificial intelligence (16%) (Basco and Lavena, 2021) (see figure III.5).

Figure III.5
Argentina, Brazil, Chile, Colombia and Mexico: technology use in 2020
(Percentages, n=500)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of information from the Inter-American Development Bank (IDB).

Note: The sample consists of 100 companies in each of the five countries selected. The survey was directed at sectors with the greatest export potential in each country. Firms in the following sectors account for 70% of the sample: agroindustry; chemicals, petrochemicals and pharmaceuticals; machinery and tools; the automotive industry; mining and metalworking; and optical and medical instruments. The remaining 30% is made up of knowledge-based services firms.

In addition to the traditional challenges of connectivity, in particular coverage, quality and the deployment of fifth-generation (5G) networks, the acceleration of the digital transformation presents other important challenges.

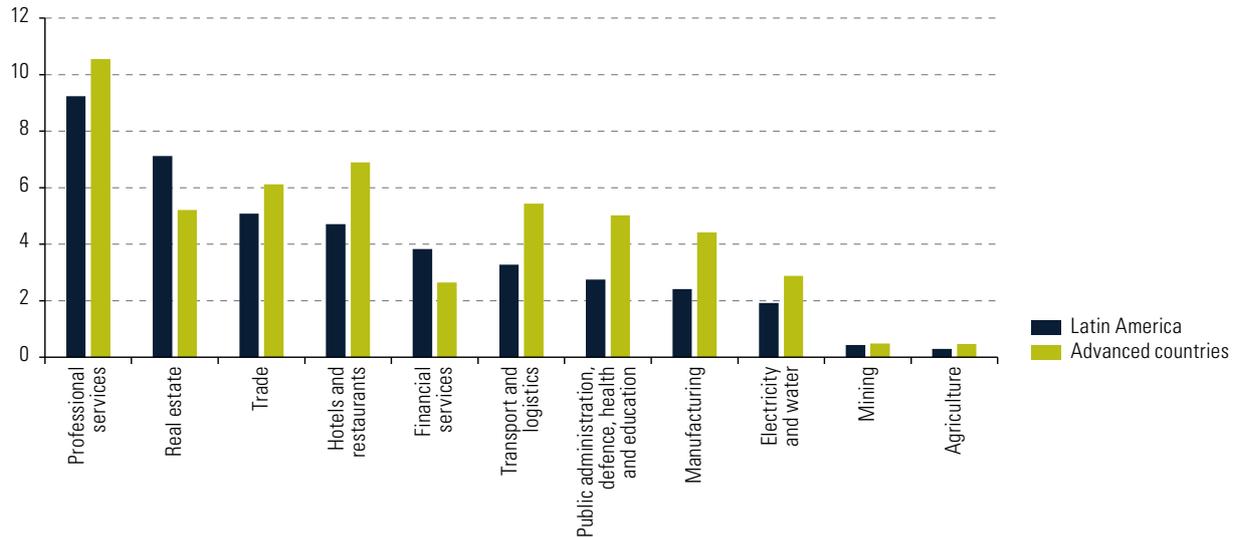
- First, as already mentioned, is the lack of people with the qualifications required in the new digital context. In fact, a recent survey indicates that 31.6% of companies in Latin America have trouble finding qualified workers, a figure significantly higher than the global average (21.2%) (World Economic Forum, 2020a).

³ While 70% of companies in Organisation for Economic Co-operation and Development (OECD) countries were using the Internet in their supply chains in 2018, the figure in Latin America and the Caribbean, for companies for which these data were available, was just 37% (ECLAC, 2020).

- Second, although nearly 50% of companies in Argentina, Brazil, Chile, Colombia and Mexico invested in research and development (R&D) during the pandemic, 30% did not. Predictably, companies in these countries with more than 200 employees have advanced the most in technology adoption.
- Third, at the sector level, there are important differences in the degree of digitalization (Katz, n.d.). In fact, levels of digitalization are low in agriculture, mining and manufacturing, three of the most important sectors for the region's GDP (see figure III.6).⁴

Figure III.6

Latin America and advanced countries: proportion of direct intermediate digital inputs, by economic sector (Percentages)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of R. Katz, "Evidencia sobre el nivel de digitalización sectorial en América Latina", unpublished.

Note: Latin America includes Argentina, Brazil, Chile, Colombia, Costa Rica, Mexico and Peru. Advanced countries include Australia, France, Germany, Japan, the Republic of Korea, the United Kingdom and the United States.

3. Sectoral digital transformation

At the international level, there is abundant evidence of the impacts of the adoption of digital technologies, both emerging and mature, on different areas and sectors of the economy. There are also data that confirm this trend in Latin America.

(a) E-commerce and services

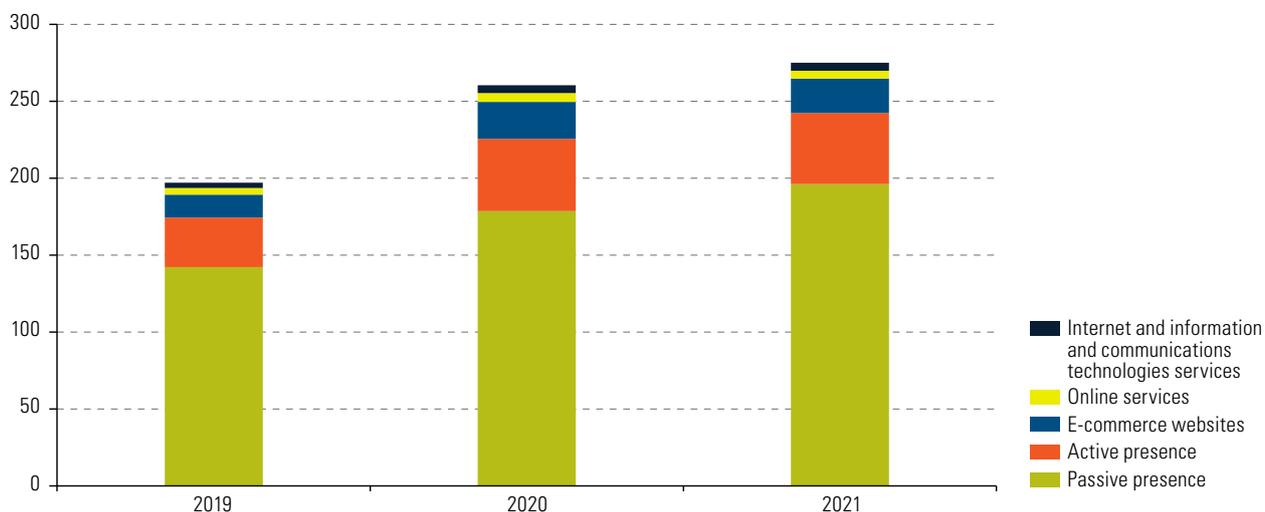
The restrictions imposed by the pandemic were an important driver of online purchasing. Companies were obliged to enhance their virtual presence using websites or social networks, or to improve their digital platforms by adding transaction functionality. Between 2019 and 2021, the number of new commercial websites increased by 40% in Brazil, Chile, Colombia and Mexico (see figure III.7). While the toughest restrictions were in effect, commercial websites that had enabled online purchasing, e-commerce companies and online services grew by 46%, 60% and 36%, respectively. When in-person shopping resumed, the same categories saw a slight contraction, while sites with a passive presence (no online purchasing functionality) saw higher growth, which explains the slower expansion of companies' Internet presence in 2021 (see figure III.7).

⁴ Using the input-output table methodology, it is assumed that the greater the proportion of intermediate digital inputs, the greater the digitalization of the sector.

Figure III.7

Brazil, Chile, Colombia and Mexico: new commercial websites, by category, 2019–2021

(Thousands of websites)



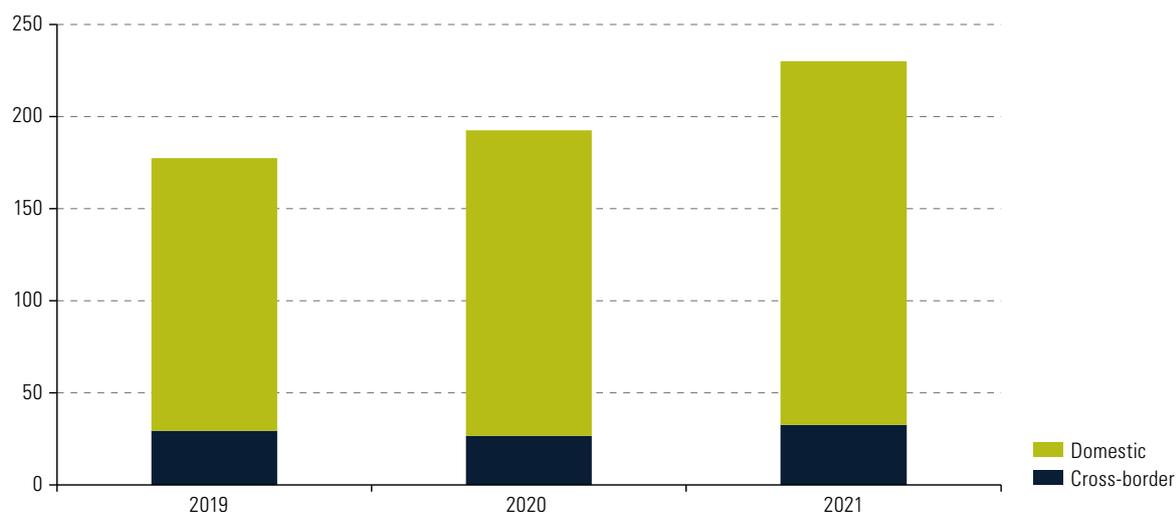
Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of information from Dataprovider.com [online] <https://www.dataprovider.com/>.

Greater online presence, along with the emergence of e-commerce platforms and companies, were a strong driver of digital commerce in the region. In 2021, the value of online transactions was nearly US\$ 230 billion, 30% higher than in 2019. Domestic e-commerce grew the most (33%), representing nearly 86% of the total increase (see figure III.8). Ninety-one per cent of e-commerce website traffic is domestic, enabled by local retail platforms (Mercado Libre, Lojas Americanas and Falabella) and by international companies' domestic market outlets (Shopee and Dafiti). In contrast, cross-border e-commerce is largely controlled by the big international platforms (Amazon and Alibaba) (see figure III.9). However, this segmentation is likely to diminish in the medium term as the big international platforms continue to attract vendors in the main markets of the region and as local companies begin to offer a broader range of international products, mostly from China.

Figure III.8

Latin America: e-commerce, 2019–2021

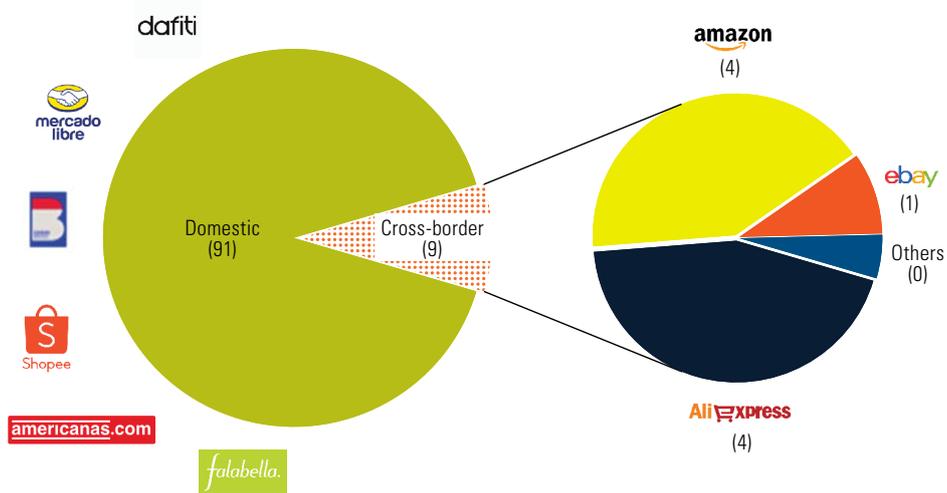
(Billions of dollars)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of EBANX, *Beyond Borders 2020/2021: A study on the state of cross-border e-commerce in Latin America. Focus on Brazil, Chile, Colombia and Mexico, 2020* [online] <https://imgcdn.larepublica.co/cms/2020/12/16091007/EBANX-Beyond-Borders-2020.pdf>.

Figure III.9

Latin America: traffic to local and cross-border e-commerce websites, by major platform, 2021
(Percentage of visits to e-commerce websites)

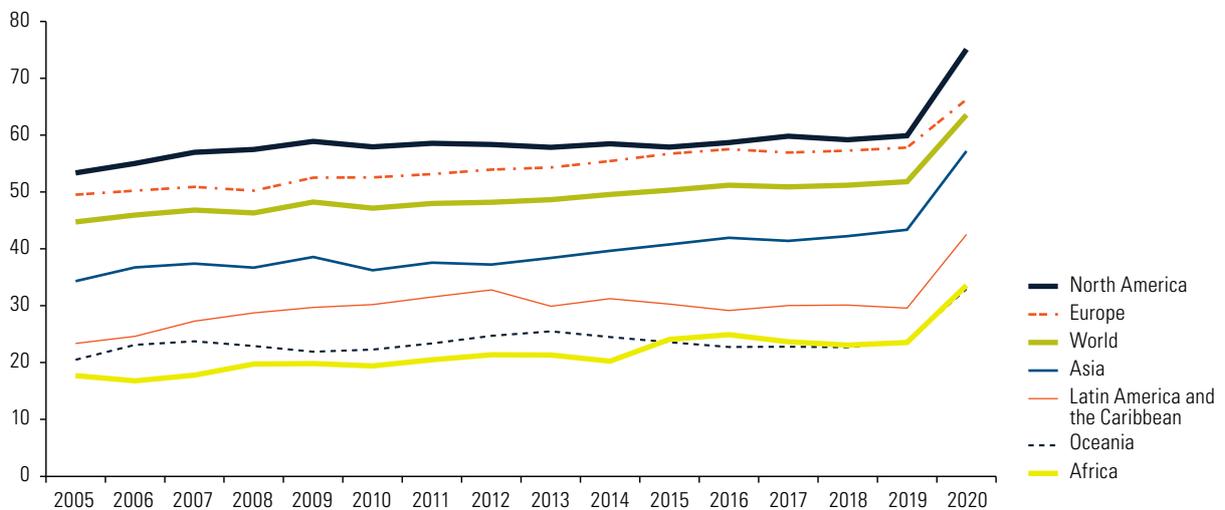


Source: Economic Commission for Latin America and the Caribbean (ECLAC), Regional observatory for digital development, on the basis of information from SimilarWeb.com [online] <https://www.similarweb.com/>.

Recently, the share of services provided digitally (also called modern services) in overall services has increased worldwide. The trend is more pronounced in North America and Europe, where service sectors are more competitive and innovative, and incorporated digital technology into business models early on. Modern services accounted for nearly 42% of total service exports in Latin America and the Caribbean in 2020, 21 percentage points below the global average (see figure III.10). In 2020, just 1.7% of global modern services exports originated in the region, while Europe, North America and Asia were the source of 53%, 19% and 26%, respectively.

Figure III.10

World: share of trade in services provided in digital format in total international trade in services, by region, 2005–2020
(Percentages)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), Regional observatory for digital development, on the basis of United Nations Conference on Trade and Development (UNCTAD), UNCTADstat [online] <https://unctadstat.unctad.org>.

(b) The agriculture sector

Agriculture accounts for 8% of the GDP of Latin America and the Caribbean. Nowadays, the agriculture sector is incorporating digital technology into value chains to boost efficiency and maintain international competitiveness. The technologies being adopted have evolved from simple solutions that predict the weather or provide pricing information to more sophisticated offerings, such as digital agritrade platforms and smart agriculture applications. In 2018, there were some 450 enterprises in the region engaged in technology innovation in the agriculture sector. Among these start-ups, 19% provided commercial platforms, outsourced services, financing or technologies for logistics and food distribution, while 60% were focused on precision agriculture, data handling, data services and education for producers, or on mechanization and automation (Vitón, Castillo and Lopes Teixeira, 2019). There are now more than 1,400 agricultural and food technology (agrifoodtech) start-ups in the region, twice as many as six years ago, that develop and scale relevant technology for agrifood systems.

These companies connect producers, shippers and a wide range of potential customers, from final consumers to hotels and restaurants. The solutions they provide reduce the number of intermediaries, lower transaction costs, help farmers and producers to obtain better prices, and improve access to production inputs.

The Latin American market for precision agriculture solutions is expected to expand from US\$ 1.21 billion to some US\$ 2.13 billion between 2021 and 2026 (Market Data Forecast, 2022). In the region, Brazil has the greatest number and variety of start-ups for improving on-farm processes using Industry 4.0 technology. In 2021, there were 1,574 of these start-ups, more than a third of which specialize in farm management solutions, data integration systems, marketing platforms and logistics and traceability.⁵ Start-ups such as these are also increasingly common in other countries of the region, mainly Argentina, followed by Chile, Colombia, Uruguay, Peru and Mexico (Vitón, Castillo and Lopes Teixeira, 2019).

The digital transformation of farming is fostering the development of farmers and ranchers who are more specialized and have access to new tools and markets. The adoption of digital technologies in the agriculture sector is making strategic improvements to producers' output, helping reduce costs and risks, and supporting expansion and crop sustainability. Some innovations are also boosting access to the channels for buying and selling inputs and products. Access to a range of value chain information is one reason why producers are increasingly valuing and adopting digital technologies for the agriculture sector. As an example, 66.1% of producers in Brazil choose agritech tools to obtain information and plan their work, 43.3% use asset management solutions, 40.5% use applications for buying and selling inputs and products, 32.7% use land-use mapping and planning technology, and 30.2% use technologies that enable them to predict climate risk (see figure III.11).

Agritrade platforms and digital on-farm management solutions also generate data, either through marketing channels or smart algorithms based on high-resolution satellite images. The availability of these data makes it easier for small producers to get loans, since it allows for more efficient evaluation of the weather, producers' financial capacity and credit risk. Other important uses related to blockchain technology and artificial intelligence are product traceability, food security and certification. Full traceability, which means having an audit trail for all production and distribution phases of the food chain, is increasingly a requirement for access to markets that certify quality, origin and compliance with food safety standards and the sustainability of agriculture products (Sotomayor, Ramírez and Martínez, 2021).

Agritech innovation is increasingly relevant in the current global context of market upheavals caused by climate change, the COVID-19 pandemic, and more recently, the war in Ukraine. Agrifood systems, which were vital for stabilizing the situation and mitigating the impact of the pandemic on food availability, are under pressure again as a result of the shock caused by the war. In this scenario, investing in agricultural technology is increasingly important to increase countries' productive capacity and reduce the many sources of uncertainty.

⁵ See Radar Agtech (2021).

Figure III.11

Brazil: main uses of digital technologies in the agriculture sector, 2020
(Percentages)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of Brazilian Agricultural Research Corporation (EMBRAPA), “Agricultura digital brasileira: 84% dos produtores usam pelo menos uma tecnologia”, AGROemDIA, 2020 [online] <https://agroemdia.com.br/2020/08/10/agricultura-digital-brasileira-84-dos-produtores-usam-pelo-menos-uma-tecnologia/>.

(c) The automotive industry

The COVID-19 pandemic and recent supply chain problems, mainly affecting semiconductor supply, as well as heavy dependence on China, have had serious impacts on the automotive industry. Logistics chains have therefore become increasingly important, driving companies in the sector to accelerate migration towards an Industry 4.0 model.

Companies around the world—from start-ups to large technology multinationals—have developed and incorporated innovative solutions for the automotive industry. These technology solutions include self-driving and electric vehicles, new long-life batteries, and new systems for services, including insurance paid by the mile, e-commerce platforms, short-term or car-sharing arrangements and car-as-a-service models (Lustig, 2019).

In Latin America and the Caribbean, the main adopters of advanced technology processes, products and services are the subsidiaries of multinational corporations, which are taking advantage of the R&D investments made by their parent companies, chiefly outside the region. Tier 1 suppliers are also the biggest adopters of advanced technology, which enables them to maintain close ties with the companies in their organizations that acquire their products (World Economic Forum, 2019). Most innovation is concentrated in the two largest markets in the region: Brazil and Mexico. However, as a general rule, the regional subsidiaries of multinationals lag farther behind in the adoption of advanced technologies than their peers in Europe, the United States and China (World Economic Forum, 2019).

Automotive sector innovations in Latin America and the Caribbean may be divided into different categories, such as e-commerce platforms or digital marketplaces for vehicle sales; carsharing platforms (temporary or shared vehicle use) to improve urban mobility and smart factories that use cloud computing, the Internet of things, and autonomous robots that enable original equipment manufacturers to monitor multiple units in real time and adjust production efficiently.

There are also many start-ups in the region that are increasingly relevant in the automotive sector, in particular because business models are being redefined and new links are emerging in value chains, such as the sale of products (vehicles and parts) and car-as-a-service arrangements.

For example, in Brazil, the adoption of advanced technologies in the automotive sector has been led by the subsidiaries of the big vehicle manufacturers: General Motors, Volkswagen and Stellantis.⁶ They have smart factories that are connected through cloud computing and have Internet of things devices and artificial intelligence software that make them more productive, flexible and autonomous. The plants have robots, self-driving vehicles and systems that send real-time data on vehicles on the production line, enabling greater efficiency in quality auditing. They also have augmented reality laboratories where they can test vehicles and improve customer care, as well as 3D printers to make parts more quickly and economically.

The adoption of advanced technologies by some automobile industry firms has also spilled over to other participants in the production chain and even to other manufacturing industries. In Brazil, tier 1 suppliers have become the greatest adopters of advanced technology as they attempt to keep up with the pace of innovation of original equipment manufacturers (World Economic Forum, 2019). There are several suppliers that offer services for implementing advanced technologies in the supply chains of original equipment manufacturers, from large multinational companies to local start-ups⁷ (Cruz and Roldán, unpublished).

Lastly, the adoption of advanced technologies is also helping to improve vehicle features. These technologies are enabling the manufacturing of vehicles that generate lower CO₂ emissions, cause fewer accidents and less traffic, and also improve customer experience. This is achieved through the use of long-life batteries for electric vehicles, wireless artificially intelligent sensors for self-driving vehicles and cloud computing that enables digital updates for vehicles' software.

B. The future of the labour market

As discussed above, the acceleration of the digital transformation is opening up opportunities for new products and services, productivity improvements, wealth generation and new jobs. However, concern is growing among policymakers that these changes could also have negative repercussions on the labour market, both in its formal and informal segments. In fact, even as the digital revolution creates new jobs, it is changing the structure of jobs and employment, affecting the way in which jobs are transformed and eliminated (see diagram III.1).

Demand for workers in cognition-intensive jobs, which pay better wages than labour-intensive jobs, has increased over the last two decades. Cognitive skills are therefore a key variable for improving participation in current and future labour markets. Given the increasing number of routine cognitive tasks in the average job in the region, the risk of greater polarization in the labour market in the future will depend on the degree to which these types of jobs are automated.

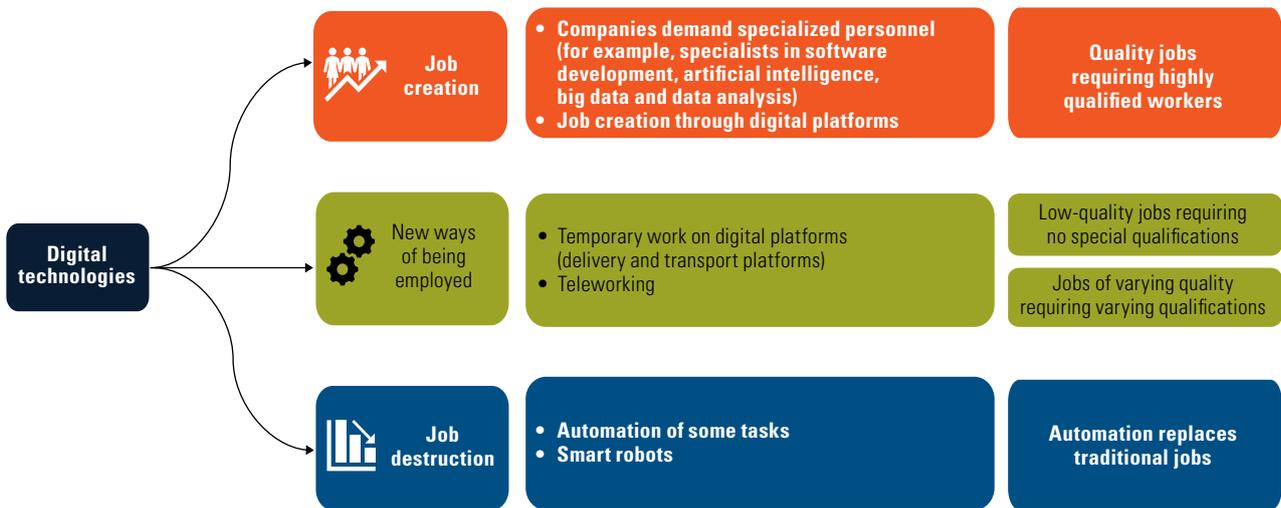
In that regard, the future of the job market remains uncertain and will depend on factors that include the evolution of technology and its use, economic performance, and the job development and labour rights protection policies implemented. In order to advance towards inclusive digital development in Latin America and the Caribbean, it will be critical for governments, the private sector and trade unions to deploy actions, policies and strategies that create more opportunities for quality jobs and encourage continuous professional development for workers.

⁶ Stellantis, based in the Netherlands, is the result of the January 2021 merger between Italian-American manufacturer Fiat Chrysler Automobiles (FCA) and French group PSA. Stellantis manufactures and markets the Fiat, Alfa Romeo, Lancia, Maserati, Abarth, Jeep, Chrysler, Dodge and Ram brands of FCA, and PSA group's Peugeot, Citroën, DS Automobiles, Opel and Vauxhall brands.

⁷ These suppliers provide telecommunications technologies, Internet of things devices, industrial cloud computing services and machine learning software, which has improved traceability, efficiency and accuracy in plants' production and assembly processes. The adoption of cloud computing technologies and the Internet of things has enhanced capacity to offer more efficient services and reduce emissions and waste, making production more sustainable. Other companies are providing self-driving vehicles and robots that enable process automation to free workers from having to lift heavy items and complete repetitive tasks, leading to faster, safer and more reliable internal processes for transporting parts and components (Software.org, 2018).

Diagram III.1

Digitalization and employment trends



Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of ECLAC, *Economic Survey of Latin America and the Caribbean, 2021* (LC/PUB.2021/10-P/Rev.1), Santiago, 2021.

1. Uneven risk of technological substitution of labour

In a context in which technology advances are changing production, consumption and work, the debate on the risks generated by new digital technologies for jobs and working conditions is increasingly relevant.

There are several methods that can be used to estimate how new technologies can take the place of work done by humans (ECLAC, 2021a). The risk that a job will be replaced by technology in the region varies considerably depending on the methodology used to make the calculations. The negative impact estimated using Frey and Osborne's methodology (2013) is far worse than if the adjusted methodology of Weller, Gontero and Campbell is used (2019). Using the adjusted method, which acknowledges the segmentation of the region's labour markets, low-productivity sectors are less affected by technology changes. In fact, according to the original method, nearly two thirds of jobs are vulnerable to substitution by technology; using the adjusted method, that figure falls to one quarter.

In countries with a higher proportion of workers in low-productivity sectors, such as El Salvador, Honduras and the Plurinational State of Bolivia, the average likelihood of technological substitution is lower, while in Argentina, Chile and Uruguay, the proportion of workers at risk is higher (by more than 30%).⁸

In addition, not only does the level of risk of technological substitution differ based on workers' labour market segment, there are also differences related to sex, education level and age (see table III.1). Because the proportion of women working in low-productivity sectors is higher than for men, 36.3% of men and 26.7% of women are at medium or high risk of job substitution.

Regarding level of education, the estimates show that the relative risk of substitution for workers with higher education levels is lower. In addition, workers with an intermediate education level of education become those at greatest risk of technological substitution (one in five workers) (see table III.1).

⁸ According to the original method, per capita income and the risk of technological substitution of labour in countries in the region are negatively correlated: the lower the per capita income, the higher the proportion of workers in high-risk occupations (IDB and others, 2018; Ripani and others, 2020). However, the adjusted method yields the opposite result: countries with relatively high per capita GDP have more workers at high risk of technological substitution (Weller, Gontero and Campbell, 2019). This contrast exists because countries with low per capita GDP tend to have a high proportion of workers in low-productivity sectors, for which technological substitution is unlikely.

Table III.1

Latin America and the Caribbean (12 countries):^a risk of technological substitution of employment, by sex, education level and age, simple averages, around 2015 (Percentages)

| Risk of substitution | Sex | | Education level | | | Age group | | |
|--------------------------|------|-------|-----------------|--------|------|-------------|-------------|-------------------|
| | Men | Women | Low | Medium | High | 15–29 years | 30–54 years | 55 years and over |
| Low-productivity sectors | 53.8 | 59.6 | 73.6 | 54.2 | 23.5 | 52.1 | 54.1 | 69.0 |
| Low | 9.9 | 13.7 | 1.2 | 6.1 | 45.3 | 8.8 | 13.5 | 9.7 |
| Medium | 18.8 | 12.6 | 11.9 | 19.6 | 16.9 | 18.8 | 16.8 | 11.0 |
| High | 17.5 | 14.1 | 13.2 | 20.2 | 14.2 | 20.3 | 15.7 | 10.4 |

Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of J. Weller, S. Gontero and S. Campbell, “Cambio tecnológico y empleo: una perspectiva latinoamericana. Riesgos de la sustitución tecnológica del trabajo humano y desafíos de la generación de nuevos puestos de trabajo”, *Macroeconomics of Development series*, No. 201 (LC/TS.2019/37), Santiago, ECLAC, 2019.

^a Argentina, Brazil, Chile, Dominican Republic, Ecuador, El Salvador, Guatemala, Honduras, Mexico, Peru, Plurinational State of Bolivia and Uruguay.

Of all age groups, young people face the greatest relative risk of technological substitution of employment. On average, one in every five people between the ages of 15 and 29 works in a job at high risk of substitution, unlike groups aged between 30 and 54 and those aged 55 and over, of whom 16% and 10% are at risk, respectively (see table III.1). However, because of the age composition of the workforce, most people whose jobs are at high risk of substitution are middle-aged (56% of all employed persons at high risk) (ECLAC, 2021a). In addition, on the basis of the adjusted methodology, the sectors with the largest proportion of workers at high risk of technological substitution are financial and business services (40%), public administration (29%) and manufacturing (27%) (ECLAC, 2021a).

In short, when the structural characteristics of the region’s labour markets are taken into consideration, given the importance of low-productivity sectors, there is a lower probability of technological substitution, on average. In addition, as discussed in the next section, job destruction through technological substitution may be offset by the creation of new jobs.

2. The potential of digitalization to generate new jobs and occupations

The digital transformation could stimulate job creation in a number of ways. When new jobs are created, it does not necessarily mean that new occupations have been created; existing occupations may instead have been transformed through the advent of new technologies.

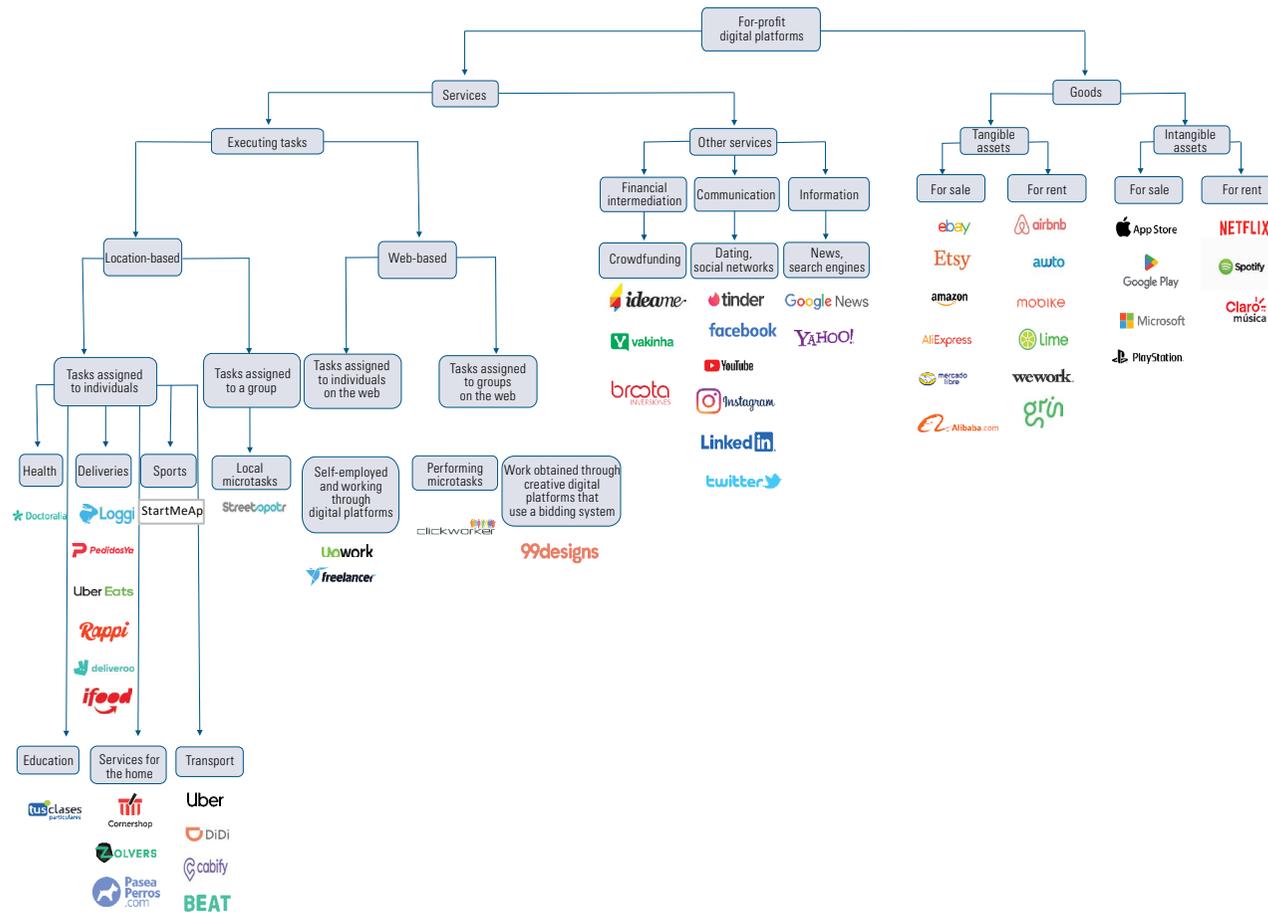
As an example, according to a survey conducted by the World Economic Forum, more than 90% of large firms in Argentina, Brazil and Mexico indicated that, over the next five years, they would introduce new technologies in cloud computing and in text, image and voice processing. Approximately 80% of firms surveyed also said that they would introduce technology related to big data, artificial intelligence, the Internet of things, e-commerce and cybersecurity over the same period. In this scenario, the occupations for which demand will increase the most are artificial intelligence, data analysis and digital marketing (World Economic Forum, 2020b).⁹

The structure of employment is changing for work mediated by digital platforms that trade in goods and services (see diagram III.2). As digital platform business models have coalesced, two types of jobs have emerged, depending on the area and market they serve: jobs done online for a global market and those performed locally. Digital platform workers performing local jobs are usually delivery workers, drivers, caregivers, maintenance and repair workers, teachers, or pet sitters and trainers, among others. Work done through digital platforms can also create new jobs, in particular when the work is done online, where jobs can include design, engineering, translation and language-related work, software development and data handling, among others (ECLAC, 2021a).

⁹ In two of the three countries, the occupations with the greatest projected expansion include specialists in digital transformation, Internet of things, fintech and process automation, among others (World Economic Forum, 2020b).

Diagram III.2

Categories of digital platforms for goods and services, by type and scope of task



Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of E. Menéndez, “Clasificación del trabajo en plataformas digitales”, cited in Economic Commission for Latin America and the Caribbean (ECLAC)/International Labour Organization (ILO), “Decent work for platform workers in Latin America”, *Employment Situation in Latin America and the Caribbean*, No. 24 (LC/TS.2021/71), Santiago, 2021.

While recent times have seen a global acceleration in the digital transformation, its future effects on job creation remain uncertain. In fact, job growth should happen quickly enough to offset any destructive effect. In the United States, for example, growth of 15.4% is expected between 2021 and 2031 in jobs related to computing and mathematics, which is higher than the 5.3% job growth projected overall (Bureau of Labor Statistics, 2022). Although the ability to make such projections in Latin America and the Caribbean could be very useful in designing policies to adapt education and vocational training systems to the changing demand for skills, they are just beginning to be made (Gontero and Albornoz, 2019). It is likely, however, that job creation directly related to new technologies will happen more slowly than in the advanced economies.

To sum up, there is a creative aspect to digital disruption in labour markets that could generate new jobs, both in existing occupations and emerging ones. However, it is important to take into account the transformations that affect workers who remain employed and the public policy challenges of new work modalities.

3. The new challenges of the digital transformation of jobs and occupations

Besides harbouring the potential to destroy and create jobs, accelerated technological progress may also profoundly alter those that remain. Although it is difficult to know with any degree of certainty how work will evolve, some trends can already be identified. In fact, even as some jobs are being eliminated, new occupations, spatial configurations for work and business models are emerging.

The work of the future is likely to give rise to practices and needs that are very different from those of today. New technologies—cloud computing and robots, and especially artificial intelligence—are extending the automation of tasks and processes that used to require human intervention and are also creating new jobs. Similarly, as discussed above, the effective and efficient use of these technologies requires workers to have new skills.

New technologies have also enabled novel ways of organizing work, in particular teleworking during the pandemic. In fact, digital technologies made it possible to work from home during lockdowns and when in-person activities were restricted, which allowed some economic activities to be maintained and limited the socioeconomic impact of the crisis. ECLAC estimated that nearly 21.3% of workers in Latin America and the Caribbean could work remotely, far fewer than in Europe and the United States, where nearly 40% of jobs could be performed remotely (ECLAC, 2020). These calculations were confirmed for a group of countries in Latin America¹⁰ by the International Labour Organization (ILO), and it was estimated that in the first half of 2020, only 20% to 30% of wage earners who were employed were working from home (ILO, 2021).

However, access to telecommuting in the region is very uneven. Among the most vulnerable groups, three factors affect the ability to work remotely: high levels of informal employment, low connectivity and limited digital skills. Despite the increase observed in teleworking among informal workers in some countries, more than 80% of those working remotely after the second half of 2020 were formally employed (ILO, 2021). In Argentina and Costa Rica, for example, more than 70% of remote work or work done from home in the first half of 2020 was concentrated in the fourth and fifth quintiles (see figure III.12).

In relative terms, people with lower labour income, men, people of African descent, young people and persons who did not complete primary education have teleworked less. In this area, the prevalence of women over men is particularly interesting and can be explained by high female participation in the tertiary sector, in which teleworking is possible for some jobs (ECLAC, 2021a).

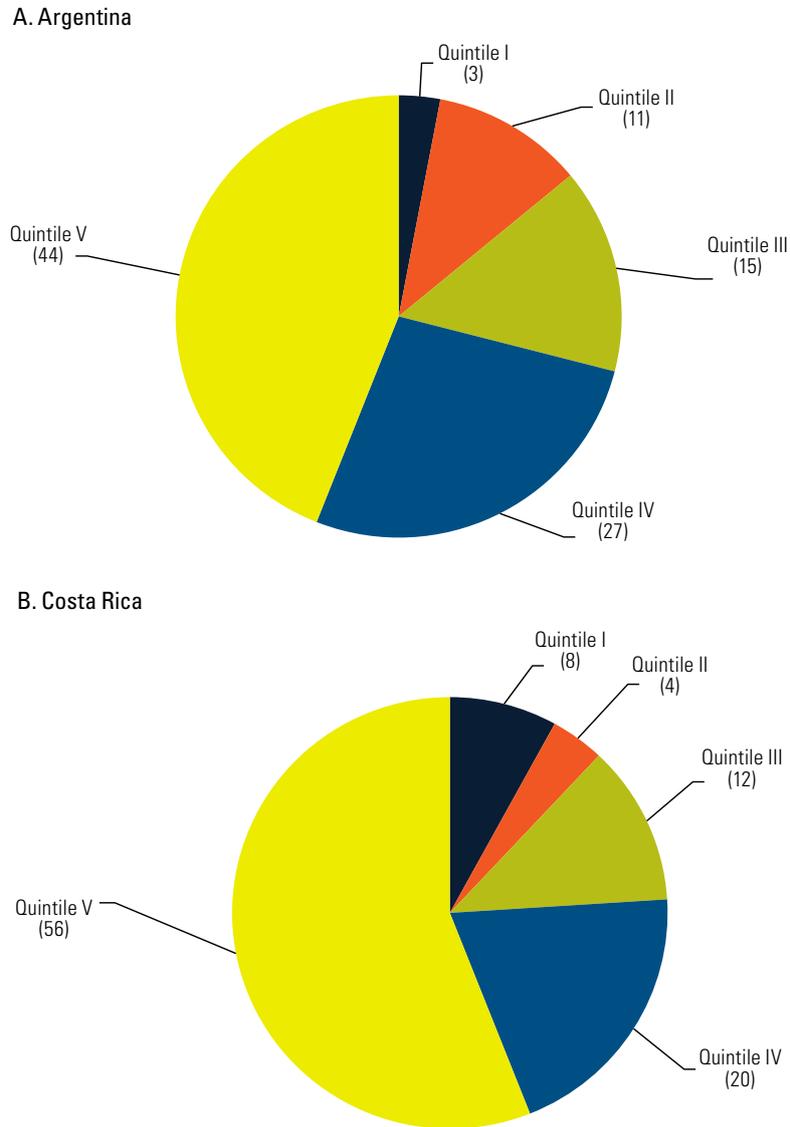
As previously mentioned, remote work was an important instrument to enable certain economic activities to continue during the pandemic. In fact, companies have increased the use of teleworking. Between April and August 2020, more than 30% of formal companies in Brazil, Chile, Costa Rica, Mexico and Peru were using teleworking (ECLAC/ILO, 2020). However, there are also significant gaps between companies, depending on their size.¹¹

¹⁰ Argentina, Brazil, Chile, Costa Rica, Peru and Uruguay.

¹¹ In June 2020, around 38% of small companies in Brazil were using teleworking, compared to 86% of large companies. In Mexico, the difference is even more marked: while in May 2020, 29% of MSMEs had opted to allow teleworking, this figure was almost 95% in large enterprises (ECLAC/ILO, 2020).

Figure III.12

Argentina and Costa Rica: distribution of home-based work and telework, by labour income quintile, first quarter of 2020 (Percentages)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of International Labour Organization (ILO), *2021 Labour Overview: Latin America and the Caribbean*, Lima, 2021.

Note: The data correspond to the quarter prior to the outbreak of the COVID-19 pandemic, and are therefore indicative of the profile of workers (by income quintile) who were able to continue their activities from home during the pandemic.

Although it is still too early to predict how teleworking will evolve in the region, it is expected to become increasingly relevant, probably in combination with in-person work (hybrid mode) (Maurizio, 2021). If this is the case, getting the most out of the potential of technology will mean addressing existing inequalities, both in terms of the digital divide and the labour market. In this regard, progress is needed to develop an appropriate framework for this type of work and to ensure effective compliance with it.

Another work modality that is conditioned by digital technologies and has generated significant transformations in employment is work done through platforms. In this segment, work opportunities and conditions are quite heterogeneous. The potential benefits include flexible working hours and access to the labour market for

some groups who, because of commitments or limitations, have not been able to find regular work (including young people, students, migrants, persons with disabilities and others). This modality also entails some risks, mainly associated with the precariousness of contracts, and, in some cases, working conditions. Among the challenges posed by digital platforms for decent work are therefore the following: job and income instability, unpaid work, long workdays, lack of social and labour protection and lack of representation.

Initiatives to organize platform workers and actions to strengthen their labour rights have therefore arisen in several countries in the region to address this vulnerability. However, the degree of organization among these workers is still low, meaning that they generally have limited power to dialogue and negotiate (ECLAC, 2021a).

In short, the development of digital technologies is bringing profound changes to various dimensions of the world of work. Regarding spatial organization, these technologies have enabled remote work, which, despite unequal access, became a key tool during the pandemic. In terms of new business models, work on digital platforms is generating opportunities while also increasing precariousness. In both cases, there are regulation and public policy challenges for ensuring job quality.

4. Progressing towards a fair labour market and decent jobs in the future

Digital technologies are destroying, creating and transforming jobs and changing working conditions. Political will and coordinated action from multiple public and private stakeholders and civil society will be needed to maximize the benefits and contain the risks of these technologies.

Appropriate public policies and regulations are critical to harmonize the emergence of digital technologies with better opportunities for quality jobs and better working conditions. This can only be achieved through the strengthening and diversification of the productive sector such that new technologies become a key tool to simultaneously address some of the challenges facing the region, including productivity gaps and the creation of quality jobs.

As the crossroads between technology change and employment, businesses are indispensable for the realization of the potential benefits of digitalization and decent jobs. Business strategies that include modernization and investment in continuous learning for employees should therefore be supported and promoted, along with good practices to create and maintain jobs and income to improve workers' quality of life.

Lastly, strengthening mechanisms for worker dialogue and representation is essential to raise awareness of labour rights and level the playing field between social stakeholders. The democratic participation of workers in discussing and negotiating their working conditions is an important step for an inclusive and fair labour market in the future.

C. Digital transformation of government

In recent years, the governments of Latin America and the Caribbean have made important strides in modernization by offering integrated online information and services to their citizens. This progress was driven by ambitious strategies and plans for the digital transformation of the State. However, it is important to acknowledge that these initiatives accelerated in 2020 during the health, economic and social crisis caused by the COVID-19 pandemic, because of the need to provide digital access to public services owing to mobility restrictions and lockdowns.

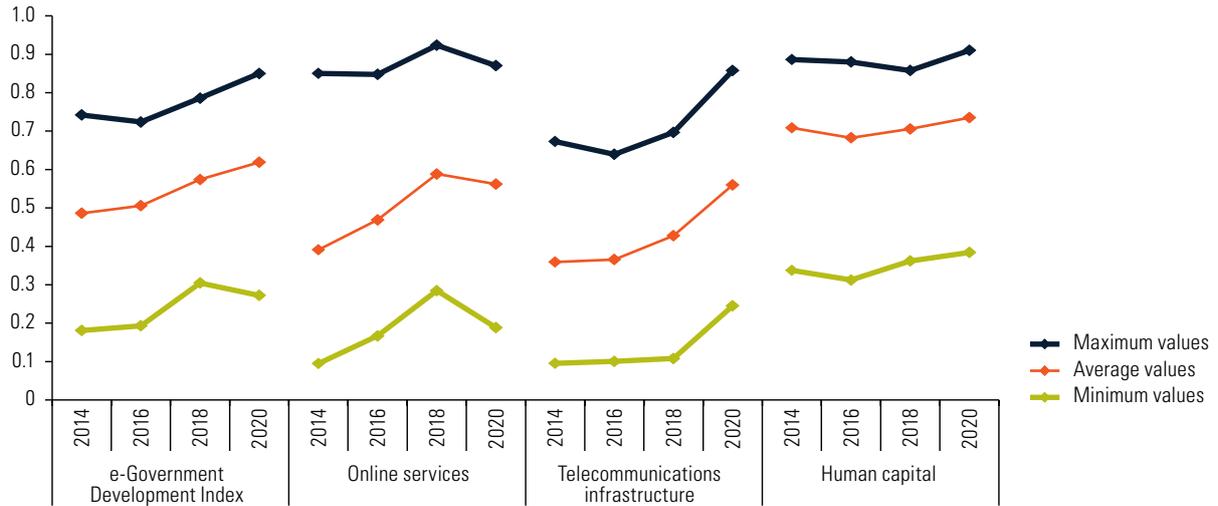
Digital governance strategy means not only improving the ways in which public services are delivered by the State, but also their management, planning, administration and institutional interlinkage.

Although the progress made in digital governance is undeniable, the situation of the countries of the region remains highly unequal, as reflected in the e-Government Development Index (EGDI) prepared by the United Nations Department of Economic and Social Affairs, which conducts a systematic evaluation of

government progress in the use of digital technologies in three areas: online services, telecommunications infrastructure and human capital (United Nations, 2020). In 2020, 28 of the 33 countries of the region¹² had a high or very high EGDI. However, analysis of the trend between 2014 and 2020 shows that dispersion between the most advanced countries and those that are lagging persists in each of the subindices (see figure III.13).

Figure III.13

Latin America and the Caribbean: United Nations e-Government Development Index (EGDI), 2014, 2016, 2018 and 2020 (Changes in minimum, average and maximum values)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of United Nations, *E-Government Survey 2020: Digital Government in the Decade of Action for Sustainable Development*, New York, 2020.

To obtain an overview of progress in digital governance, ECLAC gathered data related to four areas:

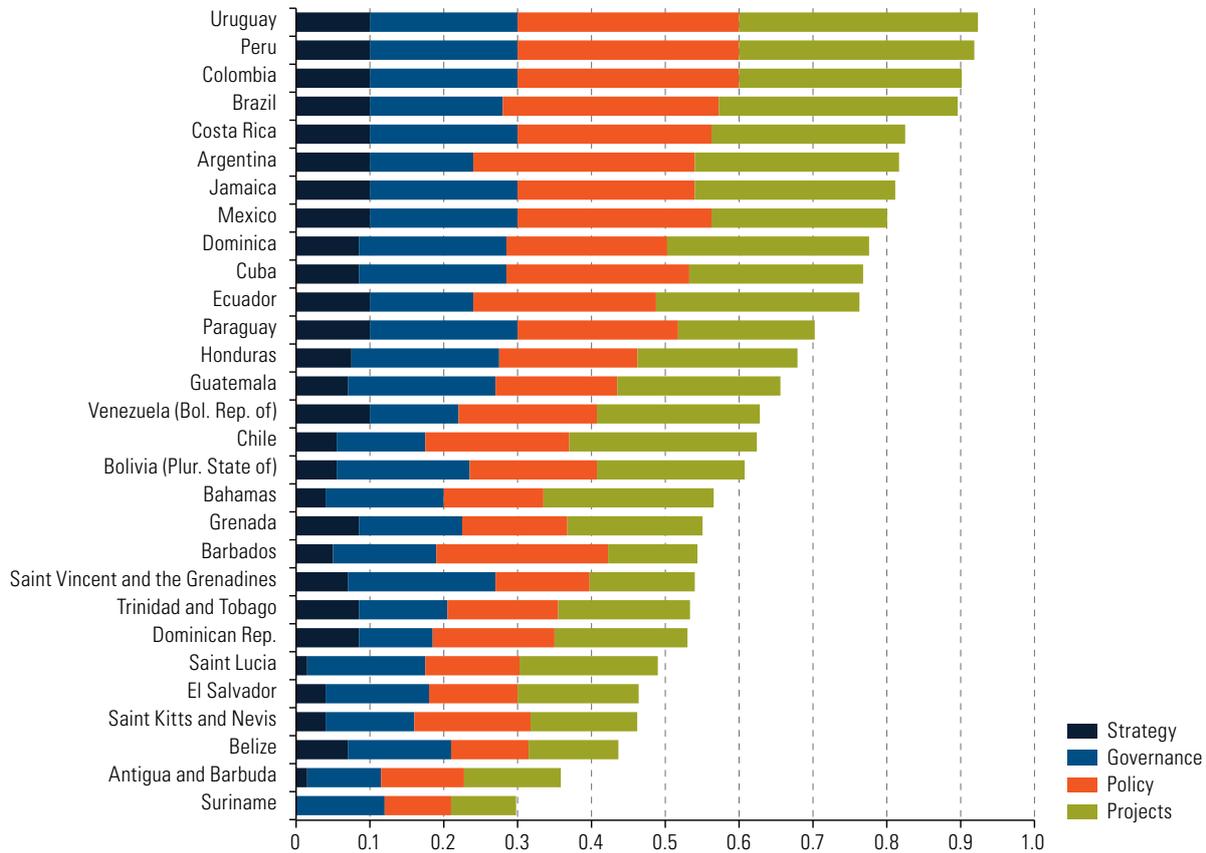
- **Strategies:** a national snapshot of the development of digital governance, enabling the coordination of actions or initiatives intended to promote the digital transformation of government.
- **Governance:** how the government and its institutions are organized to achieve its digital governance objectives.
- **Policies:** normative frameworks that organize and lead the overall development of digital governance and of the main institutions and initiatives.
- **Projects:** enabling and flagship digital governance initiatives.

The results obtained place the countries of the region in one of three groups: (i) advanced countries, with a score above 0.8 (Uruguay, Peru, Colombia, Brazil, Costa Rica, Argentina, Jamaica and Mexico); (ii) intermediate countries, with a score between 0.6 and 0.79 (Dominica, Cuba, Ecuador, Paraguay, Honduras, Guatemala, Bolivarian Republic of Venezuela, Chile and Plurinational State of Bolivia) and (iii) countries that are lagging, with a score under 0.6 (Bahamas, Grenada, Barbados, Saint Vincent and the Grenadines, Trinidad and Tobago, Dominican Republic, Saint Lucia, El Salvador, Saint Kitts and Nevis, Belize, Antigua and Barbuda and Suriname). Of the areas evaluated, progress is stronger in strategies and governance, while the greatest lags are seen in policies and projects for digital governance (see figure III.14).

¹² To represent Latin America and the Caribbean, Canada and the United States have been omitted from the figure reflecting 7 countries with very high EGDI and 23 with high EGDI.

Figure III.14

Latin America and the Caribbean (29 countries): digital governance ranking, 2021



Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of an e-government survey conducted by the Latin American and Caribbean Institute for Economic and Social Planning (ILPES).

Note: The survey was conducted in late 2021, covering the 33 countries in the region. No responses were received from Guyana, Haiti, Nicaragua or Panama.

There have been significant advances since the first digital agenda was implemented in Chile in 2004. At present, most countries in Latin America and the Caribbean (25 out of 29) have national digital government strategies.

Considerable progress has also been made in terms of governance. In the region, 69% of countries (20) have governance bodies for key technological projects and 86% (25) have governing bodies with powers to prioritize, coordinate or reformulate digital government initiatives. Of these 25 countries, 60% (15) have enshrined the functions of the governing body in law. In 86% of the countries (25) there is a body that oversees integration of online services into one-stop shops or subject-based portals. All the countries have initiatives in place to integrate digital procedures into one-stop shops, and just two countries do not have cross-body governance to address the challenges of e-government. A chief information officer (CIO) has been appointed in 83% of the countries (24) to lead or manage the government's digital strategy. In 71% of cases (21 countries), the CIO reports to a ministry (15 countries) or directly to the office of the president or the office of the prime minister (6 countries).¹³ There are inter-agency coordination bodies in 93% of the countries, and a balance between general coordination meetings, meetings on specific topics, and planning and follow-up meetings.

¹³ Of the five countries that report not having a CIO as part of the administration, three are among those lagging (Antigua and Barbuda, Bahamas and Suriname) and two are at the intermediate level (Chile and the Plurinational State of Bolivia).

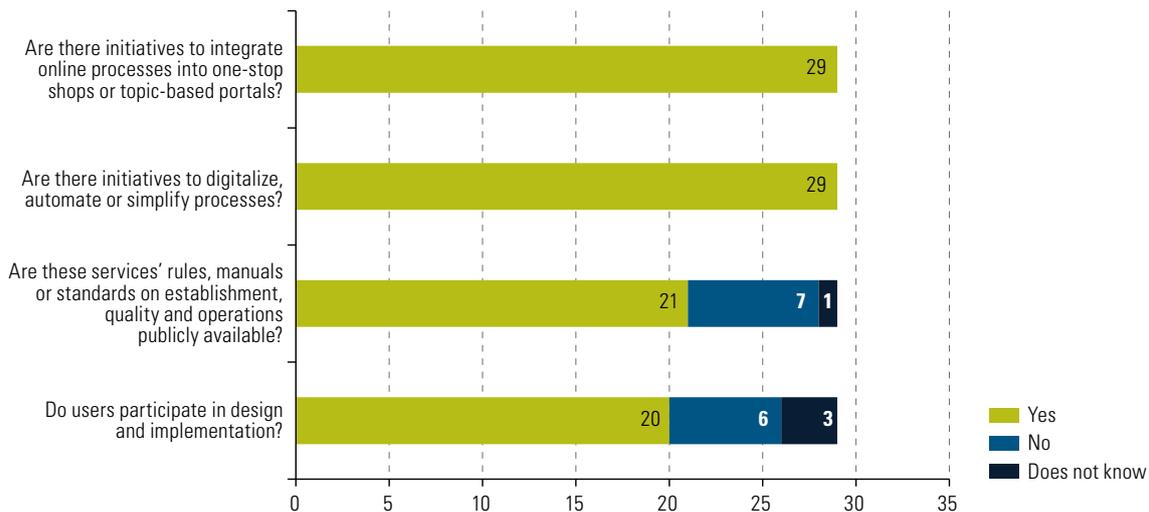
To ensure that e-government initiatives are sustainable, it is important to have frameworks of regulations and guidelines in place. The former (laws, orders, rules, instructions and regulations) organize and provide direction for addressing the different areas of development of digital government. The latter (technical and practical documents such as guides, standards, cases of usage, examples or models) allow initiatives to be implemented in a uniform manner for all government institutions.

In Latin America and the Caribbean, only 45% of countries (13) have legal frameworks for open government data, 55% (16) have legal frameworks for not requesting data or documents from citizens more than once, 55% (16) have digital identity standards, 66% (19) have legal frameworks for cybersecurity, 72% (21) have regulatory frameworks for interoperability, 76% (22) have legislation on personal data protection and 90% (26) have a legal framework for digital signatures.

All the countries have initiatives for digitalizing procedures and services and integrating them into one-stop shops or topic-based portals. In 69% (20) of cases, users participate in design and implementation of these projects, and in a similar percentage citizens have public access to the rules, manuals and quality standards of the provided services (see figure III.15).

Figure III.15

Latin America and the Caribbean (29 countries): projects for digitalization of procedures, 2021
(Number of countries)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of an e-government survey conducted by the Latin American and Caribbean Institute for Economic and Social Planning (ILPES).

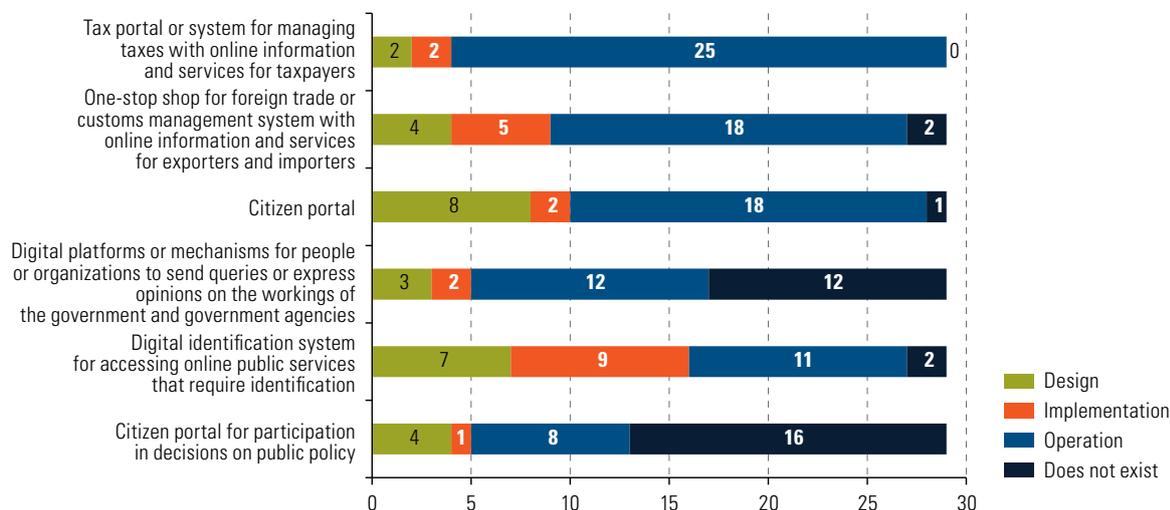
Note: The survey was conducted in late 2021, covering the 33 countries in the region. No responses were received from Guyana, Haiti, Nicaragua or Panama.

In terms of digital procedures and services, 25 countries have tax portals, 18 have citizen portals and a one-stop shop for foreign trade, 12 have digital mechanisms for sending queries about the workings of the government and its institutions or for expressing opinions on them, 11 have digital identity systems and 8 have citizen portals for participation in public policy decisions. In this regard, there is limited measurement of the economic and non-financial benefits of e-government projects or of dashboards that provide a quick overview of projects and their status for decision makers and citizens (see figure III.16).

In short, the countries of Latin America and the Caribbean are making significant efforts, in terms of both human and financial resources, to accelerate e-government initiatives. However, some structural aspects need to be strengthened to ensure that the progress made is sustainable. These include establishment of regulatory frameworks for State administrative procedures in a digital format, equivalence between signed documents that are on paper and those in digital format, the need for an institutional framework that ensures compliance with the regulatory framework and that has powers and capabilities to do so, and strengthening of technical and coordination skills within institutions to pursue and oversee digital initiatives.

Figure III.16

Latin America and the Caribbean (29 countries): existence and status of digital projects in key areas, 2021
(Number of countries)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of an e-government survey conducted by the Latin American and Caribbean Institute for Economic and Social Planning (ILPES).

Note: The survey was conducted in late 2021, covering the 33 countries in the region. No responses were received from Guyana, Haiti, Nicaragua or Panama.

In addition to establishing practical e-government infrastructure, citizens' access to services as users must also be guaranteed. In fact, the ultimate aim of e-government is to simplify and provide quality services to citizens, improving communication and trust. This is why another crucial area is development of cross-cutting digital competencies in the population, to build a society that is ready to take advantage of the benefits of digital technologies, and is able to do so.

The countries of the region are moving steadily towards establishment of e-governments, albeit at different speeds and according to their national development goals. Despite the different levels of progress and challenges specific to each country, the region is facing shared challenges that can be addressed collaboratively. Digital development presents an opportunity to improve government and how it interacts with society.

D. Digitalization and the green transition: the importance of an integrated approach

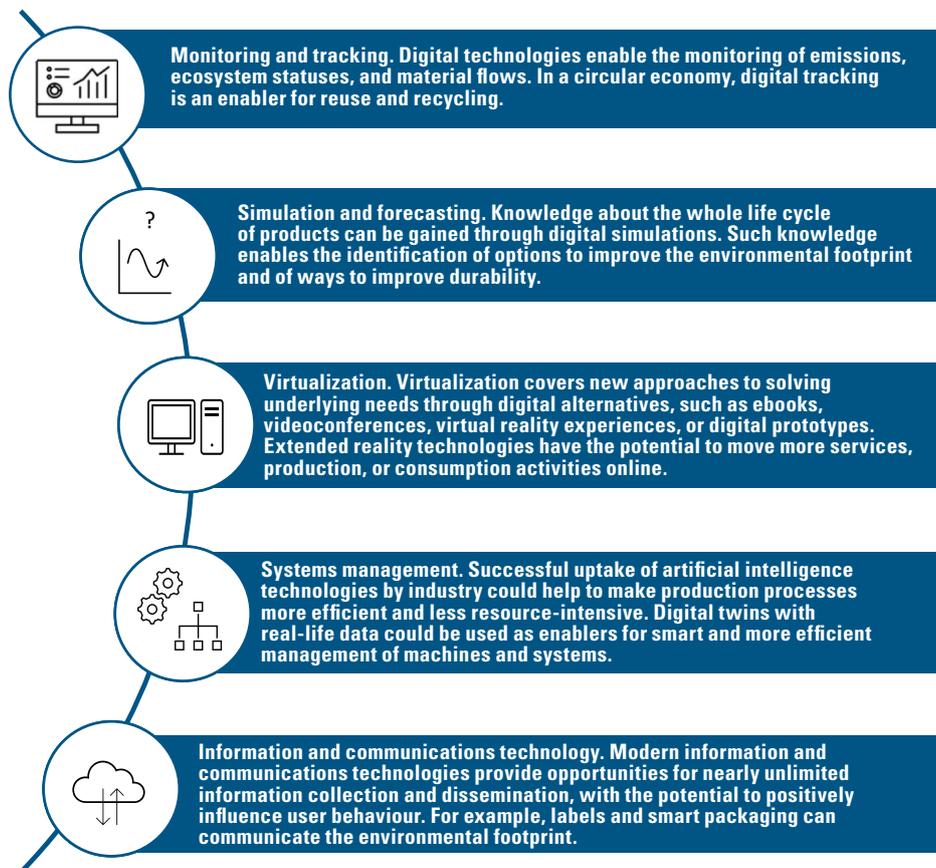
Digitalization results in new forms of value creation, with the potential to improve productivity, competitiveness, well-being and socioeconomic resilience. It is also key to meeting the commitments of the 2030 Agenda for Sustainable Development and the Sustainable Development Goals (SDGs), especially with regard to the green transition. In fact, digital technologies enable the changes in production and consumption patterns that are required for humanity to live within planetary boundaries. In that regard, there is a genuine opportunity to foster a digital transformation that favours a healthier, safer, cleaner and more equitable environment for all people. To seize the opportunity, the approach to the challenges faced and to the required public policies must be an integrated one.

Digital technologies can foster and support the green transition through multiple channels (see diagram III.3). Among these is their ability to dematerialize the economy by enabling a supply of digital goods and services, contributing to reducing the need for travel and thus cutting emissions of greenhouse gases and other pollutants (ECLAC, 2021b). Digitalization also facilitates disintermediation—whereby value chains have fewer stages or links—resulting in savings in terms of energy and inputs and lower transaction costs. Lastly, incorporation of digital technologies can offer smart solutions that optimize resource management in all economic sectors, leading to smaller environmental footprints. In this regard, advanced technologies could boost and strengthen,

for example, efforts relating to renewable energy generation and use, the transition to a circular economy, biodiversity protection, sustainable food production, access to clean and safe drinking water, and climate research (Mondejar and others, 2021).

Diagram III.3

The roles of digital technologies in the green transition



Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of S. Muench and others, *Towards a Green & Digital Future* (EUR 31075 EN), Luxembourg, Publications Office of the European Union, 2022.

It is estimated that digital technologies could reduce emissions by 20% by 2050 in the three most emission-intensive sectors: energy, materials and mobility (WEF, 2022). In fact, this technological potential is already beginning to be reflected in perception in the business sector. In a recent survey of 400 executives from different sectors and regions, 40% stated that digital technologies were already having a positive impact on their sustainability goals (Anderson and Caimi, 2022).

However, digitalization is not without ecological risks or harmful environmental effects. Firstly, growing demand among individuals and businesses for high-speed connectivity and for devices with high computing and processing power and fast data transfer rates requires continuous deployment of network infrastructure, production of devices and hardware, and data centres (ECLAC, 2021b). These are highly intensive in mineral use and energy consumption, driving up greenhouse gas emissions. In fact, the Internet is estimated to be responsible for 7% of global electricity consumption and 3.8% of total CO₂ emissions, a larger share than international air traffic (2.5%) (UNEP, 2021).

The data centres and transmission networks that form the basis of digitalization are major energy consumers (see table III.2). Despite a sharp rise in demand for digital services and considerable growth in the number of Internet users in recent decades, growth in energy demand from data centres and transmission networks has been moderate. Sustained improvements in energy efficiency have contributed to this pattern. Today, data centres and transmission networks each account for 1%–1.5% of global electricity consumption (IEA, 2022).

Table III.2

Global trends in digital and energy indicators, 2015 and 2021

| | 2015 | 2021 | Variation (Percentages) |
|--|-------------|-------------|----------------------------|
| Internet users | 3 billion | 4.9 billion | +60 |
| Internet traffic | 0.6 ZB | 3.4 ZB | +440 |
| Data centre workloads | 180 million | 650 million | +260 |
| Data centre energy use (excluding cryptography) | 200 TWh | 220–320 TWh | +10–60 |
| Cryptography power usage | 4 TWh | 100–140 TWh | +2 300–3 300 |
| Power usage of data transmission network | 220 TWh | 260–340 TWh | +20–60 |

Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of International Energy Agency (IEA), *Data Centres and Data Transmission Networks*, Paris, 2022 [online] <https://www.iea.org/reports/data-centres-and-data-transmission-networks>.

Development and manufacturing of connected devices and networking components not only puts pressure on limited resources and uses inputs that pollute, but also contributes to generation of waste electrical and electronic equipment (e-waste).¹⁴ As the life cycles of these products are becoming shorter, there is an ever-greater need for better waste management and recycling. In 2019, a record 53.6 million metric tons of e-waste were produced, equivalent to 125,000 Boeing 747 jumbo jets (UNEP, 2021). However, one issue that calls for targeted action is the fact that just 17% of e-waste is formally recycled.¹⁵

Therefore, environmental sustainability is not an inevitable or clear outcome of digitalization (CODES, 2022). In fact, the spaces that allow the digital and green transitions to strengthen each other have not been fully opened up or explored to date. As a result, much of the progress with digitalization has come at the price of a substantial environmental footprint. Urgent action is needed to reverse this situation and strike a better balance between these two long-term trends, which have the potential to bring about positive transformations of economies and societies (ECLAC, 2021b).

This requires a comprehensive policy and strategy approach to align digitalization with sustainable development. Such an approach must take into account the urgent issue of ongoing climate change, the measures needed to ensure decarbonization to protect the environment, promotion of sustainable technology, and mitigation of harmful effects on the planet.

Several advanced economies have already incorporated digitalization and the green transition into their development strategies, interlinking the areas. In fact, the European Union has made the double transition (digital and green) a priority in its post-pandemic recovery measures. To achieve this, it has a broad range of regulatory instruments, incentives and financing at its disposal.¹⁶ In Latin America and the Caribbean, some progress has been made with digital and environmental agendas. However, in general, these isolated efforts are still uneven and poorly coordinated, with too small a scale.

Provided that certain requirements are met, there could be improved synergies between these two trends. First, governments, business and wider society must commit to and be open to acceleration of changes in production and consumption patterns. Second, changes must take place in a fair and inclusive manner, thus facilitating their acceptance (adequate infrastructure and accessible technologies are key to this). Third, awareness-raising is required, along with adoption of stricter environmental rules, regulations and standards that mitigate the possible harmful effects of digitalization. Fourth, public and private investment must be mobilized to facilitate deployment of enabling technologies for the digital and green transition (Muench and others, 2022).

¹⁴ Unwanted, non-functioning electronic products that are nearing or at the end of their “useful lives”.

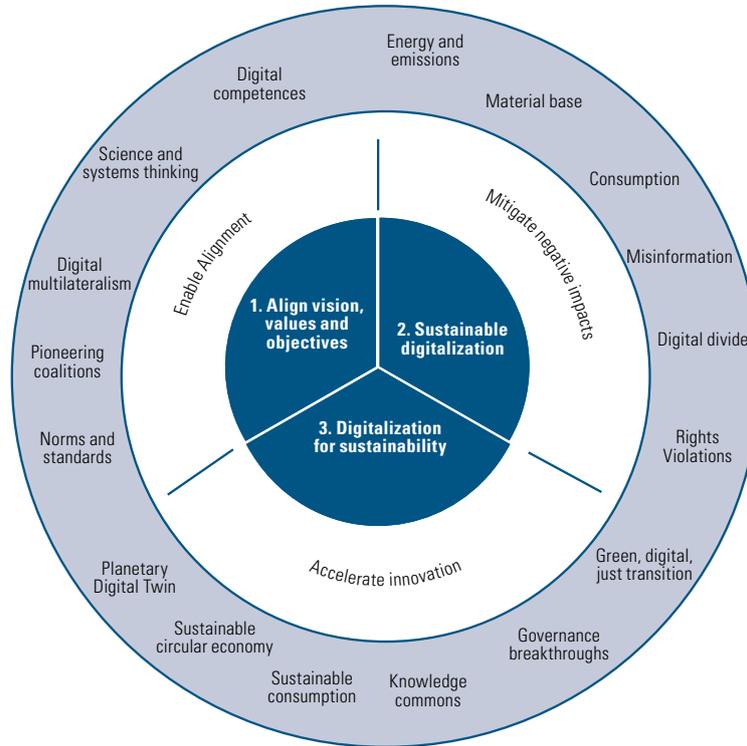
¹⁵ Other e-waste is deposited in landfills, often contaminating soil and water for farming, or is recycled informally, posing a contamination risk to workers.

¹⁶ In addition to the dedicated Recovery and Resilience Facility (RRF), with a budget of 750 billion euros, and national government plans to increase spending in the digital sphere, the European Commission has implemented the European Digital Agenda and the Horizon Europe Framework Programme for Research and Innovation, among others.

Among others,¹⁷ the Coalition for Digital Environmental Sustainability (CODES) is an interesting initiative that seeks to develop an effective action plan in this area (CODES, 2022).¹⁸ The action plan includes three Systemic Shifts (see diagram III.4).

Diagram III.4

Components and priorities of an action plan



Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of Coalition for Digital Environmental Sustainability (CODES), *Action Plan for a Sustainable Planet in the Digital Age*, 2022 [online] https://wedocs.unep.org/bitstream/handle/20.500.11822/38482/CODES_ActionPlan.pdf.

- **Align the vision, values and objectives of the digital age with environmentally and socially sustainable development.** To achieve this, there must be shifts in values and norms that drive a transition beyond profit towards positive social and environmental outcomes. This requires evolving to a new set of values focusing on transparency, accountability and inclusive stakeholder engagement. In addition, a shared set of sustainability values and standards must be encoded into the design, development and deployment of digital products, services, platforms and business models.
- **Mitigate the negative impacts and commit to sustainable digitalization.** Digitalization is encouraging unsustainable consumption, causing environmental impacts across supply chains, increasing demands on energy and resources, and entrenching and exacerbating social divides. Avoiding these undesirable effects requires action in problem areas for digitalization, such as energy and emissions, consumer behaviour, digital divides, misinformation and rights violations.
- **Advancing investment in digitalization for sustainability, to accelerate innovation.** Technology and innovation can help empower government, businesses, communities and individuals to make decisions and take action that can enable planetary sustainability and equitable human development. In this regard, digitalization can catalyse a green transition and sustainable development.

¹⁷ The European Green Digital Coalition (EGDC), supported by the European Commission and the European Parliament, brings together companies such as Telefónica, Deutsche Telekom, Ericsson, Nokia, Orange, Vodafone, Telenor and Telia with a commitment to facilitate the green digital transformation.

¹⁸ CODES founders and backers include the United Nations Environment Programme (UNEP), the United Nations Development Programme (UNDP), the International Science Council, the German Environment Agency, the Ministry of Environment and Forestry of Kenya, and the international network Future Earth and its Sustainability in the Digital Age initiative, which has more than 1,000 stakeholders from more than 100 countries.

These guidelines can steer governments in the search for complementarities and synergies between the digital and environmental agendas. They can also be referred to in order to evaluate the strengths and weaknesses of existing strategies in the two areas and the degree of coordination and alignment between them.

In short, digitalization affects the environment in different ways. The beneficial effects that contribute to accelerating the green transition and neutralizing environmental footprints are not automatic, and require purposeful actions by governments, businesses and civil society. Political will and strong institutions are key to implementing and coordinating public policies that contribute to changing consumption and production patterns, to pursue environmentally friendly digital development.

E. Boosting innovation at the local level: smart cities

Latin America and the Caribbean is a predominantly urban region. According to ECLAC, more than 82% of the region's population lives in urban areas, and 17% is concentrated in six cities with more than 10 million inhabitants. This reflects the importance for local governments of agendas that promote economic, social, environmental and technological development. Digital technologies offer great opportunities to address various challenges that cities face in terms of planning, administration and resource management. For this reason, moving towards smart cities is particularly important in the current agendas of local governments.

The region's cities do not lead international rankings of smart cities. However, looking beyond structural conditions, some of the cities have the necessary resources to undertake innovative technological projects in several areas, given their size and relative importance.

Implementation of IoT solutions is one of the technological trends marking the development of smart cities, as they use devices and sensors to enable data transfers, facilitate decision-making and automate processes and systems. It is estimated that by the end of 2020, there were more than 680 million IoT connections in Latin America and the Caribbean, and the figure is expected to rise to 1.2 billion by 2025. Another key technology adding to this trend is 5G mobile technology, which is just beginning to be deployed in the region, but is expected to see significant growth, reaching 35 million connected devices by the end of 2022 and 241 million connected devices by 2026.

These trends in connectivity and sensorization are mirrored in other advanced technologies, such as AI, cloud computing and blockchain, three areas that are part of the ongoing technological revolution. However, their adoption and use depend not only on technological processes, but also on governance and institutional models' capacity to facilitate their adoption and maximize their impact. Another condition that is important is the link with the private sector to enable synergies, learning and linkages to drive the digital transformation.

1. Advances in connectivity and opportunities for the deployment of advanced digital technologies

Cities can become important strategic actors in encouraging people to engage in the digital transformation and make it their own. Connectivity and infrastructure deployment are key to progressing towards what is known as a "smart city". Sensors, cloud computing and managing and handling large volumes of data enable greater connectivity of people and things, which facilitates public management. Cities that can gather and integrate data from many sources, which are then processed and transformed into information that facilitates decision-making, can mitigate, organize, anticipate or predict an endless variety of urban problems. Cities will also take the lead in the deployment of 5G networks that will enable the delivery of services such as telemedicine, automation and augmented reality.

In terms of connectivity, cities have made great strides: their indicators are above national averages and they have deployed their own networks (see figure III.3). In Buenos Aires and Mexico City, for example, household broadband penetration is over 100%. Cities are also moving forward with actions to reduce connectivity gaps. In Mexico City, a connectivity and telecommunications infrastructure centre has been launched to regulate the use of the related infrastructure and reduce inequalities in coverage across different areas of the city. Mexico City is also a leader in proprietary networks and public access points. In 2021, it was listed in the Guinness Book of World Records as the most connected city in the world, with nearly 21,500 free Internet access points (Cabello, 2022).

Table III.3

Buenos Aires, Mexico City, São Paulo and Bogotá: connectivity infrastructure, public and private networks, 2022

| | Buenos Aires | Mexico City | São Paulo | Bogotá |
|--|----------------------------------|----------------------|------------------|--------|
| | Private operator networks | | | |
| Access points per 100 households | 108 | 100 | 66 | 81 |
| Download speed (Megabits per second (Mbps)) | 73 | 65 | 203 | 70 |
| | Own networks | | | |
| Access points per km ² | 6 | 14 | 0.2 | 0.1 |
| Government headquarters and buildings | 28 access points | 13 714 access points | 32 access points | ... |

Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of S. Cabello, “El camino de desarrollo de las ciudades inteligentes: una evaluación de Bogotá, Buenos Aires, Ciudad de México y São Paulo”, *Project Documents* (LC/TS.2022/86), Santiago, ECLAC, 2022.

Despite this progress, cities are still facing significant challenges in boosting the deployment of infrastructure. These barriers relate to a variety of areas: administration, regulation, environment, health and technology. Administrative barriers can include obtaining permits for installing antennas and easements for extending fibre-optic networks. Local regulations often mean that obtaining permits is a burdensome and bureaucratic process. Progress towards integration and coordination among the different levels of government is therefore important for infrastructure deployment and for the harmonization of standards, norms and requirements.

There is growing interest in cities in implementing projects that use “smart” advanced technologies, although they are still in the earliest stages of adoption in the region (see table III.4). There are currently various initiatives that use artificial intelligence and the Internet of things to improve the management of traffic, health and safety, among others. However, most relevant are actions to deploy free Wi-Fi networks, digitize procedures for paperwork and improve transparency and openness in city management.

Table III.4

Buenos Aires, Mexico City, São Paulo and Bogotá: most-used advanced technologies, 2022

| | Buenos Aires | Bogotá | Mexico City | São Paulo |
|-------------------------|--------------|--------|-------------|-----------|
| Artificial intelligence | | | | |
| Blockchain | | | | |
| Biometrics | | | | |
| Measurement devices | | | | |
| Sensors | | | | |
| Georeferencing | | | | |

Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of S. Cabello, “El camino de desarrollo de las ciudades inteligentes: una evaluación de Bogotá, Buenos Aires, Ciudad de México y São Paulo”, *Project Documents* (LC/TS.2022/86), Santiago, ECLAC, 2022.

2. Institutional frameworks: an enabling condition for smart cities

Institutional maturity is key for the development of smart cities. It requires governance frameworks that are designed to promote the incorporation, use and management of technology by government institutions, companies and citizens. In order for this to be achieved, among other factors, an entity that can do the following is required to lead the process: (i) manage policies, standards and regulations; (ii) provide ongoing training to civil servants, so that they remain up-to-date on the latest technology, get the most out of technology trends and are able to implement them in a timely manner; (iii) coordinate with national digital policies in order to harmonize procedures; (iv) encourage the private sector to become an ally in developing solutions and (v) remain in constant contact with citizens and the private sector, through consultation, participation and cooperation mechanisms (Cabello, 2022).

Digital institutional frameworks have advanced in some cities in the region. In Buenos Aires, São Paulo, Mexico City and Bogotá, there is a one-stop agency or body that leads, designs and controls the implementation of technology solutions, defining the guidelines that orient development and monitoring. Among other features in common, these cities all have a smart city development policy, and, to a greater or lesser degree, all promote digital fluency for civil servants and citizen coordination mechanisms. Coordination with the national digital agenda and work with the private sector need to be strengthened (see table III.5).

Table III.5

Buenos Aires, Mexico City, São Paulo and Bogotá: digital institutional frameworks, 2022

| How cities manage digital innovation | Buenos Aires | Bogotá | Mexico City | São Paulo |
|--|--------------|--------|-------------|-----------|
| Authorities in charge of digital policy and innovation | | | | |
| Smart city development policies | | | | |
| Promoting civil servants' digital capacity | | | | |
| Coordination with the national agenda | | | | |
| Coordination with the private sector (government technology initiatives) | | | | |
| Coordination with citizens | | | | |

| | |
|-----|--|
| Yes | |
| No | |

Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of S. Cabello, "El camino de desarrollo de las ciudades inteligentes: una evaluación de Bogotá, Buenos Aires, Ciudad de México y São Paulo", *Project Documents* (LC/TS.2022/86), Santiago, ECLAC, 2022.

Note: Although Buenos Aires has a smart city policy, it is not acknowledged by all relevant institutions. In São Paulo, promoting digital capacity is not a priority, nor is it monitored; coordination with citizens is limited.

To become smart, cities need a strategic plan that aligns with their development goals and is not simply based on implementing isolated technologies. Similarly, a systemic approach to project execution is key (with clearly defined decisions, milestones and responsibilities), as this enables optimized project execution and ensures that projects are aligned with the city's goals. In Buenos Aires, São Paulo, Mexico City and Bogotá, there are normative frameworks that assign concrete tasks to the different departments of digital and innovation agencies, although there is no standardized template for project execution.

The main institutional challenges that cities face relate to budgets and to innovative projects being given low priority because of the risk they entail. The regulatory barriers relate to standards that have not been updated and to the lack of guidelines for innovation. There are also deficits in building the technical capacity of civil servants and in the governance models for project implementation. Lastly, obstacles also arise in transitions from one management approach to another when a new government is elected, mainly because processes are not systematized, which leads to a loss of institutional memory and knowledge.

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CHAPTER

IV

Agendas, institutional framework and new partnerships for the digital transformation

- A. Tools to address the challenges of the digital age
 - B. Towards greater digital integration and cooperation
- Bibliography

The rapid technological progress brought about by digitalization poses enormous challenges for the design of agendas and policies, and also for developing the corresponding institutional framework. To speed up technological adoption and innovation processes, on the one hand, and to address the disruptions caused in certain markets by the emergence of new products and business models, on the other, laws, rules and regulations must be dynamically updated to manage the digital transformation effectively. Digital policy affects various domains, including telecommunications regulation, security, privacy and personal data protection, antitrust, labour rights protection and taxation.

Digital technologies have enormous potential to improve the performance and efficiency of the economy, and to meet citizens' needs. Accordingly, the policy challenges relate to the ability to articulate a common strategic vision that makes it possible to adapt positively to technological change, while coordinating different entities and government bodies, to generate synergies and develop tools that foster technological development and innovation. These challenges must be taken into account in the institutional design of digital plans and strategies, along with other elements, such as the hierarchical level of the agency in charge of leading this process, the ability to implement sectoral measures, the existence of monitoring and measurement mechanisms, and the allocation of resources for their implementation.

A. Tools to address the challenges of the digital age

1. Digital agendas as an organizing element

In general, implementing comprehensive national agendas and maintaining them through time, have proven to be crucial for promoting the dissemination, use and adoption of digital technologies. These instruments have been supplemented by sector-level plans to promote the adoption of digital technologies in various areas such as education, health, government and agriculture. Similarly, at the provincial, state or municipal level, digital strategies have been adopted to address multiple challenges, related to mobility, the environment and security, among other issues.

National digital agendas have been adopted increasingly around the world in recent years. Between 2014 and 2020, the proportion of countries reporting that they had information and communications technology (ICT) plans and policies in place increased from 23% to 60% (see figure IV.1). A large number of Latin American and Caribbean countries have already adopted digital agendas. In 2022, 12 of the 16 countries surveyed¹ reported that they had a digital agenda that was either being implemented or updated, while the remaining four were in the process of designing their respective agendas (see figure IV.2).

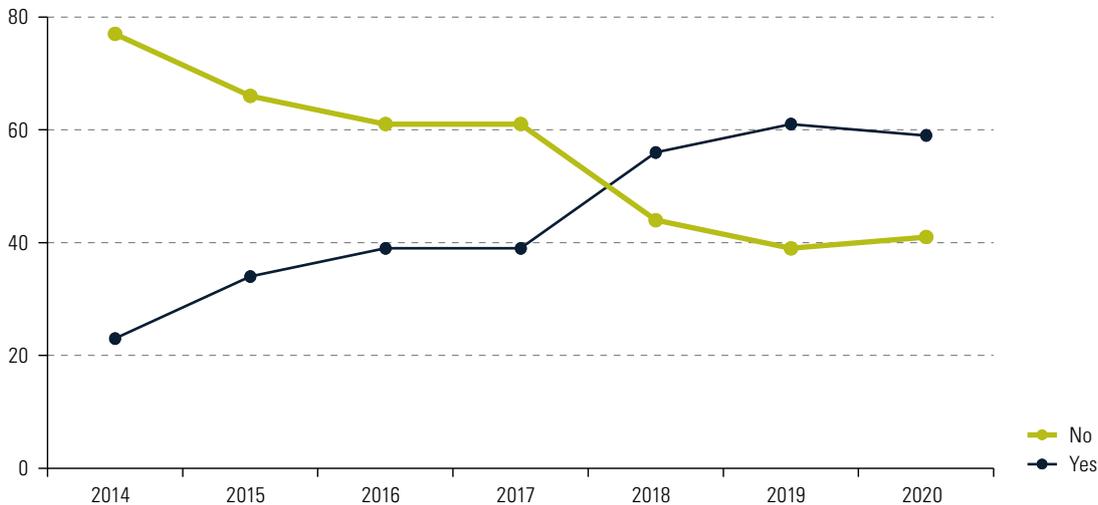
Since the late 1990s and early years of the 2000 decade, the adoption of digital plans and agendas in the region has accumulated a lengthy learning and maturation process. Since then, several governments have adopted national digital agendas and plans, including Uruguay, which has managed to give continuity such actions with an agenda that is already in its fourth version. Several countries also have digital agendas with a time horizon stretching beyond 2022. Examples include the Dominican Republic, with the Digital Agenda 2030; El Salvador, with the National Digital Agenda 2020–2030; and Uruguay, with the Uruguay Digital Agenda 2025.

A review of the topics and policy measures contained in the national digital agendas confirms the continuing importance of issues related to infrastructure and access, e-government, digital skills and cybersecurity. It also reveals that less importance is given to production issues, such as promotion of the ICT industry, entrepreneurship and e-commerce, and the digital transformation of small and medium-sized enterprises (SMEs). In this context, the region is facing the challenge of advancing the formulation and implementation of more complex digital agendas that address challenges related to greater use and adoption of these technologies, linked mainly to productivity, competitiveness and innovation issues.

¹ Between June and August 2022, the Economic Commission for Latin America and the Caribbean (ECLAC) conducted a survey among government representatives and agencies responsible for digital policy in the region. The following 16 countries responded to the survey: Argentina, Barbados, Belize, Brazil, Chile, Costa Rica, Cuba, the Dominican Republic, Ecuador, Grenada, Guatemala, Honduras, Mexico, Nicaragua, Panama and Uruguay.

Figure IV.1

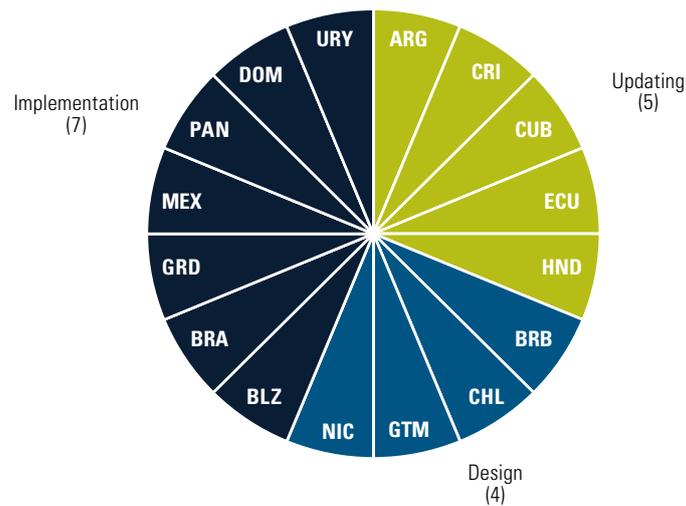
Existence of a national policy or master plan for information and communications technology (ICT) in 129 countries of the world
(Percentages)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of International Telecommunication Union (ITU), “Digital strategies and broadband plans”, Data Hub [online] <https://datahub.itu.int/data/?i=100053>.

Figure IV.2

Latin America and the Caribbean (16 countries): status of the national digital agenda, 2022



Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of a survey of government representatives and agencies in charge of digital policy conducted in June–August 2022.

In the countries of Latin America and the Caribbean, the institutional framework of the agencies tasked with leading the digital agenda varies widely. In some cases, there are ministries specialized in ICTs, telecommunications or science and technology, while in other countries second-tier entities have been created to lead these strategies, generally attached to the office of the president. There are also countries, especially in the Caribbean, in which sector ministries in the areas of economy, trade, industry or public administration

lead the agenda. Although institutional design is not governed by a single criterion, it is clear that the countries that have succeeded in giving continuity to policies of this type and achieve better results are also those with more mature institutions (ECLAC, 2021a).

The cross-cutting nature of digital technologies means they have an impact on various sectors and are therefore linked to different areas of government. The institutional design of the digital policy must recognize this reality, so intergovernmental coordination mechanisms are needed that facilitate the specification of actions in different areas, such as telecommunications, defence of competition, consumer protection, data protection and cybersecurity. Sectoral agencies also have a key role to play in the digital transformation, in areas such as health, education and productive development. These challenges require a comprehensive view of policy and the definition of strategies that make it possible to coordinate different endeavours, objectives and tools.

The institutional maturity of the digital agenda can be assessed by considering issues related to the hierarchical level of the organization tasked with leading these processes, the capacity to convene other stakeholders in policy design, the availability of specific agencies to implement the digital policy, and the existence of clearly defined coordination mechanisms and spaces. The mechanisms through which measures targeting social and productive areas are incorporated can also be considered. The most advanced agendas have been structured as a general framework through which plans in specific areas or sectors are marshalled, rather than existing only as isolated measures. This affords a greater level of detail in the actions, while simultaneously establishing the responsibilities of the relevant agencies in each area. Lastly, the agenda should also be analysed in relation to measurement and multisectoral coordination mechanisms, and the inclusion of an explicit budget (see table IV.1 below).

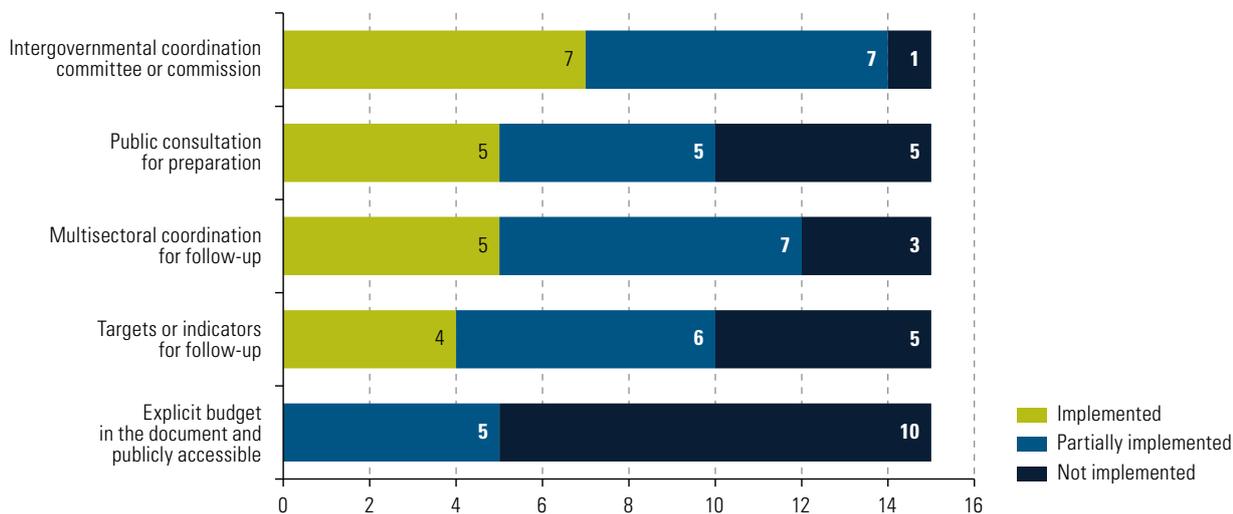
Table IV.1
Institutional considerations in the digital agenda

| Degree of maturity | High | Medium |
|---|---|----------------------------------|
| Institutional factors | | |
| Institutional hierarchy of the entity responsible for formulation and follow-up | First tier | Second or third tier |
| Public consultation or participation in its preparation | High or medium | No |
| Intergovernmental coordination committee or commission | Exists formally | No |
| Areas of intervention | | |
| Sectoral measures (for example, agriculture, commerce or industry) | Sectoral agendas or strategies | Definition of sector initiatives |
| Attention to social areas (for example, health or education) | Sectoral agendas or strategies | Definition of sector initiatives |
| Enabling and regulatory environment | Definition of regulatory reforms | No |
| Implementation | | |
| Definition of indicators to evaluate fulfilment of objectives | Goals, indicators and follow-up mechanisms | No |
| Multisectoral coordination for follow-up and implementation | Committee or commission with private stakeholders | No |
| Explicit budget aligned with objectives and targets | Included in the agenda | No |

Source: Economic Commission for Latin America and the Caribbean (ECLAC).

According to the survey conducted by the Economic Commission for Latin America and the Caribbean (ECLAC), nearly half of the countries indicated that they have digital agendas with intergovernmental coordination committees or commissions. In contrast, only one third of the countries stated that they hold a public consultation to prepare the agenda and have some kind of multisectoral coordination mechanism for follow-up. Lastly, only four countries define targets or indicators in the plan, and no country reports having a budget for the agenda (see figure IV.3). This reveals the pending challenges that need to be addressed in order to enhance the consistency of this type of initiative.

Figure IV.3

Latin America and the Caribbean (15 countries):^a institutional characteristics of the national digital agenda, 2022

Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of a survey of government representatives and agencies in charge of digital policy conducted in June-August 2022.

Note: The figure only includes countries that responded to the respective questions.

^a Argentina, Belize, Brazil, Chile, Costa Rica, Cuba, the Dominican Republic, Ecuador, Grenada, Guatemala, Honduras, Mexico, Nicaragua, Panama and Uruguay.

2. Emerging issues for a new generation of digital agendas

(a) Prioritization of strategic areas: sectoral digital agendas

Today more than ever, Latin America and the Caribbean needs an economic transformation. The region suffers from a poorly diversified production structure, low productivity and high levels of informality. These structural characteristics weaken the dynamics of growth and job creation. In this context, harnessing technological change is key to boosting productive development.

Digital technologies can play a key role in speeding up productive restructuring and help to reduce the environmental impact of this process. Advanced technologies, such as artificial intelligence, sensorization, big data analytics and robotization, are revolutionizing industrial processes, goods manufacturing and the provision of services in all sectors. These advances can be observed in areas such as manufacturing industry (advanced manufacturing, Industry 4.0), and also in sectors such as health (emotional technology, care technology, monitoring and telemedicine applications), energy (optimization of energy purchase and sale processes) or agriculture (precision irrigation, big data analytics for climate information) (ECLAC, 2021a).

In this context, the potential of digital technologies to transform and add value to all sectors of the economy must be harnessed and promoted. However, according to the ECLAC survey, the establishment of sector strategies in areas such as e-commerce, health, manufacturing and agriculture is still incipient (see table IV.2). Promoting this type of policy in strategic areas is essential to facilitate value creation in lagging sectors, and to enable them to integrate with others of greater technological content.

Notwithstanding the challenges, some progress has also been made in the design of digital agendas at the sector level. For example, Brazil has a specific agenda in the area of digital agriculture and has also set up an Agriculture 4.0 Chamber. In the case of industry, Colombia runs entrepreneurship, innovation and business productivity programs through its entrepreneurship and innovation agency, iNNpulsa. Other interesting experiences in the industry domain include Brazil's National Plan for the Internet of Things, Colombia's Centre for the Fourth Industrial Revolution and Uruguay's Montevideo Digital Manufacturing Laboratory (FabLab-MVD) (ECLAC, 2021).

Table IV.2

Latin America and the Caribbean (14 countries): adoption of sectoral digital agendas, 2022

| Country | E-government | Connectivity (broadband) | Education | E-commerce | Health | Artificial intelligence | Agriculture | Industry |
|-------------------------|--------------|--------------------------|-----------|------------|--------|-------------------------|-------------|----------|
| Dominican Republic | | | | | | | | |
| Uruguay | | | | | | | | |
| Chile | | | | | | | | |
| Brazil | | | | | | | | |
| Argentina | | | | | | | | |
| Grenada | | | | | | | | |
| Belize | | | | | | | | |
| Honduras | | | | | | | | |
| Ecuador | | | | | | | | |
| Panama | | | | | | | | |
| Nicaragua | | | | | | | | |
| Guatemala | | | | | | | | |
| Costa Rica | | | | | | | | |
| Barbados | | | | | | | | |
| No agenda or strategy | | | | | | | | |
| In design phase | | | | | | | | |
| In update phase | | | | | | | | |
| In implementation phase | | | | | | | | |

Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of a survey of government representatives and agencies in charge of digital policy conducted in June-August 2022

Note: The figure only includes countries that responded to the corresponding questions.

(b) Emerging technologies for the productive sector

The adoption of technologies opens up great opportunities for the countries of Latin America and the Caribbean. Although they are still lagging behind in this area, some of the region's traditional sectors, such as agriculture and manufacturing, are embarked on rapid and profound restructuring processes as a result of the incorporation of advanced technologies, such as sensorization, robotization and automation. The classification of economies by the United Nations Industrial Development Organization (UNIDO), according to their level of adoption of advanced digital production technologies, shows that most countries in the region are laggards in terms of industrialization. In fact, only four countries (Argentina, Brazil, Colombia and México) are at a "follower" level, and none qualifies as a "frontrunner" country (UNIDO, 2019).

Recently, several countries in the region have started to target their digital agendas towards specific programmes to boost the adoption of emerging technologies (artificial intelligence, blockchain, Internet of things and advanced robotics) in prioritized production sectors. The Uruguay Digital Agenda has objectives that include the digital transformation of production sectors, promotion of Industry 4.0, digital technology solutions for the agriculture sector, and the establishment of a digital manufacturing laboratory. In Brazil, the E-Digital strategy establishes a National Internet of Things Plan and the creation of a chamber that brings together public organizations that promote the development of solutions based on this technology. It also focuses actions in four specific areas: health, agriculture, manufacturing and smart cities. In Colombia, the ICT Plan 2018-2022 supports projects aimed at the use of the Internet of things, artificial intelligence and blockchain in digital business transformation processes. Lastly, the Argentina 4.0 Productive Development Plan promotes investment in advanced technological solutions in local firms.

Despite the difficulty of evaluating these initiatives comprehensively, it is possible to draw some conclusions and recommendations from them. As noted above, it is important to adopt a systemic approach and to have adequate policy coordination, since the dissemination of digital technologies requires the participation of multiple actors and flexible management. This allows for the development of a favourable ecosystem with the necessary enabling elements: infrastructure and connectivity, regulation, and the development of skills and competencies.

On the other hand, many companies are unaware of the value of advanced digital technologies and the specific solutions that could benefit them in this area. It is therefore important to continue to raise their awareness of the potential of digital transformation. Similarly, to improve access to advanced digital technologies and their adoption, governments and the private sector should work together to expand the ecosystem dedicated to developing solutions. This requires strengthening the instruments for promoting technology-based entrepreneurship, so that they act as catalysts for innovation and the generation of cooperation networks. Lastly, when designing programs of this type, the heterogeneity of the entrepreneurial universe should be considered, in terms of size, sectoral specialization, technological capacity and territorial location (Grosman and others, 2021).

(c) The digital transformation of smaller firms

Micro, small and medium-sized enterprises (MSMEs) are a fundamental component of the production fabric in Latin America and the Caribbean, accounting for 99.5% of all firms and generating nearly 60% of employment. However, they only contribute 25% of output (Heredia, 2020). There are several reasons for this situation: (i) structural heterogeneity and productivity gaps between different firm sizes; (ii) the fact that MSMEs frequently specialize in activities of scant value-added (linked to the previous point); and (iii) large productivity differences between sectors, which reflect disparities in capacities and the incorporation of technical progress (Dini and Stumpo, 2020).

In this context, digital technologies can provide a great opportunity for smaller firms to improve many of their activities and operations. For example, these technologies afford greater visibility; and they increase access to information, reduce traditional barriers to trade, facilitate financial transactions, improve performance and management, and facilitate the development of new products and services. They also help firms improve their capacity to respond to changes in the environment.

This background reinforces the importance of promoting the adoption of digital technologies, especially when this process has not been homogeneous among firms of different sizes. The available information shows that smaller firms make less sophisticated use of these technologies, a tendency that is accentuated as the complexity of the digital solutions and applications used increases. In short, the smaller the firm, the lower the intensity of use of digital tools (Dini, Gligo and Patiño, 2021).

There are four main factors that affect technology adoption by firms: (i) factors related to the characteristics of the firm (size, human capital, sector of activity and technological background); (ii) factors related to the use of and access to technology, investment costs and the availability of solutions; (iii) factors related to the environment (legal and regulatory framework, external support and competitive pressure); and (iv) factors related to the economic context in which the company operates (Consoli, 2012).

In recent years, several countries in the region have made progress, albeit with nuances, in designing digitalization policies for MSMEs. Many of the existing programmes are relatively new and still evolving (see table IV.3). The coronavirus disease (COVID-19) pandemic served to highlight the importance of these instruments and boosted business digitalization and e-commerce policies (Heredia, 2020). Basically, the instruments that exist for promoting digital technologies in MSMEs can be grouped into initiatives on awareness and business culture, support services and financing. The countries that are further advanced in the design of these policies have initiatives in all of these areas.

Table IV.3

Latin America (10 countries): instruments for the adoption of digital technologies in smaller firms, 2022

| Tipo de instrumento | | ARG | BRA | CHL | COL | CRI | ECU | SLV | MEX | PER | URY |
|---------------------------------|--------------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Awareness and corporate culture | Events | | | | | | | | | | |
| | Observatories | | | | | | | | | | |
| | Specialized websites | | | | | | | | | | |
| | Awards | | | | | | | | | | |
| Support services | Support and training services | | | | | | | | | | |
| | Mentoring networks | | | | | | | | | | |
| | Access to technological solutions | | | | | | | | | | |
| | Simplification of procedures | | | | | | | | | | |
| Financing | Integrated services | | | | | | | | | | |
| | Research, development and innovation | | | | | | | | | | |
| | Entrepreneurship | | | | | | | | | | |
| In operation | | | | | | | | | | | |
| Under development | | | | | | | | | | | |
| Not implemented | | | | | | | | | | | |

Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of M. Dini, N. Gligo and A. Patiño, "Transformación digital de las mipymes: elementos para el diseño de políticas", *Project Documents* (LC/TS.2021/99), Santiago, ECLAC, 2021

Note: The analysis was based on public sources and qualitative information.

In the region, digitalization initiatives for smaller firms exist that have multiple tools. One example is Chile's *Digitaliza tu Pyme* SME digitalization program, which supports the digital transformation process by offering a wide range of services, training and tools, as well as a mentoring network. The services offered by the program include: *Ruta Digital*, an online training platform; *Chequeo Digital*, a virtual tool that makes it possible to ascertain the level of digital maturity of the firm; *Pymes en Línea*, a mechanism that provides users with free training content for selling over the Internet, and *Arriba tu Pyme*, a catalogue of benefits of collaborative partnerships. Brazil also has a variety of instruments of this type, delivered through the Brazilian Micro and Small Business Support Service (SEBRAE) and the Brazilian Agency for Industrial Research and Innovation (EMBRAPII). Within this framework, firms can access technological and innovation services of various kinds, such as technological consulting, certifications, prototyping and audits (Dini, Gligo and Patiño, 2021).

(d) Strengthening online security

Insofar as the COVID-19 pandemic hastened digitalization processes, it also heightened the risks associated with online activities. For this reason, it is crucial to strengthen trust in digital media by making cybersecurity a central element of the digital policy. In recent years, the governments of Latin America and the Caribbean have taken significant steps to improve cybersecurity. In 2020, 13 of the 33 countries in the region had a cybersecurity strategy, whereas in 2015 only six governments had made progress in this area. Moreover, the number of countries that were signatory to the Council of Europe Convention on Cybercrime² increased from two to eight over the same period.³ Also, in 2020, 19 of the region's countries formed a cybersecurity incident response team, which demonstrates the relevance of this topic (Lehuedé, 2020).

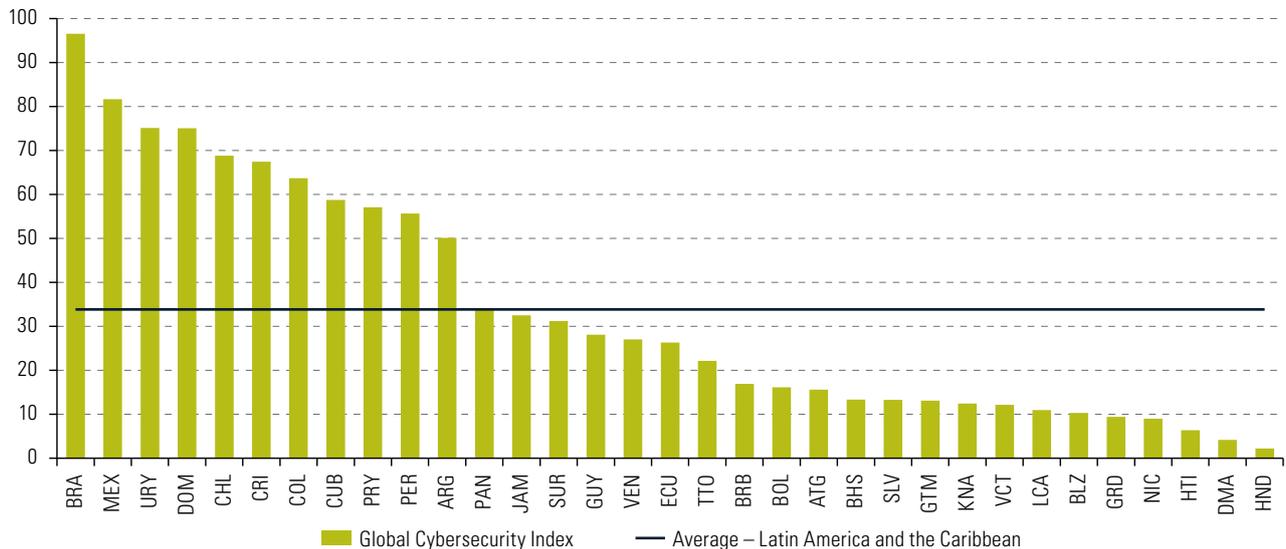
² The Convention on Cybercrime is a 2001 international treaty promoted by the Council of Europe, with the aim of increasing international cooperation and generating harmonized legal frameworks among nations to deal with cybercrime and criminal activity on the Internet.

³ Argentina, Chile, Colombia, Costa Rica, the Dominican Republic, Panama, Paraguay and Peru are the Latin American countries that have signed the Convention on Cybercrime, while Brazil, Ecuador, Guatemala and Mexico have observer status.

Despite progress in this domain, there are still major challenges in several areas and great heterogeneity between countries. The Global Cybersecurity Index of the International Telecommunication Union (ITU)⁴ reveals some of these differences. Brazil leads the ranking, followed by Mexico, Uruguay and the Dominican Republic. In contrast, several countries, mainly in Central America and the Caribbean, are below the regional average (see figure IV.4). According to the five pillars of the Global Cybersecurity Index, Latin America and the Caribbean has the greatest weaknesses in areas related to organization and capacity-building. These challenges are compounded by the adoption of new legal frameworks and their updating, as well as issues related to the technical and organizational capacity of the teams tasked with implementing cybersecurity strategies.

Figure IV.4

Latin America and the Caribbean (33 countries): Global Cybersecurity Index, 2020



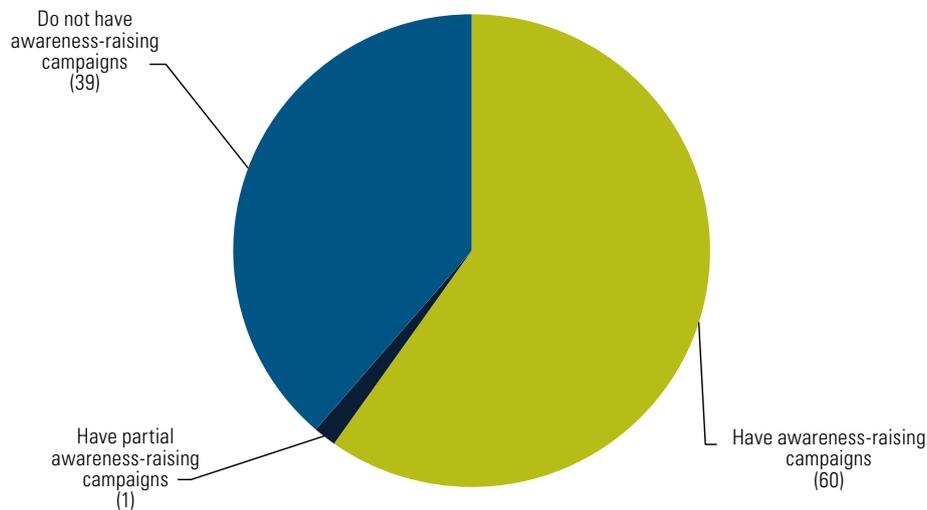
Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of International Telecommunication Union (ITU), Global Cybersecurity Index 2020, Geneva, 2021 [online] https://www.itu.int/dms_pub/itu-d/opb/str/D-STR-GCI.01-2021-PDF-E.pdf.

One of the key issues is the need to improve cybersecurity requirements in the private sector. The COVID-19 pandemic accelerated the digitalization of firms, especially MSMEs, which started using digital channels to keep operating in the context of physical distancing measures. However, smaller firms are often at a disadvantage when it comes to addressing cybersecurity challenges. This highlights the need for improved awareness and training activities on these issues targeting this group of enterprises. In 2020, the results of the Global Cybersecurity Index showed that around 60% of countries were concerned, or had been concerned in recent years, with improving cybersecurity awareness among smaller businesses, private sector firms or government agencies (see figure IV.5).

⁴ One of the objectives of the Global Cybersecurity Index is to measure the type, level and evolution of cybersecurity commitment in countries over time. It consists of five pillars: (i) legal measures; (ii) technical tools to defend against cyberattacks (including computer incident response teams); (iii) organizational measures (national institutions to ensure cybersecurity); (iv) a capacity building framework for certification (related to scientific activities); and (v) cooperation to address cybercrime.

Figure IV.5

Number of countries with cybersecurity awareness campaigns targeting small businesses, the private sector and government agencies, 2020
(Percentages)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of International Telecommunication Union (ITU), *Global Cybersecurity Index 2020*, Geneva, 2021 [online] https://www.itu.int/dms_pub/itu-d/opb/str/D-STR-GCI.01-2021-PDF-E.pdf.

B. Towards greater digital integration and cooperation

1. Critical factors for driving regional integration in the digital age

In 2021, international trade in Latin America and the Caribbean rebounded after collapsing in 2020 as a result of the COVID-19 pandemic. However, the recovery has been asymmetric and heterogeneous among the countries of the region; and export growth in 2021 was driven mainly by higher commodity prices. This highlights the need to promote a regional economic integration agenda that will enable progress towards a more integrated market that fosters processes that diversify production towards goods with a higher technological content and modern services (ECLAC, 2021a).

The weakening of intra-regional trade coincides with the region's limited capacity to integrate into global value chains. Nonetheless, the region has a number of characteristics that could alter this trend. The composition of trade flows in the main integration blocs (Southern Common Market (MERCOSUR), the Andean Community, the Pacific Alliance and the Central American Common Market (CACM)) is more diversified (low- and medium-tech manufacturing sectors) than trade flows involving countries outside the region. Moreover, microenterprise exporters participate more in intraregional than in extraregional trade (ECLAC, 2021a).

A major benefit of regional economic integration, besides tariff liberalization, is the establishment of trade and investment rules. Compared to the situation prevailing in the middle of the 2010 decade, all integration groupings are now making headway in establishing regulatory frameworks on issues such as trade facilitation, public procurement, the treatment of foreign investment and electronic commerce (see table IV.4). In addition, several integration blocs have been promoting the design of digital agendas for a number of years. Examples include the Pacific Alliance's Roadmap for the Regional Digital Market, the MERCOSUR Digital Agenda Action Plan and the Andean Community's Andean Digital Agenda.

Table IV.4

Latin America and the Caribbean: progress on selected issues in the main economic integration mechanisms, 2022

| Topic | Andean Community | Central American Common Market (CACM) | Southern Common Market (MERCOSUR) | Caribbean Community (CARICOM) | Pacific Alliance |
|--|------------------|---------------------------------------|-----------------------------------|-------------------------------|------------------|
| Degree of liberalization of goods trade | Very high | Very high | Alto | Very high | Very high |
| Regulatory framework for service trade | Yes | Yes | Yes | Yes | Yes |
| Regulatory framework for foreign investment | Yes | Yes | Yes ^a | Yes | Yes |
| Regulatory framework for trade facilitation | Yes | Yes | Yes | Yes | Yes |
| Harmonization or mutual recognition of technical standards | Yes | Yes | Yes | Yes | Yes |
| Regulatory framework for e-commerce | No | Yes | Yes | Under negotiation | Yes |
| Digital agenda | Yes | No | Yes | Yes | Yes |

Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of ECLAC, *International Trade Outlook for Latin America and the Caribbean, 2020* (LC/PUB.2020/21-P), Santiago, 2021.

^a Intra-MERCOSUR investment cooperation and facilitation protocol (in force between Brazil and Uruguay only).

A review of the thematic content of the digital agendas of the different integration blocs reveals coincidences in different areas, such as the deployment of networks, innovation and entrepreneurship, digitalization of MSMEs and emerging technologies. The Pacific Alliance's regional digital market road map places greater emphasis on issues related to infrastructure and connectivity, the digital economy and new technologies and e-commerce. The Andean Community's agenda includes a larger number of issues related to skills, talent and e-government. New issues related to technological development are also becoming increasingly important, including cross-border flows of trade and data.

(a) Cross-border e-commerce

As a result of the mobility restrictions and physical distancing measures put in place to confront the COVID-19 pandemic, e-commerce expanded vigorously worldwide. Latin American and Caribbean countries were no exception, as is confirmed by the results of the main e-commerce platforms operating in the region. For example, according to Mercado Libre, between February and May 2020, new buyers increased by 40% in Argentina, 28% in Brazil and 11% in Uruguay relative to the year-earlier period (Dini, Gligo and Patiño, 2020; ECLAC, 2021a).

Cross-border e-commerce, which performed differently during the pandemic, contracted by an estimated 25% in 2020, owing mainly to a correlation with international trade and the reduction in passenger flights, which resulted in less cargo capacity and delayed delivery times, compounded by other logistical problems. In 2021, as restrictions were eased and these difficulties were resolved, cross-border e-commerce growth resumed, with an increase of 41%, even outpacing that recorded by national e-commerce (EBANX, 2022) (see figure IV.6).

The region still has ample room to expand cross-border e-commerce activities, since it accounts for just 11% of the total. This figure coincides with traffic trends in terms of visits to e-commerce sites, which show that close to 90% of traffic is concentrated in nationally focused websites. As the regional market matures, the volume of cross-border e-commerce can be expected to grow as well. Some estimates suggest growth rates of nearly 40% by 2025 (EBANX, 2022).

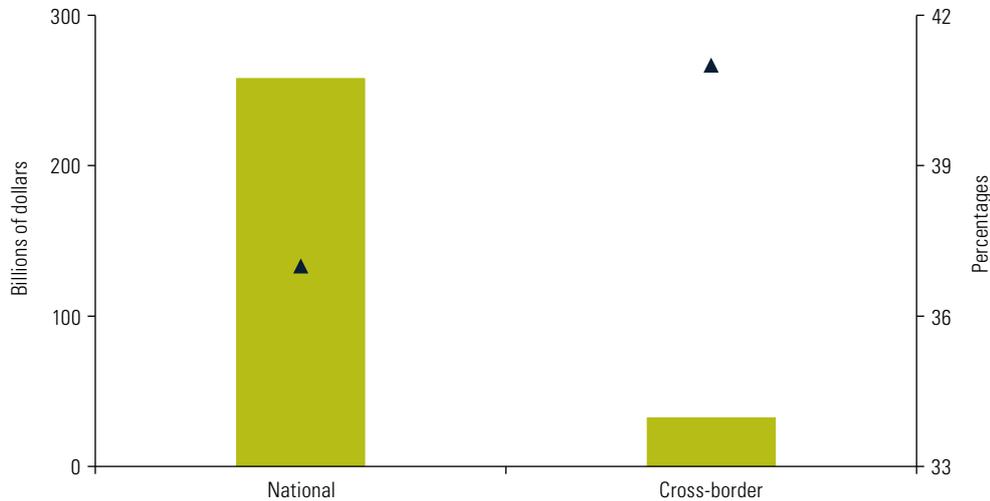
Prominent in cross-border e-commerce are digital products (online games, music, streaming services and others) and travel (airline and bus tickets, hotel and accommodation and other services). These digital products are estimated to account for about 53% of cross-border e-commerce (see figure IV.6).

Figure IV.6

Latin America (15 countries): domestic and cross-border e-commerce, 2021

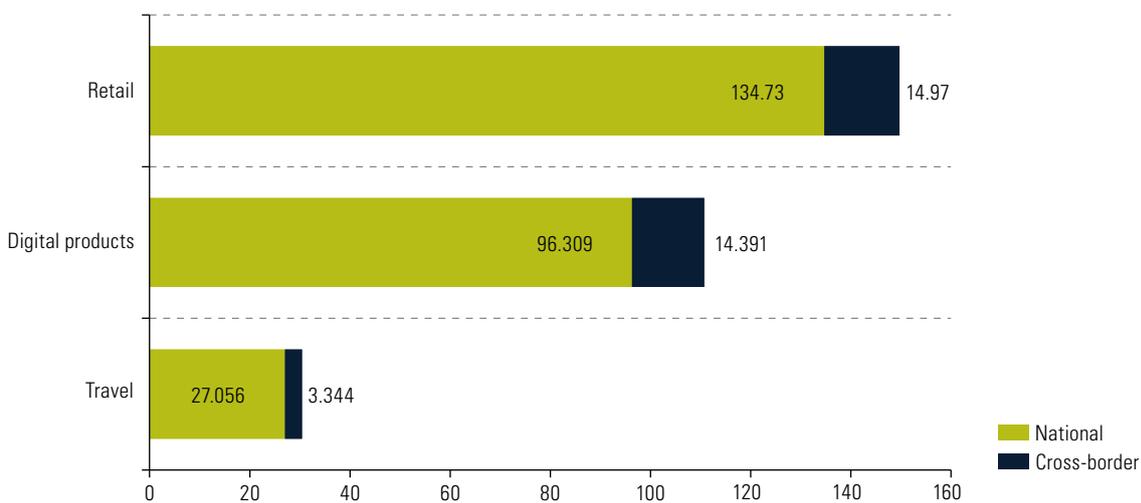
A. Total value and growth rate

(Billions of dollars and percentages)



B. Total value in vertical markets

(Billions of dollars)



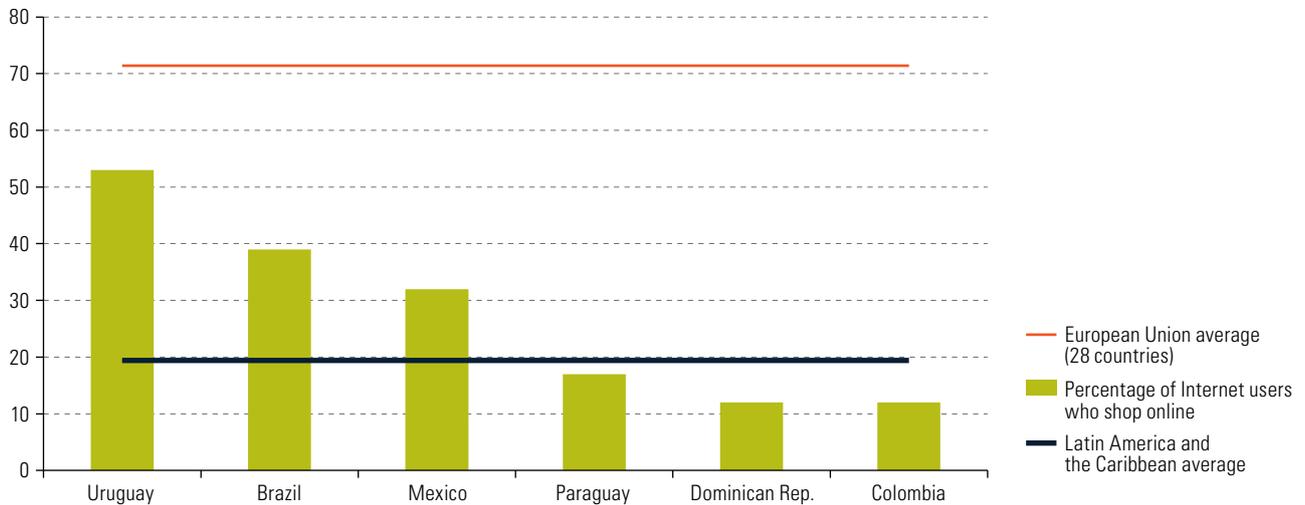
Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of EBANX, *Beyond Borders 2021/2022: How digital payments and e-commerce are gaining traction in Latin America, 2022* [online] <https://business.ebanx.com/hubfs/EBANX-Beyond-Borders-2021.pdf?hsCtaTracking=19f7c7df-10ea-469a-994e-127eec84c12a%7Cf8f27894-5e13-491c-ad93-94e462e0e268>.

Note: E-commerce encompasses all online purchases of goods and services, irrespective of the device or payment method used.

Owing to the linguistic and cultural similarities that exist between Latin American and Caribbean countries, cross-border e-commerce has great potential. In fact, empirical data show that cultural differences have become one of the main barriers to online commerce (Martens, 2013). The region represents a potential market of over 600 million people and an Internet penetration rate of 70%. However, only 20% of Internet users make purchases online, compared with 71% in the European Union (see figure IV.7). Among the main policy challenges that could have an impact on improving the dynamics of cross-border e-commerce are the penetration of electronic means of payment and the improvement of logistics and parcel delivery services. (UNCTAD, 2021b).

Figure IV.7

Latin America and the Caribbean (selected countries) and Europe (28 countries):
Internet users who shop online, 2019
(Percentages of Internet users)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of United Nations Conference on Trade and Development (UNCTAD), *The UNCTAD B2C E-commerce Index 2020: Spotlight on Latin America and the Caribbean*, UNCTAD Technical Notes on ICT for Development No. 17, 2021 [online] https://unctad.org/system/files/official-document/tn_unctad_ict4d17_en.pdf.

Note: Data for Colombia refer to 2018.

The countries of Latin America and the Caribbean regulate digital trade to different degrees. According to the Digital Services Trade Restrictiveness Index prepared by the Organisation for Economic Co-operation and Development (OECD),⁵ regulations in Argentina, Brazil and Colombia are much tighter than the regional average, while those of Costa Rica and Mexico are considerably less restrictive (see figure IV.8).

Similarly, the Digital Trade Restrictiveness Index (DTRI), developed by the European Centre for International Political Economy (ECIPE) (Ferracane, Lee-Makiyama and Van der Marel, 2018),⁶ establishes that Argentina and Brazil are the countries with the highest level of fiscal and trade restrictions linked to digital trade, mainly discriminatory measures in respect of ICT goods that have been implemented as part of deliberate productive development and international integration strategies. Nonetheless, according to this index, the countries of the region are better placed in terms of measures involving regulations on cross-border data flow and investments in technology sectors (Díaz de Astarloa, 2021; Ferracane, Lee-Makiyama and Van der Marel, 2018).

Tighter restrictions on digital trade could impose higher transaction costs on the supply and demand of digital goods and services. Moreover, differences between the regulatory frameworks that govern digital trade heighten uncertainty and sow distrust in online transactions. This generates higher costs for firms, which have to adapt their processes to each country's specific framework. On the other hand, the elimination of cross-border barriers provides incentives to exploit the scale advantages of a larger market, which has positive repercussions on investment and business development.

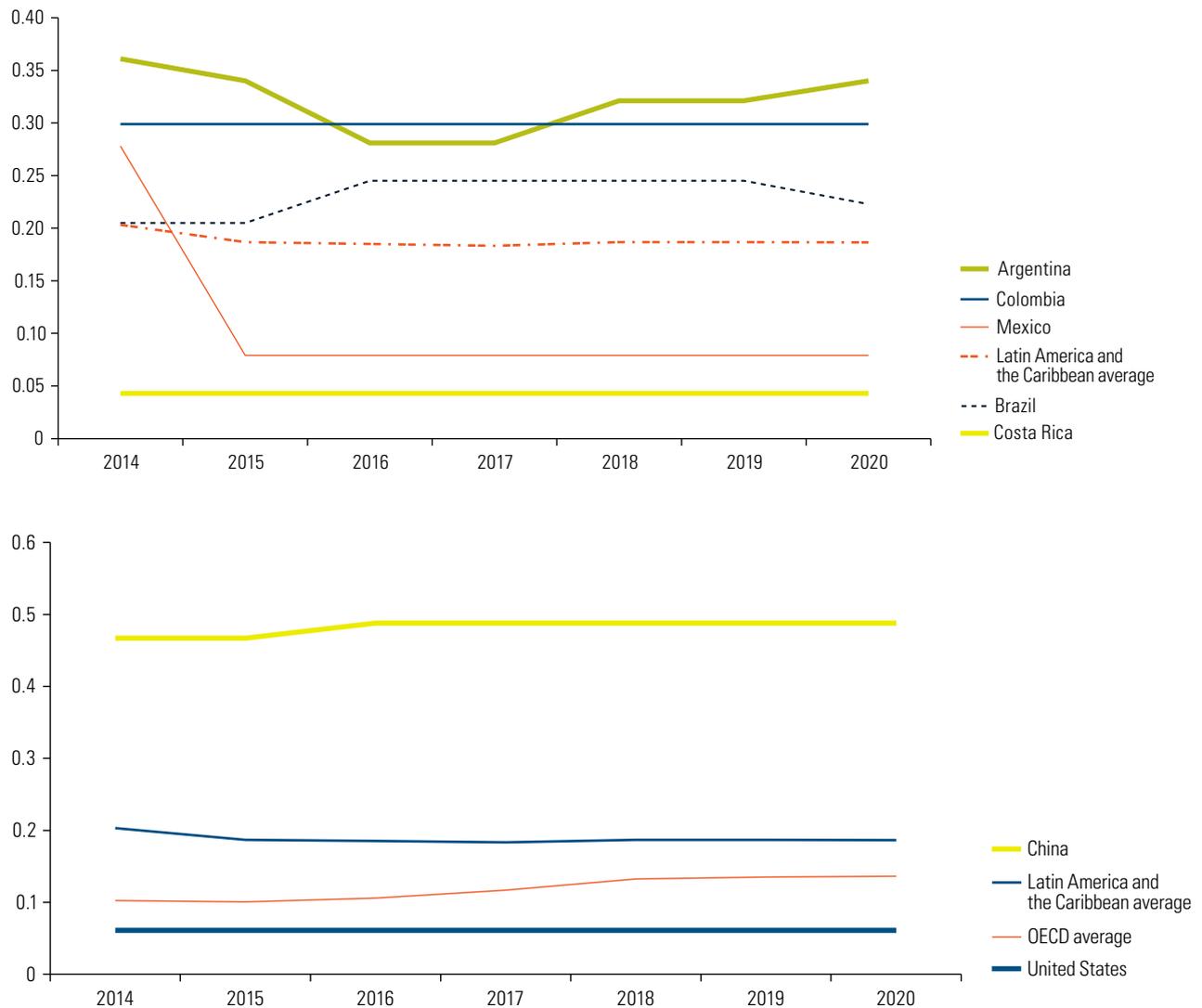
Although the regulatory framework and regulation itself are fundamental for encouraging digital trade, other aspects should also be taken into account. These are related to trade facilitation and logistics, such as the simplification and harmonization of procedures and information flows associated with the import and export

⁵ The OECD Digital Services Trade Restrictions Index identifies barriers affecting trade in digitally enabled services in more than 50 countries. Among other variables, it considers national policies on infrastructure and connectivity, electronic transactions, payment systems and intellectual property rights.

⁶ The Digital Trade Restrictions Index measures the degree to which countries restrict e-commerce. It takes into account more than 100 policy dimensions, such as import restrictions, local content requirements, Internet content restrictions and social network regulations. It is structured along four dimensions: tax and market access restrictions, restrictions on establishments, data restrictions, and restrictions on trade.

of goods, in addition to the importance of reducing the time and cost of conducting commercial transactions. The latter is also essential for improving the competitiveness of national economies and enhancing regional integration, and for achieving strategic integration in value chains.

Figure IV.8
Digital Trade Restrictions Index, selected countries, 2014–2021



Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of Organisation for Economic Co-operation and Development (OECD), “Digital Services Trade Restrictiveness Index”, 2021 [online] https://stats.oecd.org/viewhtml.aspx?datasetcode=STRI_DIGITAL&lang=en.

(b) Cross-border data flows

As noted above, data has become the most valuable intangible asset in today’s economy, as demonstrated by trends in terms of data generation, transmission and processing. Between 2017 and 2022, Internet Protocol (IP) traffic in Latin America tripled, at a compound annual growth rate of 21%. By 2022, monthly IP traffic will total 18.8 exabytes, up from 7.2 exabytes per month in 2017. However, most Internet traffic takes place in the Asia-Pacific and North America regions, while Latin America accounts for a small percentage (Cisco, 2022).

Data are multidimensional, since their value is determined not only in economic terms, but also by social aspects related to the safeguarding of human rights, privacy and other areas, such as national security. Similarly, in relation to cross-border flows, data can be characterized according to origin and users. It is important to note that cross-border data flows differ from trade flows because in some cases the data are not directly monetizable or cannot be expressed in economic terms (UNCTAD, 2021a).

Three types of data can be distinguished in cross-border flows: (i) commercial; (ii) official and open; and (iii) consumer. Commercial data are basically those originating from business-to-business (B2B) and business-to-consumer (B2C) service interactions, in which the flow is determined by internal company rules or intellectual property considerations. Official data, on the other hand, are produced by governments and in some cases may be subject to a degree of confidentiality for security reasons. However, there are also open government data that are public for transparency and innovation motives. Lastly, consumer data are generated from transactions and exchanges between consumers and businesses in different countries (in some cases, such data are considered personal data) (UNCTAD, 2021a).

In the last two years, the governments of Latin America and the Caribbean have taken various steps not only to create regulatory frameworks on data protection, but also to strengthen those that already existed before the health crisis and to build an institutional framework around them. The exercise of sovereignty over data protection and privacy is a complex issue, since it requires guaranteeing the security of citizens' data when they cross borders. In this case, it is important to distinguish between data protection and data protectionism.

The number of countries in the world with forced data localization regulations in place has increased (Cory and Dascoli, 2021). These regulations, which are a form of digital protectionism, are considered barriers to the development of e-commerce and innovation. In 2021 there were 62 countries that had implemented 144 barriers to the free flow of data. In some cases, these barriers inhibit economies of scale, increase the cost of data sharing and, in some cases, make it illegal. Forced localization impacts emerging and smaller firms in particular, since they do not always have the capacity to install servers in several countries. This can be seen as an entry barrier imposed by governments.

Countries that have data localization measures in the region include Brazil, where sensitive data⁷ must not be processed on cloud computers and must be located in national territory. In Chile, for example, certain strategic and important data⁸ must be located in the country. In Peru, the draft national strategy for artificial intelligence encourages the use of data centres and cloud computers located in the country. The Bolivarian Republic of Venezuela also requires the infrastructure for payment data processing to be located in national territory.

There are various rationales for the adoption of data protectionism to address risks relating to issues such as privacy, cybersecurity, censorship and surveillance, or national security. There are also economic motives, such as job creation and technology development (Cory, 2019). However, it can be argued that most of the value extracted from data is the result of its processing and accumulation, so it is important to strike a balance between the aforementioned policy objectives and the free flow of data. On the other hand, although attractive, the implementation of data localization rules does not guarantee greater protection, better cybersecurity or economic benefits, because these, in turn, depend on different technical, economic, security, jurisdictional and privacy factors, as well as the availability of the necessary enabling infrastructure.

⁷ Sensitive data (including backup data) consist of confidential information produced or guarded by the federal government and should be physically located in Brazil (Aleixo and others, 2019). At the same time, Draft Law 4723/2020 seeks to amend the text of the General Personal Data Protection Law by establishing the forced localization of personal data in national territory.

⁸ Data are considered strategic if they concern important activities in which any weakness or failure in the provision or execution of the service has a significant effect on regulatory compliance, business continuity, information security (own or that of customers) and the quality of services, products, information and image of the contracting entity (SBIF, 2017).

In this context, it is essential that policy makers take into consideration the importance of striking a balance between maximizing the gains from cross-border data flows and minimizing the associated risks. In neither case can the solution be polarizing, between approaches that advocate for total liberalization of circulation on the one hand, or full localization as a general rule, on the other.

The governance of cross-border data flows occurs amidst a diverse framework of national, regional and international policies. There is no single international regulatory system; but cross-border data flows have become one of the major global challenges in the digital economy. In this context, at the international level (or at the regional level initially), cooperation should seek to reach agreements on how to facilitate the global exchange of data to generate a social benefit and find common criteria in the digital economy to foster inclusive and sustainable development (see table IV.5).

Table IV.5

Considerations for a new institutional framework on data governance

| Needs | Key policy areas | Actions to be considered |
|---|---|--|
| Avoid fragmentation of the digital space | Agree on definitions and taxonomies | End the under-representation of developing countries in existing global and regional initiatives |
| Enable data sharing | Establish terms of access to data | |
| Prevent inequalities from widening | Strengthen measurement | Operate as a complement to national policies to make the digital economy contribute to inclusive development |
| Increase trust in the digital economy | Deal with data as a global public good | |
| Address policy challenges on dominant positions | Explore emerging forms of data governance | Provide sufficient policy space to enable countries with different levels of readiness to benefit from the digital economy |
| Avoid spillover effects of national policies | Agree on rights and principles | |
| | Establish standards | |
| | Increase international cooperation related to platform governance | |

Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of United Nations Conference on Trade and Development (UNCTAD), *Digital Economy Report 2021. Cross-border data flows and development: for whom the data flow* (UNCTAD/DER/2021), Geneva, 2021.

2. New digital partnerships and the strengthening of regional cooperation

The digital phenomenon makes it necessary to strengthen and improve global, regional and national cooperation mechanisms. Some issues that are considered crucial for promoting the implementation of technology and reducing its harmful effects, require greater convergence and complementarity. For example, in the infrastructure domain, a large part of such deployment is organized at the global level, such as submarine and overland cables, spectrum allocation standards, or processes for defining and managing Internet protocols and numbers. In addition, the international community is increasingly demanding coordination on issues such as taxation, consumer protection, data flow and cybersecurity (Salazar-Xirinachs, 2022) (see table IV.6).

According to the High-Level Panel on Digital Cooperation, set up by the United Nations Secretary-General, there is a desire to improve digital cooperation mechanisms to obtain more tangible results and promote more active participation by governments and other stakeholders. Areas for improvement include the low priority accorded to digital technology cooperation at the national, regional and global levels; the overlaps and complexity of digital cooperation structures; and the inadequate response to digital technologies, which affect ever more policy areas across different institutions; and the lack of reliable data to support policy design (United Nations, 2020).

Table IV.6
Critical areas for digital cooperation

| | International | Regional | National | Local |
|----------------------|---|----------|--|-------|
| Critical area | Digital infrastructure | | | |
| | Submarine and terrestrial cables | | | |
| | Spectrum allocation | | | |
| | Internet exchange points | | Concessions and tenders | |
| | | | Universal access and service | |
| | | | Infrastructure access and sharing | |
| | | | Connectivity | |
| | Definition of standards and interoperability | | | |
| | Domain names | | | |
| | Allocation of IP numbers | | | |
| | Root servers | | | |
| | Parameters and protocols in the Internet and Internet of things | | | |
| | Regulatory frameworks | | | |
| | Cybersecurity | | | |
| | Cross-border data flow and personal data protection | | | |
| | E-commerce | | | |
| | Consumer protection | | | |
| | Intellectual property | | | |
| | Taxation | | | |
| | | | Teleworking | |
| | | | Promotion of competition | |
| | Skills development | | | |
| | | | Development of competencies and skills | |
| | | | Education systems | |
| | Production development | | | |
| | | | Cluster development | |
| | | | Sectoral policies | |
| | | | Innovation and entrepreneurship | |
| | | | Financing | |
| | | | Digital transformation of micro-, small and medium-sized companies (MSMEs) | |

Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of J. M. Salazar-Xirinachs, "Estrategias y políticas para la reconstrucción con transformación pospandemia en América Latina y el Caribe", *Project documents* (LC/TS.2022/22), Santiago, ECLAC, 2022.

There are some outstanding examples of digital cooperation around the world. A benchmark in this area is the European Union, which has succeeded in building an integrated regional platform for collaboration and common regulation (see table IV.7). The fact that Latin America and the Caribbean has important cultural and value affinities with the European Union could facilitate the renewal and establishment of partnerships on digital issues, based on the exchange of good practices, technical cooperation, technology transfer and knowledge generation.

Within this framework, it is necessary to renew and promote cooperation mechanisms in Latin America and the Caribbean, which entails improving spaces for dialogue, coordination of initiatives and exchange of experiences, thereby enabling greater convergence of national and international policies.

Table IV.7

The “Europe fit for the digital age” strategy: spaces for cooperation

| Area of work | Description |
|----------------------------------|---|
| Production | |
| Digitalization of industry | Proposes a strategy with a series of actions to facilitate the transition to clean, circular and digital technologies and globally competitive industries, including smaller firms. |
| Artificial intelligence (AI) | Establishes a legislative framework for trustworthy artificial intelligence and proposes the creation of new artificial intelligence capabilities. |
| Platforms | Proposes new rules to deepen the internal market for digital services, extending and harmonizing the responsibilities of online platforms and information service providers, and strengthening the supervision of platform content in the European Union. |
| E-commerce | Establishes a New Consumer Agenda, with the aim of empowering consumers to make informed choices and play an active role in the digital transformation. |
| Fintech | Creates a framework to enable competitive and secure digital finance, including legislative proposals on cryptoassets and the operational and cyber-resilience of the financial sector, as well as a strategy to develop an integrated payments market in the European Union. |
| Social | |
| Formal employment/future of work | Proposes an initiative is proposed to improve working conditions in firms operating on platforms. |
| Digital skills and competencies | Proposes a Digital Education Action Plan (2021-2027) towards 2030 to boost digital literacy and skills at all education levels. It also puts forward a strengthened skills agenda with a special focus on early career transitions and building digital capabilities in the areas of artificial intelligence, supercomputing, quantum computing and blockchain. |
| Health | Promotes online health records based on a common European-wide exchange format to facilitate the exchange of healthcare data across the European Union. |
| Governmental | |
| Cybersecurity | Proposes a European cybersecurity strategy, including the creation of a joint cybersecurity unit, revision of the directive on the security of networks and information systems, and promotion of a single cybersecurity market. |
| Cooperation | Creates a digital centre to build and consolidate a cooperation space that promotes the values of the European Union and mobilizes Member States, as well as the bloc’s industry and civil society organizations. |

Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of European Union, *Shaping Europe’s Digital Future*, Luxembourg, 2020.

The Digital Agenda for Latin America and the Caribbean (eLAC) could play a fundamental role in promoting renewed digital cooperation, in addition to generating new alliances with various stakeholders. This involves not only improving cooperation with the private sector, civil society and the tech community, but also facilitating cooperation with countries in other regions that share common values and principles around digitalization. The Agenda should play a leading role in coordinating these efforts, which requires greater commitment from the governments and institutions leading the process. If it can improve the coordination of resources, facilitate the exchange of experiences, reduce information asymmetries, promote the implementation of common activities and encourage public and private investment, it will be possible to stimulate technological change in the region.

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CHAPTER

V

Policy recommendations

- A. Creating enabling conditions for a digital society for all
- B. Developing inclusive, smart digital solutions for well-being
- C. Fostering a sustainable digital transformation in the production sector
- D. Establishing appropriate governance for the digital age
- E. Strengthening regional digital cooperation and integration

Finding a new path for sustainable development for the countries of Latin America and the Caribbean will depend in large part on the manner in which societies, productive sectors and governments adopt digital technologies. The profound changes being wrought by the digital transformation on models for social interaction, consumption and production mean that regulatory and policymaking frameworks are needed that foster the proper conditions for governments, consumers, producers and citizens to develop new capacities, generate value and become active participants in society.

The implementation of actions to achieve the digital transformation is not a simple task. In fact, to address a complex and digitally interwoven system, a long-term, holistic vision is required, supported by strategies focused on a wide range of areas. The mainstreaming of digitalization will require elements including but not limited to policies to enhance and improve telecommunications services connectivity, measures focused on Industry 4.0 and actions that promote digital education and health, e-commerce, the use of financial technologies and digital governance. Also required are actions that catalyse the development of an innovation ecosystem that can navigate the complexities, benefits and challenges of advanced technologies.

Intense and rapid digitalization is also creating tension in a variety of regulatory and normative areas, in which emerging themes, whose very novelty presents a challenge, must be addressed. In that regard, legal frameworks must be updated in areas as varied as telecommunications, market competition, employment, and digital taxation and trade, and new regulations and institutional structures must be established in emerging areas such as cybersecurity, protection of personal data, data flows, ethics and artificial intelligence (AI). An adequate regulatory framework is essential to build an enabling environment in which the digital transformation is accelerated through investment, start-ups and the use of digital solutions.

The cross-cutting and multipurpose nature of digital technologies also poses governance challenges in institutional settings, since responsibilities linked to the digital transformation and its economic and social effects rest with various levels of government. Managing this complex web of policy areas requires a comprehensive, national view of digital policy and its interaction with different actors and levels of government.

The cross-border nature of the digital economy and of the related actors and flows requires alignment with international progress and guidelines on several topics, while considering national situations and outlooks. Therefore, the need for regional coordination of various legal and regulatory aspects relating to trade, taxation, data flows, data protection and cybersecurity is increasingly pressing.

There is no question that digital governance must promote the building of a welfare state and enhance prosperity, driven by an inclusive, competitive and sustainable production and consumption model, and based on the use, ownership and development of new technologies. To achieve this, the following objectives must be pursued:

- **Digital inclusion:** ensure universal access to digital technologies, reduce the socioeconomic barriers that restrict their use and develop the capacities required for such technologies to be adopted and used in economic and social activities.
- **Digital equality:** protect the exercise of the economic, social and labour rights of the population and promote the provision of public education, health and government services via digital channels, as well as the creation of digital skills and capacities. This entails building trust in the use of digital solutions by protecting personal data, preventing cybercrime and protecting digital users and consumers.
- **Competitiveness and digital productivity:** promote sustainable structural change through innovation and by expanding the use of technology in production structures, creating new business models, integrating technology into value chains, protecting and promoting competition and developing funding models.
- **Digital sustainability:** leverage the potential of digital technologies to support the transition to more sustainable production and consumption models, given their potential to reduce and optimize resource use in production processes and their contribution to making better consumption decisions that are supported by enhanced product information and traceability; at the same time, promote more responsible practices in digital industry, in particular as regards digital waste and the energy consumption associated with data processing.

For a sustainable digital transformation, it is therefore urgent to make progress along five action lines, as follows: (i) generate the enabling conditions for a digital society for all; (ii) develop inclusive, smart digital solutions for well-being; (iii) foster a sustainable digital transformation in the production sector; (iv) establish appropriate governance for the digital age and (v) strengthen regional digital cooperation and integration.

A. Creating enabling conditions for a digital society for all

- **Broadening service coverage.** In terms of supply, in order to reduce the digital connectivity gap, it is urgent to pinpoint actions that can enhance coverage in areas with low commercial profitability. For that to be achieved, there is need of innovative solutions that enable a combination of different access technologies, such as mobile, satellite or fibre-optic networks. In addition, innovative business models are required to deploy infrastructure and provide services. They should include new types of operating licenses, funding mechanisms and systems for cooperation between various actors from the State, digital industry and other specific sectors (such as agriculture or mining), as well as members of the communities where services are provided.¹ Financing mechanisms could include reforms to the use of universal access funds. This requires the development of service deployment strategies targeted by geotype.²
- **Ensuring effective universal connectivity.** In terms of demand, the digital gap is determined by access to broadband service at speeds that allow the use of data-intensive services and by the ability to acquire appropriate devices to access that service. For this reason, Internet access should be facilitated for vulnerable segments of the population by providing a basic digital basket that effectively enables them to connect (broadband, devices to access it and training in basic digital skills) so that they can take advantage of the benefits of digital technologies. Coordination between the public sector, businesses and civil society organizations is key in that regard.
- **Speeding up the deployment of fifth-generation (5G) networks that enable the use of advanced solutions.** Making progress in this area will mean accelerating the processes for assigning spectrum and launching a tender for commercial provision of 5G service. 5G networks are not simply services for accessing mobile and fixed broadband; they also constitute a platform for new applications and services based on advanced digital technologies (including applications for advanced automation, health, vehicle monitoring and smart cities).
- **Fostering the development of digital skills.** Improved well-being means more than simply having access to digital technologies; it also entails creating the conditions to allow them to be used effectively. To foster the development of basic digital skills, public-private cooperation focused on specific groups, including women, older persons, children, adolescents and vulnerable populations, will be needed.
- **Fostering human development in the digital age.** Digital skills will be increasingly important for both business productivity and employability. Advancing in the development of human resources will require specific programmes and innovation in education and professional training programmes. Implementing technical training programmes that dovetail with national development strategies will

¹ Examples include Amazon's "Kuiper" project to broaden coverage through low-orbit satellites, the "Internet for all" project of the Andean Development Corporation (CAF), the Inter-American Development Bank (IDB), Telefónica and Meta, which has created a rural mobile infrastructure company, Microsoft's "Airband" initiative, which takes advantage of unused bands of spectrum between TV stations, called white spaces, and the Digital Communities programme of American Tower.

² These strategies focus on serving a specific population group or geographic area. They entail scoping the goal, assessing nearby connectivity and energy infrastructure to evaluate what technical options are viable, and analysing the socioeconomic characteristics of the population or area to understand their income sources, payment capacity and digital literacy. This information is then used to determine the business model, the applicability of demand-side subsidies and the programmes to develop digital capacities that support effective ownership of technologies.

encourage people to obtain and enhance intermediate digital skills, mainly targeted at micro-, small and medium-sized enterprises (MSMEs) and self-employed workers, for retraining and upgrading to improve job opportunities. Businesses have a key role to play in continuous learning and retraining the workforce for the fourth industrial revolution. At the same time, advanced digital skills must be developed, which means promoting the development and incorporation of digital skills and of competencies in science, technology, engineering and mathematics into teaching and learning, by updating curriculum content, digital education resources and teaching standards for the skills required today and for the work of the future.

B. Developing inclusive, smart digital solutions for well-being

- **Providing relevant digital content and solutions for the population.** Digitalization should be sped up in the provision of public services, including education, health and government services, and in the development of solutions for smart cities, with a view to benefiting and empowering citizens.
- **The State as an engine of digital transformation.** Digitalization can improve many areas of public administration: procedures of all types, procurement, the payment of services, contributions and taxes, customs administration, social benefit disbursements and services for citizens, among others. Providing such services through digital channels can hasten the adoption of the related technology by citizens and businesses, making the State into a digital transformation catalyst. In this context, public innovation and the provision of proactive government services through multiple channels and devices should be encouraged to promote the development and interoperability of infrastructure, platforms, architecture and systems that will guarantee the digital transformation.
- **Promoting focused social policies based on empirical evidence.** Providing services to citizens through digital channels, in addition to improving service quality, can generate information that is relevant for social policy design, through smart data management. Beneficiaries and their needs can be more accurately identified in this way, and they can be registered and receive their cash transfers (assistance, pensions and subsidies), while policy monitoring and impact assessment can be enhanced. These tools facilitate the implementation of policies and instruments that consider socioeconomic, geographic, age-related and gender-related criteria. To improve the future skills of the public sector, the following is needed: (i) encourage the development and improvement of internal capacity and of the skills of those who craft the policies required for working with data; (ii) guarantee interoperability between different data sources as well as data sharing and cooperation between public and private data providers; (iii) guarantee transparency in the use of predictive algorithms and (iv) ensure that the necessary regulatory and technical safeguards are in place for data handling and network security.
- **Promoting a governance framework for data management and use in the public sector.** Data are the foundation of development in the digital age and present many opportunities for people, businesses, organizations and government institutions. Governments should promote a data governance model that includes the implementation of principles, procedures, policies, processes, metrics and technology for efficient data management. The ultimate purpose of this governance is to promote the use of data by government agencies to improve policymaking and policy management, by research bodies to generate knowledge, and by different stakeholders and sectors (health, education, environment, transportation and finance) to strengthen strategic decision-making mechanisms. These actions will promote transparency, innovation, feedback, accountability and citizen participation.

C. Fostering a sustainable digital transformation in the production sector

- **Developing an ecosystem that favours entrepreneurship and innovation.** Technology-based companies form the cornerstone of digital transformation processes, so it is vital to foster their creation through initiatives such as business incubators, start-up accelerators, mentoring and support systems and angel investor networks. Public-private coordination and its link with educational and technical centres are key to creating complementarities and synergies that enhance development of new ventures and technology-based companies.
- **Promoting digitalization of companies, with a focus on MSMEs.** In this area, it is essential to raise awareness of the potential of digital solutions with regard to business management and performance. Similarly, capacities must be built and financing mechanisms must be provided for access to technology and different digital solutions.
- **Promoting incorporation of advanced technologies into the productive sector.** It is crucial for advanced technologies —such as the Internet of things (IoT), cloud computing, AI and autonomous robotics— to be adopted throughout the value chain (procurement, design and development, manufacturing, operations, distribution, marketing and after-sales service) in order to improve the productivity and competitiveness of traditional sectors, as well as to foster development of new technology- and knowledge-intensive sectors. Such actions should be aligned with efforts to diversify the production structure and the development of business clusters and networks.
- **Promoting the green transition by digitalizing the productive sector.** A transformation of business and production models must be fostered, with sustainability as a central driving force of productivity and competitiveness. Public-private coordination will be key to making progress in this regard and taking advantage of the new opportunities presented by the green transition. To move beyond certain ingrained business practices, incentives must be established to encourage adoption of technologies that support the green transition and reduce carbon emissions and effects on climate change.
- **Promoting e-commerce policies.** This entails better coordinating policies to foster e-commerce, strengthening public-private links and aligning policies with national digital agendas. A global approach to e-commerce is also required, to take advantage of opportunities to increase participation in international markets, even in non-traditional sectors. At the national level, efforts should be made to more rapidly implement policies to enhance the enabling environment for e-commerce, relating to digital connection quality, trade facilitation, reliable logistics services, financial inclusion and modernization of the regulatory framework for electronic payments.

D. Establishing appropriate governance for the digital age

- **Strengthening synergies between digital policies and national development strategies.** Digital technologies can transform the development model as they enable innovative policy responses. National development strategies must factor in application of these technologies as tools in their various areas of development, which entails raising awareness among decision makers in the various sectors about the potential and challenges of digital transformation, as well as the creation of spaces for coordination at the highest level.
- **Formulating comprehensive digital agendas that are coordinated with sectoral strategies.** Because digital technologies are multipurpose, digital agendas must be designed with a cross-cutting approach to sustainable development, simultaneously interlinking them with actions in key areas such as education, health, government services, commerce and industry. Given the disruptive nature of advanced technologies such as AI, blockchain and IoT, digital agendas must also include actions to facilitate their deployment and adoption.

- **Strengthening the institutional frameworks for digital agendas.** To achieve this, the agencies and bodies that design and implement digital agendas must be given greater seniority, which will enable establishment of multisectoral coordination mechanisms at the State level, as well as spaces for public-private collaboration. Similarly, adequate financial resources must be allocated for implementation of digital agendas and to establish assessment mechanisms that include improvements to instruments for measuring digital development.
- **Modernizing regulation related to digital infrastructure.** This entails adapting the frameworks of rules and regulations for telecommunications in areas such as licensing, coverage obligations and spectrum allocation, as well as facilitating alternative financing mechanisms to increase coverage and broadband service provision,³ and providing investment incentives. Countries in the region should advance on two fronts concurrently: increasing coverage of broadband services in their territories and accelerating deployment of 5G and fibre-optic networks. Increased adoption of 5G networks and multicloud approaches in the context of Industry 4.0 will require more storage capacity and faster download speeds, and in turn installation of more advanced data centres.
- **Adapting competition regulations, to promote fair and competitive markets in the digital age.** Competition regulations must be adapted to the new trends in business models enabled by digital technologies, which entails fully understanding the behaviour of economic agents and the determinants of market power, including ownership and use of digital data.⁴ Tax systems must also be adapted to the new business practices enabled by digital technologies. Therefore, capacities must be built to regulate competition and establish tax systems that are suited to the challenges of the digital age.
- **Strengthening cybersecurity and data protection.** National cybersecurity strategies are needed, to help public and private actors address cyberattacks in a coordinated manner, as well as regulatory frameworks concerning data privacy, to improve the security of digital solutions and increase trust in their use. This entails creating appropriate institutional frameworks for their implementation. Cybersecurity regulations should also aim to protect critical infrastructure, to prevent cyberthreats from endangering public services (including water, electricity, telecommunications, transport, the logistics chain and port systems).
- **Adapting labour frameworks to promote new forms of employment and telework.** The pandemic has led to forms of telework that, far from being temporary, are becoming more commonplace. Labour legislation must be adapted to the new business models and forms of hiring enabled by digitalization, but without neglecting labour rights and keeping in mind the risks of employment becoming more precarious.

E. Strengthening regional digital cooperation and integration

- **Pursuing a regional digital market.** Measures in this area would enable establishment of a collective strategy to increase trade, expand the digital economy and increase competition through regulatory consistency, integration of infrastructure and development of digital platforms, cross-border data flows and measures to facilitate trade. In this respect, steps could be taken with regard to regulatory convergence and cooperation through trade organizations and agreements, such as the Pacific Alliance, the Central American Common Market, the Caribbean Community (CARICOM) or the Southern Common Market (MERCOSUR).

³ Consideration could be given to reforming funds for universal service and implementing a regulatory “sandbox” that enables operators to directly manage some of their contributions to funds to cover the costs of providing services to lower-income households. Authorization for self-management of resources may be subject to the fulfilment of conditions set by regulators to promote competition between service providers, which will lead to improved conditions being offered so that this authorization can be obtained.

⁴ Namely, ensuring that data are not used or stored in an anti-competitive manner, in order to enable equitable access for all parties; facilitating access to data (for example, in a market that can only be accessed by paying a fee) and ensuring an adequate level of protection for information in order to improve the competitive position of MSMEs in the digital economy.

- **Promoting greater regional cooperation and coordination for policy design.** In this regard, it is necessary to strengthen spaces for dialogue and regional efforts, such as the Ministerial Conference on the Information Society in Latin America and the Caribbean, a space to define shared principles and priorities that brings together the 33 countries of the region and representatives from the private sector, civil society and the technical community. The Digital Agenda for Latin America and the Caribbean has emerged as a key instrument for capacity-building and policymaking, as well as for facilitating better linkages and coordination with the actions carried out by the various cooperation agencies and forums. Dialogue within the framework of the Digital Agenda could facilitate identification of shared projects and challenges in areas such as cross-border trade, cybersecurity and payment systems.

The rapid advance of digital technologies and their increasingly cross-cutting applications have driven global transformations that are affecting the entire economy and all of society. The coronavirus disease (COVID-19) pandemic marked a turning point in terms of how widely digital solutions are used, as they became vital tools for maintaining social and productive activities under the restrictions on face-to-face activities and movement put in place during the health emergency.

This more widespread adoption of digital technologies –especially of the most advanced ones linked to intensive use of data and smart solutions– is disrupting consumption, business and production models, enabling new forms of value creation with potential impacts on well-being, economic competitiveness and care for the environment. Today, digitalization is seen as a key instrument for the transition to a new, more inclusive and sustainable development model.

However, the countries of Latin America and the Caribbean still face a series of structural challenges that prevent effective adoption of digital technologies. Progress towards an inclusive and sustainable digital transformation requires a number of measures and actions, which are addressed in this document.

