International Benchmarking of the Digital Transformation 2024

CNECT/2022/LVP/0137

Final Report

Written by Visionary Analytics

Internal identification

Contract number: CNECT/2022/LVP/0137

EUROPEAN COMMISSION

Directorate-General for Communications Networks, Content and Technology
Directorate B — Digital Decade and Connectivity
Unit B.2 — Digital Decade Coordination

Contact: CNECT-B2@ec.europa.eu

European Commission
B-1049 Brussels

International Benchmarking of the Digital Transformation 2024

CNECT/2022/LVP/0137

Final Report

Directorate-General for Communications Networks, Content and Technology
2024 EN

Written by Visionary Analytics

VISIONARY ANALYTICS

Study team:

Jan Bednorz

Austėja Makarevičiūtė

Greta Pozzo

Audronė Sadauskaitė

Dr Žilvinas Martinaitis

Directorate-General for Communications Networks, Content and Technology

2024 EN

EUROPE DIRECT is a service to help you find answers to your questions about the European Union

Freephone number (*):
00 800 6 7 8 9 10 11

(*) The information given is free, as are most calls (though some operators, phone boxes or hotels may charge you)

LEGAL NOTICE

This document has been prepared for the European Commission however it reflects the views only of the authors, and the European Commission is not liable for any consequence stemming from the reuse of this publication. The Commission does not guarantee the accuracy of the data included in this study. More information on the European Union is available on the Internet (http://www.europa.eu).

PDF	ISBN 978-92-68-14508-1	doi: 10.2759/908255	KK-02-24-421-EN-N

Manuscript completed in April 2024

First edition

Luxembourg: Publications Office of the European Union, 2024

TABLE OF CONTENTS

List of abbreviations

AI – Artificial intelligence

APS – Australian Public Service

AU – Australia

AWS – Amazon Web Services

BEAD – Broadband Equity Access and Development (US)

CCCI – Central Commission for Cybersecurity and Informatization

CN – China

DDPP – Digital Decade policy programme

DESI – Digital Economy and Society Index

DII – Digital Intelligence Index

DSGI – Digital Skills Gap Index

EGDI – E-Government Development Index

eID – Electronic identification

EU – European Union

FTTP – Fibre to the premises

GDP – Gross domestic product

GovID – Government Identification System (Israel)

HDI – Human Development Index

IAM – Identity Access Management (US, Washington state)

ICT – Information and communication technology

I-DESI – International Digital Economy and Society Index

IL – Israel

ITU – International Telecommunication Union

JP – Japan

KPI – Key performance indicator

KR – Republic of Korea (South Korea)

METI – Ministry of Economy, Trade and Industry (Japan)

MEXT – Ministry of Education, Culture, Sports, Science and Technology (Japan)

MIC – Ministry of International Affairs and Communication (Japan)

NQCO – National Quantum Coordination Office (US)

NRI – Network Readiness Index

OECD – Organisation for Economic Co-operation and Development

PPP – Purchasing power parity

SMEs – Small and medium-sized enterprises

STEM – Science, Technology, Engineering, and Mathematics

TIMNA – Israel's National Health Research Platform

TSIC – Texas Semiconductor Innovation Consortium

TSIF – Texas Semiconductor Innovation Fund

UNCTAD – United Nations Conference on Trade and Development

UK – United Kingdom

US – United States

VHCN – Very high-capacity network

WSTS – World Semiconductor Trade Statistics

Executive summary

This study supports the European Commission in reporting on the implementation of the Digital Decade policy programme (DDPP), by **assessing the EU's digital performance in the international context**. The study benchmarks the EU against seven non-EU countries identified as global best performers in digitalisation (Australia, China, Israel, Japan, South Korea, the United Kingdom, and the United States). Thematically, the study focuses on the four cardinal points of the DDPP: digital skills, digital infrastructure, the digital transformation of businesses, and digital public services. It involves both a quantitative analysis (focusing on digitalisation outcomes) and a qualitative assessment (with an emphasis on digitalisation policy frameworks) of the EU's position in comparison to these selected benchmark countries. The study is exploratory in nature. In particular, comparable international statistical data are limited, while the scope of the study is further constrained by the limited collection of primary (qualitative) data.

With these limitations in mind, some conclusions do emerge from the analysis, which can provide salient learning points for researchers and policymakers. With regard to **digitalisation outcomes**, the EU is, on average, competitive with the best-in-class countries (global digital leaders) across most indicators. The EU is also fairly consistent across different policy areas – while some countries excel in certain measures and lag behind in others, the EU overall hovers around the middle ground (probably also due to the aggregation of the average values for 27 countries, thus balancing out strengths and weaknesses of individual Member States). The key challenges faced by the EU in comparison to the benchmark countries relate to digital skills (especially advanced digital skills, as measured by the share of ICT graduates), digital infrastructure (including 5G coverage, high-speed broadband uptake, semiconductor market share and quantum patents), as well as the digitalisation of businesses – particularly the number of unicorns per capita, low levels of venture capital for AI, and low uptake of emerging technologies. The results also reveal the scale of diversity within the EU: the distribution of scores between EU Member States tends to be wide – often wider than the differences between the EU average and the scores of benchmark countries. Lastly, the analysis highlights the speed of technological progress in some areas, and thus the importance of timely data to track progress – countries can make significant leaps in certain indicators over the course of a single year (e.g. in the case of 5G coverage).

Digitalisation policy frameworks are wide-reaching and cut across multiple 'traditional' policy areas. These include education, industrial, social and R&D policy. With regard to broader policy aims, digitalisation is often perceived as a means to an end rather than a goal in itself, and is considered especially crucial in fuelling economic growth in the digital era. However, it also helps to solve broad, fundamental problems, both economic (e.g. competitiveness, sovereignty) and societal (e.g. demographics, equity). Based on this premise, the present study finds that digitalisation has become a salient topic not only in policy but also in politics, in most of the countries studied, where it is coordinated at inter-ministerial level and given the highest priority. The effects of this prioritisation in the benchmark countries are yet to be seen. In part, this is due to the recency of most policy developments – but also due to the scarcity or absence of evidence regarding their impact, and a general lack of diligent and systematic systems for tracking progress . The EU's DDPP stands out in this respect, setting clear numeric targets for the Union and establishing a monitoring framework. From a historical perspective, successful digitalisation requires a long-term strategy based on foresight, continuous high investments in R&D and an effective capital market. The examples of the US drive towards technological excellence since WWII or – more recently – the heavy prioritisation of technology by South Korea and China, and the large investments made, show how such foresight can deliver long-term effects.

In terms of specific **policy interventions**, the perceived role of the state and policy varies between countries. Some states (e.g. China, Japan) take a hands-on approach, attempting

to steer and foster digitalisation through direct interventions; meanwhile, others rely predominantly on the market to drive progress, ensuring only a sound regulatory framework with little direct interventionism in most areas (the US). Some countries address multiple aspects of digitalisation (often in ways that roughly correspond to the DDPP), while others focus on targeted and *ad hoc* responses in selected priority areas. Overall, government action is important in setting the preconditions for digital transformation, including the development of fundamental research and innovation, fostering resilience and sovereignty, and facilitating high-quality education. Of the four cardinal points that make up the DDPP, the greatest direct policy attention appears to be directed towards improving digital public services and laying out digital infrastructure. 'Digital skills' are conditional on the education system overall, and are thus rarely targeted with dedicated policy actions, while the 'digital transformation of businesses' seems to be perceived as a more 'organic' and market-driven phenomenon that requires a favourable ecosystem (e.g. pro-innovation regulatory framework), but less direct policy intervention. Lastly, there is also a growing trend of assertive interventionism in the field of high technologies that are considered to be 'strategic' (5G, semiconductors), mostly fuelled by the technological race in the context of geopolitical fragmentation. While this race for digital supremacy is mostly led by China and the US, it is spilling over or affecting other countries and blocs too.

1. Introduction

This report constitutes the final deliverable of the study 'International benchmarking of the digital transformation', requested by the European Commission, DG Communication Networks, Content and Technology (DG CNECT), and conducted by Visionary Analytics. The study aims to support the Commission in reporting on the implementation of the Digital Decade policy programme (DDPP), contributing to the State of the Digital Decade report. The primary objective of this study is to assess the EU's digital performance in comparison to a number of benchmark countries – selected as global best performers in digitalisation. The study involves both a quantitative analysis (focusing on digitalisation outcomes) and a qualitative assessment (with an emphasis on digitalisation policy frameworks) of the EU's position in comparison to the selected benchmark countries. By benchmarking the EU's digital performance, the study identifies good practices as well as areas for improvement and development in the Union's international competitiveness.

The study builds upon existing monitoring and reporting activities, especially the key performance indicators (KPIs) of the DDPP and the Digital Economy and Society Index (DESI), introducing an international component in order to position the EU's progress within the global perspective of digitalisation excellence. Specifically, the study:

- Conducts a quantitative analysis exploring the digital performance of the EU in relation to seven non-EU benchmark countries (Australia, China, Israel, Japan, South Korea, the United Kingdom, and the United States).
- Provides a qualitative assessment of each country's digitalisation policy framework, based on a comprehensive overview of policies relevant to each of the four cardinal points of the Digital Decade, as well as on interviews with experts.
- Identifies and summarises key insights relating to the EU's digital performance, highlighting relevant horizontal trends and good practices emerging from the examination of the benchmark countries.

The thematic scope of the study covers EU digital performance relative to the benchmark countries, with the analysis being framed according to the four cardinal points of the Digital Decade: (1) digital skills; (2) digital infrastructure; (3) the digital transformation of businesses; and (4) digital public services. In addition to the EU 27, the geographical scope of this study covers the seven non-EU benchmark countries, selected on the basis of their prowess in digitalisation and/or economic significance: Australia, China, Israel, Japan, South Korea, the United Kingdom, and the United States. While no strict limits have been set regarding the temporal scope of the study, a broad enough time frame has been set to account for the most significant or relevant policy initiatives or strategies related to the areas under study. For example, in the qualitative analysis, we look mostly at active policy actions. With regard to the quantitative dimension, the study's temporal scope is determined by the availability of and limitations to data, but in general, no data older than five years is included. Regarding the timeline of data collection, the study ran from November 2023 to February 2024, with most data collection activities being implemented during December 2023 and January 2024.

The remaining chapters of the report proceed as follows:

- *Chapter 2* introduces the study methodology.
- *Chapter 3* summarises the results of the quantitative analysis, in the form of a cross-country scoreboard. It presents key data pertinent to the four cardinal points of the DDPP.
- *Chapter 4* contains seven country fiches – brief snapshots of each benchmark country's digitalisation policy framework.

- *Chapter 5* provides a comparative, cross-country examination, bringing together key conclusions from the country-level analysis into a 'policy cookbook'.
- *Chapter 6* presents the conclusions of the report.
- The *Annexes* to the report provide more granular results of the quantitative (*Annex I. Final dataset*) and qualitative (*Annex II. Policy inventory*) analysis.

2. Methodology

2.1. Benchmarking framework

According to the definition presented by Auluck (2002), 'Benchmarking is the continuous process of identifying, understanding and adapting practice and processes that will lead to better performance.'[1] Although it stems primarily from the private sector and management studies, benchmarking can be an effective tool for policy. It allows policymakers to compare their policies against those of others, and to determine best practices. Through benchmarking, policymakers can gain a deeper understanding of what works well in other countries or regions, and apply that knowledge to improve their own policies and processes.[2] The idea of 'learning by comparing' can be seen as especially useful in new policy environments, such as digital transformation.[3]

Benchmarking involves comparing one's performance with that of top performers, and with respect to best practices. The comparator countries were identified by the study team on the basis of two key selection criteria:

1. Excellence in digitalisation

2. Economic power and competitive potential

In line with these criteria, the seven benchmark countries selected for the analysis are: Australia, China, Israel, Japan, South Korea, the United Kingdom, and the United States. Several international rankings and indexes have recently compared countries' digital transformation progress and digitalisation policies, including the International Digital Economy and Society Index (I-DESI 2020)[4], the IMD World Digital Competitiveness Ranking[5], the Network Readiness Index (NRI)[6], the Digital Intelligence Index (DII)[7], and the UN's E-Government Development Index (EGDI)[8,9] The countries selected for benchmarking are either among the top-performers in digitalisation according to these rankings (US, UK, South Korea, Japan, Israel, Australia), and/or are significant economic powers that excel in some aspects of the digital race (US, China).

With regard to analysing the US, the following strategy has been established: the quantitative analysis focuses on the federal level, as data are more readily available and comparable with those from other countries. For qualitative analysis, a mix of federal- and state-level approaches is deployed. At the federal level, several large policy packages have been implemented recently that signal an important development and policy turn (e.g. the CHIPS and Science Act), and it is thus paramount to include them in the analysis.

[1] Auluck (2002), in: Papaioannou, T., Rush, H., & Bessant, J. (2006). Benchmarking as a policy-making tool: From the private sector to the public sector. *Science and Public Policy*, 33, p. 91.

[2] Although authors also warn against 'naïve and mechanical applications of benchmarking procedures', which can 'undermine democracy and give rise to biased processes of institutional reform' – see Lundvall, B.A., & Tomlinson, M. (2002). International benchmarking as a policy learning tool. *The New Knowledge Economy in Europe: A strategy for International Competitiveness and Social Cohesion,* Cheltenham: Edward Elgar, 203-231, p. 203.

[3] Chakravorti, B., & Chaturvedi, R. (2016). How Benchmarking Can Help Countries Become More Digital. *Harvard Business Review*, 3; Heeks, R. (2006, July). Understanding and measuring eGovernment: international benchmarking studies. In: *UNDESA workshop 'E-participation and E-government: Understanding the present and creating the future*', Budapest, Hungary (pp. 27-28); Lundvall, B.A., & Tomlinson, M. (2002). International benchmarking as a policy learning tool. *The New Knowledge Economy in Europe: A strategy for International Competitiveness and Social Cohesion,* Cheltenham: Edward Elgar, 203-231;

[4] European Commission (2020). *I-DESI 2020: How digital is Europe compared to other major world economies?* https://digital-strategy.ec.europa.eu/en/library/i-desi-2020-how-digital-europe-compared-other-major-world-economies.

[5] IMD World Digital Competitiveness Ranking, available at: https://worldcompetitiveness.imd.org/rankings/digital.

[6] Network Readiness Index 2023, available at: https://networkreadinessindex.org/.

[7] Digital Intelligence Index, available at: https://digitalplanet.tufts.edu/digitalintelligence/.

[8] E-Government Development Index, available at: https://publicadministration.un.org/egovkb/en-us/About/Overview/-E-Government-Development-Index.

[9] See also, for example: Wyckoff, A., & Pilat, D. (2017). *Key issues for digital transformation in the G20*. OECD; Gierten, D., & Lesher, M. (2022). *Assessing national digital strategies and their governance*. OECD.

Nevertheless, we also acknowledge the wide variations in the levels of digital advancement and policy solutions in different US states. Therefore, specific attention to policy actions at state level has been taken to shape a deeper qualitative enquiry, providing an understanding of best practices. For this purpose, we take a deep dive into relevant examples of state-level policies in a subset of states: California, New York, Texas and Washington. These have been selected on the basis of several considerations including policy context, geographical/regional context, or the representation of particular industries (e.g. software development or semiconductor manufacturing).

With regard to the treatment of the EU in the benchmarking exercise, we have applied one or other of the following approaches (depending on the availability of data):

- *Using an aggregate EU score*. Where available, an EU aggregate score is used as reported in the data source.
- *Calculating an EU score*. In cases where an aggregate score was missing from the original data, we have calculated the EU score as follows:
    - *Weighted average.* We have weighted the data available for individual EU MS (or a sample of EU MS, in the case of missing values) by the EU Member States' population or GDP (depending on the specific indicator) to establish an EU average. This approach ensures that the scores of larger countries carry greater significance in determining the EU average.
    - *Median*. The median is the value in the middle of a data set, meaning that half of EU Member States have a value smaller or equal to the median, and half of them have a higher value. This measure provides an insight into the distribution of values across the EU Member States.

2.2. Data collection and analysis

The study comprises two 'streams' – quantitative and qualitative – with distinct foci and data collection methods for each.

2.2.1. Quantitative data collection

The quantitative analysis carried out under this study was aimed at examining digitalisation outcomes across the cardinal points of the DDPP and its KPIs. The analysis relies predominantly on international statistical sources, as these provide data that are usually directly comparable between countries (unless any breaks in time series or other differences in methodologies are explicitly highlighted in the source), and are relatively reliable (although the quality of each data source was still scrutinised, and any limitations indicated). The specific indicators selected for the analysis were chosen according to several key principles:

- *Feasibility.* Data were available for all or most EU Member States and benchmark countries for a recent and comparable time series.
- *Quality.* Quality assessment criteria included the credibility of the source (e.g. whether it is provided by a national statistical institute or a reputable international organisation); its accuracy and reliability (e.g. recognition of any sampling, measurement or other errors in the methodology); coherence and comparability (e.g. differences in populations, statistical units, classifications, etc.); timeliness (e.g. the existence of time series, data breaks); as well as its accessibility and clarity (e.g. the convenience with which users can obtain data and metadata, clearly explained methodology).

- *Relevance.* The indicators chosen are the best possible proxies for the EU monitoring framework (including the DDPP KPIs[10] and the DESI[11]). DESI scores cannot be used directly for international comparisons with non-EU countries as they cover only the EU Member States, and their methodologies are rarely replicated at international level. However, the DDPP and DESI scores have been used for the purpose of a 'robustness check', whereby the alignment between international indicators (proxies) and the DESI scores across the 27 EU Member States has been assessed (in terms of correlation score and correlation strength).

Despite the quality assurance measures put in place, the availability of comparable, comprehensive and reliable international statistics that, in addition, correspond closely to the EU KPIs designed to track the DDPP targets, is extremely limited. Therefore, it must be emphasised that most data included in this analysis constitute proxies (which are imperfect by nature), and are not free from drawbacks in relation to methodology (e.g. reliance on survey data) or coverage (e.g. missing values). *Table 1.* Indicators included in the analysis across the four DDPP cardinal points below summarises the selected indicators; for further details on indicator selection and data limitations, see the 'Methodological note' in *Annex I*. Besides these core indicators, data were also collected for the EU baseline (based on DESI scores and DDPP trajectories), as well as general demographic and economic data (e.g. population size, GDP, R&D investments), which were used to facilitate comparability across countries (see *Annex I* for a detailed presentation of all data).

Table 1. Indicators included in the analysis across the four DDPP cardinal points

DDPP KPI	Indicator (proxy)	Unit	Source
		Digital skills	
Basic digital skills	Individuals using the internet	% of population	International Telecommunication Union (ITU)
	Digital skills among the population	Score 1-10[12]	The Digital Skills Gap Index (DSGI)
ICT specialists	ICT graduates	% of tertiary graduates	Eurostat / UNCTAD
		Digital infrastructure	
5G coverage	5G coverage	% of population covered by mobile network technology (at least 5G)	International Telecommunication Union (ITU) / Omdia (estimates based on operator data)
Fibre to the premises (FTTP)	Fibre subscriptions	% of fibre subscriptions among total fixed broadband	OECD Broadband Portal
	FTTP coverage	% of households	Omdia's Fiber Development Index 2023 and Broadband Coverage in Europe 2022 (Omdia and Point Topic)
Fixed very high capacity network (VHCN)	High-speed fixed broadband subscriptions	Number of fixed broadband subscriptions per 100 inhabitants (≥ 100Mbit/s)	OECD Broadband Portal
Semiconductors	Semiconductor sales	% of global market share	World Semiconductor Trade Statistics (WSTS)
Quantum computing	Planned public funding	Billion USD (% of GDP)	McKinsey Quantum Technology Monitor 2023

[10] C(2023) 7500 final, *Communication from the Commission establishing Union-level projected trajectories for the digital targets.* https://digital-strategy.ec.europa.eu/en/library/communication-establishing-union-level-projected-trajectories-digital-targets

[11] SWD(2023) 574 final, *DESI 2023 methodological note*. https://digital-strategy.ec.europa.eu/en/library/desi-methodological-note-digital-decade-report-2023

[12] Where 1 is the lowest possible score, and 10 is the highest. Scores represent responses to the survey question 'In your country, to what extent does the active population possess sufficient digital skills (e.g. computer skills, basic coding, digital reading)?').

DDPP KPI	Indicator (proxy)	Unit	Source
	Quantum computing patents	Number of patents issued to date (GDP weighted)	Quantum Consortium
	'Quantum technologies' start-ups	Number of start-ups (GDP weighted)	Dealroom
Digital transformation of businesses			
Digital intensity of SMEs	Web presence	% of firms with a website	Network Readiness Index (NRI)
	E-commerce	Score 0-100[13]	The Economist Inclusive Internet Index
Cloud, big data, and AI take-up	Adoption of emerging technologies	Score 0-100[14]	Network Readiness Index (NRI)
	Cloud computing purchases	% of businesses purchasing cloud computing services	OECD ICT Statistics
	AI use	% of businesses using AI	OECD ICT Statistics
	AI talent concentration	% of LinkedIn members with AI skills or who perform an AI occupation	OECD AI Policy Observatory
	AI Venture Capital investments	Million USD (% of GDP)	OECD AI Policy Observatory
Unicorns	Unicorns	Number of start-ups valued USD 1 billion or over (GDP-weighted)	Dealroom
Digital public services			
Digital public services for citizens	Online Services Index	Score 0-1[15]	UN E-Government Development Index (EGDI)
Digital public services for businesses			
Access to e-health records	Access to e-health records or provision of e-health services	Yes/No	The Economist Inclusive Internet Index
	Individuals using the internet to seek health information	% of individuals	The Economist Inclusive Internet Index
eID	Provision of eID system	Yes/No	eID Digital Monitoring Dashboard / International Telecommunication Union (ITU)

Source: compiled by the authors.

2.2.2. Qualitative data collection

The qualitative analysis carried out under this study aimed to examine the policy framework and the broader digitalisation context in the benchmark countries, and comprised two key methods of data collection: (1) expert interviews and (2) policy mapping.

First, interviews were conducted with experts to identify the most important policy actions (feeding into the policy mapping exercise – see below), and to determine good practices and success factors in certain areas of digitalisation (DDPP cardinal points), as well as to collect general insights about the overall context, progress in digitalisation, and the policy picture in each country. Interviews were semi-structured and guided by an interview questionnaire, presented in the box below. Interviewees included academic experts on the countries and topics in focus and/or representatives of public authorities responsible for the

[13] Where 0 is the least inclusive and 100 is the most inclusive environment for e-commerce.
[14] Where 0 is the lowest adoption rate, and 100 is the highest. Scores represent the average response with regard to five different emerging technologies (artificial intelligence, robotics, app- and web-enabled markets, dig data analytics and cloud computing), e.g. 'In your country, to what extent are companies adopting artificial intelligence?'.
[15] Where 0 is the lowest possible evaluation, and 1 is the highest.

implementation of digitalisation policies (e.g. digital agencies, relevant ministries). In total, 12 expert interviews were conducted (1-3 per benchmark country) during December 2023 and January 2024.

Interview questionnaire

Policy actions in key areas of digitalisation

- Can you identify any national strategies, policy initiatives or funding programmes in the area of digital skills?
- Can you identify any national strategies, policy initiatives or funding programmes in the area of digital infrastructures (e.g. 5G network, high-speed broadband)?
- Can you identify any national strategies, policy initiatives or funding programmes in the area of the digitalisation of businesses (e.g. the digital intensity of businesses, take-up of emerging technologies such as AI, quantum computing, etc.)?
- Can you identify any national strategies, policy initiatives or funding programmes in the area of digital public services (e.g. e-health records, eID)?
- Can you identify any overarching national strategies, policy initiatives or agencies that bring together the areas discussed above?
- What are the key strengths and weaknesses of your country with respect to the following areas: (1) digital skills, (2) digital infrastructure, (3) the digitalisation of businesses, and (4) digital public services?
- What are the current key policy priorities? Are there any potential gaps or areas in which policy responses are still being developed?

Policy actions – best practices

- Out of the policies discussed, can you identify some of the most successful policy actions in relation to digitalisation in your country)? In what ways have these been successful?
- Is there any evidence available on the measured impact of these policies?
- What have been the key drivers behind the implementation and design of these policies?
- What have been the key success factors that have led to the positive outcomes of these policies?

Broader policy background

- How would you assess the overall policy environment in the area of digitalisation in your country?
- In your view, what have been the most significant developments regarding digitalisation policy in your country in recent years? How have policy discussions relating to these areas changed over time?
- What are some of the key challenges that your country is facing with respect to progress in digitalisation?
- To the best of your knowledge, how do these policy developments compare or contrast with other countries' strategies?

Source: compiled by the authors.

Second, policy mapping was carried out, with the aim of identifying and briefly describing some of the key digitalisation policy actions in the benchmark countries. The following types of policy actions were the key focus of this mapping:

- National/regional strategies, understood as overarching, comprehensive and coordinated plans of action that a country or government develops in order to achieve a specific vision

- Policy initiatives, broadly defined as proposed actions or programmes that are intended to address a specific issue or achieve a particular goal, e.g. through the development of new laws, regulations, projects or guidelines
- Financial instruments, i.e. structured mechanisms via which financial resources are provided to support a specific set of activities or objectives by financing research, projects, initiatives or other activities through grants, loans or other forms of financial support to individuals, organisations or communities

The following strategies and sources were used to identify relevant policy actions:

- *A targeted internet search*. A web search was carried out following an established protocol and using pre-identified keywords in English and other national languages (using machine translation tools).
- *Government websites*. The web resources of relevant ministries and other public authorities were systemically browsed.
- *International sources*. Key academic papers and research reports from international organisations were scoped.[16]
- *Expert interviews*. Interviews with national experts (see above) served to validate the search results, fill in gaps (identify missing actions) and provide more qualitative assessments of specific policy actions (where possible).

The following inclusion/exclusion criteria were applied to each identified policy action:

- *Topical relevance*. The action directly addresses the country's progress in digitalisation, and covers at least one of the cardinal points of the DDPP. Actions that include digitalisation as only one part of the strategy/initiative/programme (e.g. competitiveness strategies that include aspects of digital transformation) are excluded. Narrowly focused actions (i.e. those targeting a specific DDPP KPI) are of particular interest.
- *Action level.* The present study generally focuses on actions at national level, but regional- or local-level initiatives are considered in certain instances or where they are of particular relevance (e.g. for semiconductor manufacturing zones). In the case of the US, state-level actions are included, focusing on four states (California, New York, Texas and Washington).
- *Temporal relevance.* The study generally focuses on strategies/initiatives/programmes that are either currently in place or have recently ended.

The policy actions identified were described using a pre-established template, presented in the box below. Overall, 51 policy actions were included and described, forming the 'policy inventory' (see *Annex II*).

[16] See, for example, Gierten, D., & Lesher, M. (2022). *Assessing national digital strategies and their governance.* OECD.

Policy inventory template

Basic information

- Country
- Title of action
- Link

Relevance to DDPP cardinal points and objectives

- Digital skills
- Digital infrastructure
- Digital transformation of businesses
- Digital public services
- Specific DDPP KPI

Operational details

- Initiative type
- Timeline, funding
- Public authority in charge
- Stakeholders involved in the implementation

Intervention design

- Identified problems
- Expected outcomes
- Set targets
- Key steps/activities

Outcomes

- Evidence on outcomes
- Sources of evaluation

Source: compiled by the authors.

2.2.3. Data analysis and presentation of findings

The analysis of both quantitative and qualitative data was carried out at two levels:

- *Country-level analysis* builds on the raw quantitative data and relevant qualitative data about each country in focus, diving deeper into the specificities regarding the state of play in each country in terms of the digitalisation progress and policy environment. The results of country-level analysis are presented in seven country fiches (see *Chapter 4*).
- *Comparative analysis* compiles international quantitative data and the in-depth analysis for each country from a cross-country perspective. This is presented through two components: (1) the 'cross-country scoreboard', which contains quantitative (outcomes-focused) data (see *Chapter 2*); and (2) the 'policy cookbook', which summarises key conclusions stemming from the qualitative (policy-focused) analysis (see *Chapter 4*).

3. Digitalisation outcomes: a cross-country scoreboard

This chapter of the report presents digitalisation outcomes, as evidenced through the quantitative analysis. More specifically:

- Background data are used to compare the benchmark countries in terms of fundamental indicators – including population, GDP, GDP per capita, the Human Development Index (HDI), research and development (R&D) expenditure, and ICT service exports – to put the county comparisons in perspective (Section 3.1).
- The core of the analysis presents the key indicators selected as proxies for the DDPP KPIs, organised across the four DDPP cardinal points (Sections 3.2-3.5).

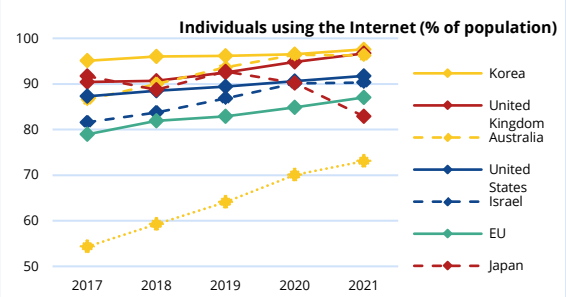
It should be noted that the availability of comparable, comprehensive and reliable international statistics that also correspond closely to the EU KPIs designed to track the DDPP targets, is extremely limited. Therefore, most data included in the analysis constitute proxies (which are imperfect by nature) – and even then, some issues remain with regard to methodology (e.g. reliance on survey data) or coverage (e.g. missing values). The sections that follow draw attention to some of the data issues, such as discrepancies between the international indicators and DESI scores, or aspects of the broader context which might help in interpreting some of the results. Nevertheless, the data should always be treated with caution.

How to read the data scoreboards?

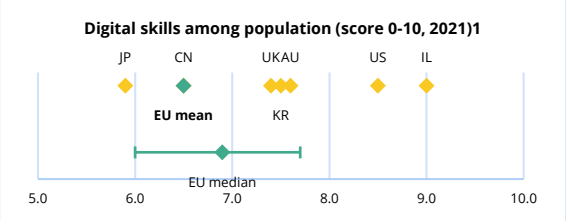
For a comprehensive description of the methodologies behind each indicator, including data limitations and correlation with the EU baseline, please consult the 'Methodological note' in *Annex I*.

The scoreboards below visually summarise the key results stemming from the analysis. They include four types of charts:

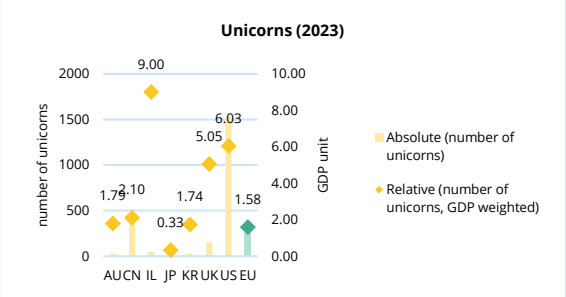
Dot plot
A dot plot presents data points using dots along a single axis, with the lowest score on the left and the highest score on the right. Country abbreviations are positioned either below or above the corresponding data points.



Line chart
A line chart presents data trends for the sample countries for the last five available years (data for earlier years, if it exists, can be found in *Annex I*). Countries in the legend are sorted from highest to lowest score for the latest year available.



Dot and box plot
This type of graph consists of two charts: the top row presents data points for the benchmark (non-EU) countries and the EU average score; the bottom row is a simplified box plot representing the distribution of scores for the EU Member States. The latter shows: (1) the median value for the EU Member States (data point); and (2) the distribution of scores (whisker), where the lower (left) end of the whisker marks the 25th percentile for the EU, while the higher (right) end – the 75th percentile.

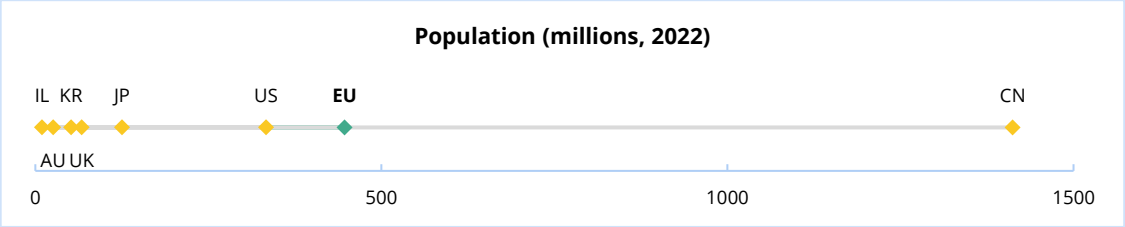


Bar and dot chart
In this type of chart, the bars represent the absolute values for the indicator, with their corresponding axis on the left. The diamond-shaped dots represent the relative measure (weighted by GDP) with their corresponding axis on the right. For clarity, the relative value also is reported numerically above each dot.

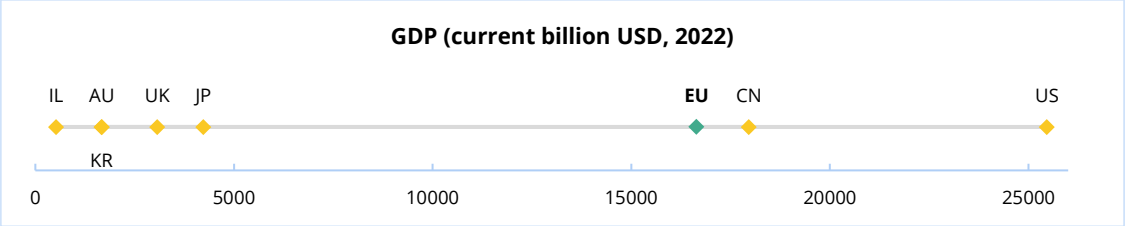
3.1. Background data

As a large economic bloc, the EU ranks second in comparison to the benchmark countries in terms of total population size, and third in terms of GDP. In terms of wealth and development measures, the EU trails behind the Anglo-Saxon countries in GDP per capita but surpasses all of the Asian economies in the sample. All countries but China are highly developed and are clustered closely together (in the 0.9-0.95 range of the HDI), although the EU's average score is somewhat lower than most. In terms of digital investments and exports, the EU sits in a low-to-middle position for R&D expenditure, but excels in terms of ICT service exports (second only to Israel).

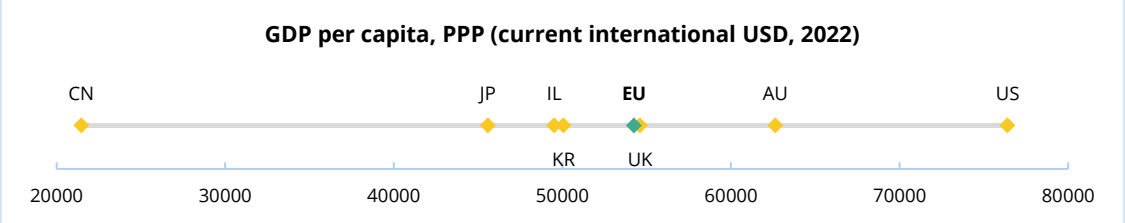
Figure 1. Background data scoreboard



Source: Eurostat and UN Population Division.

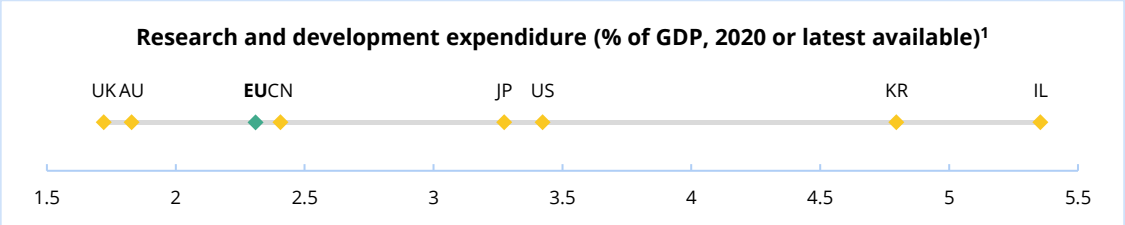


Source: World Bank.



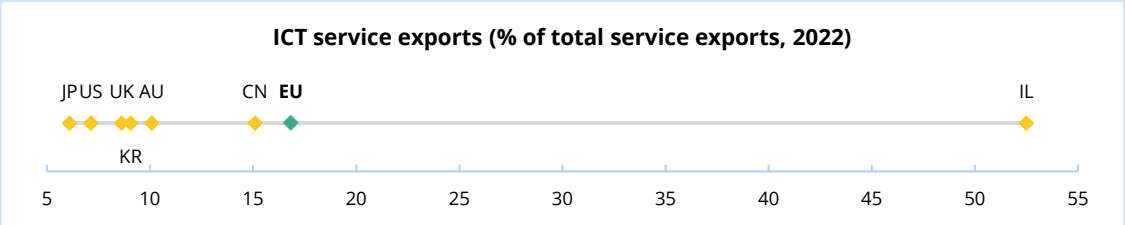
Source: World Bank.

Source: United Nations Development Programme (UNDP).



Source: World Bank.

[1]Data for 2020 are missing for Australia and the UK, so 2019 data are used instead.

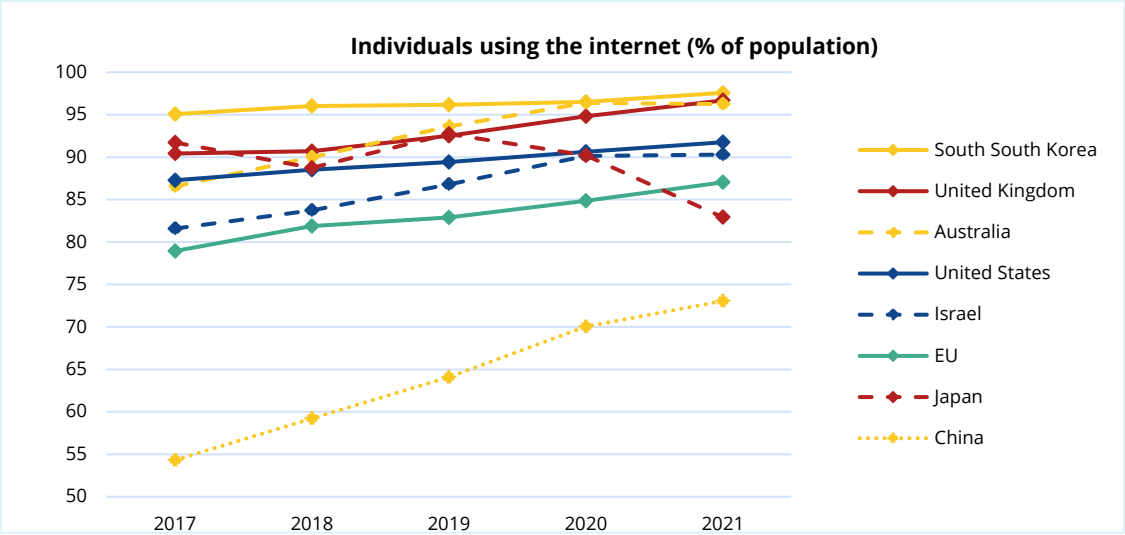


Source: World Bank.

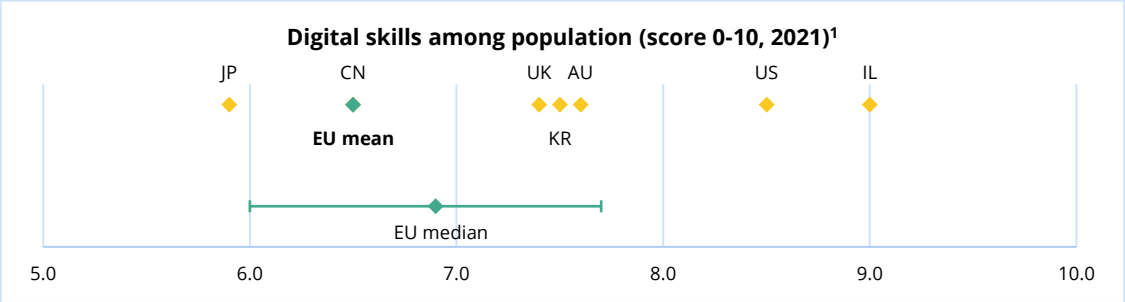
3.2. Digital skills

A clear upward trend in internet use (a proxy for basic digital skills) can be seen for all benchmark countries except for Japan, with the EU in low-to-middle ranks. Looking at the survey-based metric 'digital skills among population', it is important to consider the variation between EU countries – the distribution of EU Members States' scores is wider than that of the other non-EU countries (EU's 25th-75th percentile range enfolds the scores of most of the benchmark countries). In terms of advanced digital skills – as proxied by the share of ICT graduates – the performance of the EU, on average, is close to that of South Korea, the UK and the US, although significantly behind that of Australia and Israel.

Figure 1. Digital skills scoreboard

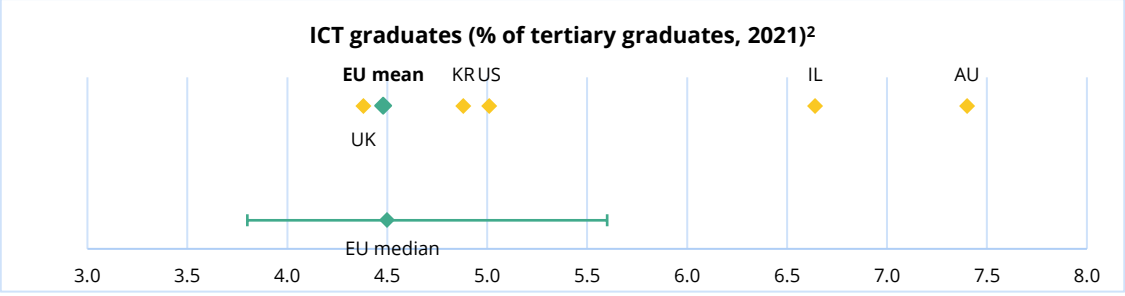


Source: International Telecommunication Union.



Source: the Digital Skills Gap Index.

[1] The indicator is based on responses to the survey question 'In your country, to what extent does the active population possess sufficient digital skills (e.g. computer skills, basic coding, digital reading)?'. See the methodological note in *Annex I* for more details.



Source: Eurostat and United Nations Conference on Trade and Development (UNCTAD).

[2] Data are unavailable for China and Japan.

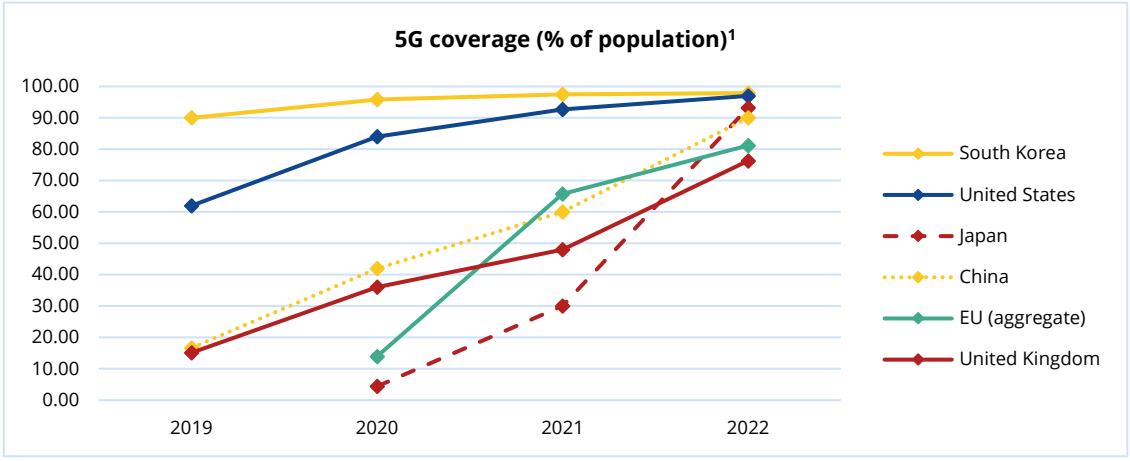
3.3. Digital infrastructure

With regard to mobile connectivity (5G), the EU is a relative late-comer, but has managed to close the gap with the leading countries over the last few years. South Korea and the US stand out as early adopters with relatively high coverage rates already in 2019, while most countries experienced a rapid acceleration of 5G rollout from below 20 % to above 80 % in four years or less (between 2019 and 2022). It is worth acknowledging the wide distribution of 5G coverage rates within the EU, ranging from 20 % to 100 % across the Member States in 2022.

In terms of broadband infrastructure, the EU scores relatively high for fibre subscriptions and fibre-to-the-premises (FTTP) coverage. However, it should be noted that some countries rely on other technologies for high-speed broadband provision. For instance, the US ranks relatively low on fibre-focused indicators, but scores much more highly for high-speed broadband subscriptions. This is due to the technology mix used – fibre accounts for only around 23 % of the internet service market in the US, compared with 47 % for cable (although the fibre market share is increasing).[17] Furthermore, there is a methodological discrepancy between the high-speed fixed broadband subscriptions indicator used herein (sourced from the OECD) and the DESI. Specifically, DESI relies on households as its measurement unit, while the OECD relies on individuals. This results in DESI scores being more than twice as high (55 % of *households* having access to ≥ 100Mbit/s connections) in comparison to the OECD score (24 % of *individuals*).

With regard to high-tech infrastructure, the EU holds approximately 10 % of the market share in semiconductor sales, while the market is largely dominated by the US, which accounts for almost 50 % of semiconductor sales (based on the headquarters of the producer). It is notable that the positions of the countries studied did not evolve greatly during the period 2017-2022. The scoreboard also presents three indicators to measure performance in the field of quantum computing; however, countries' performance varies in these three indicators. For example, the EU performs well in terms of the number of quantum computing start-ups (GDP-weighted); moderately in terms of public funding for quantum initiatives; and closer to the low end for the number of quantum computing patents issued.

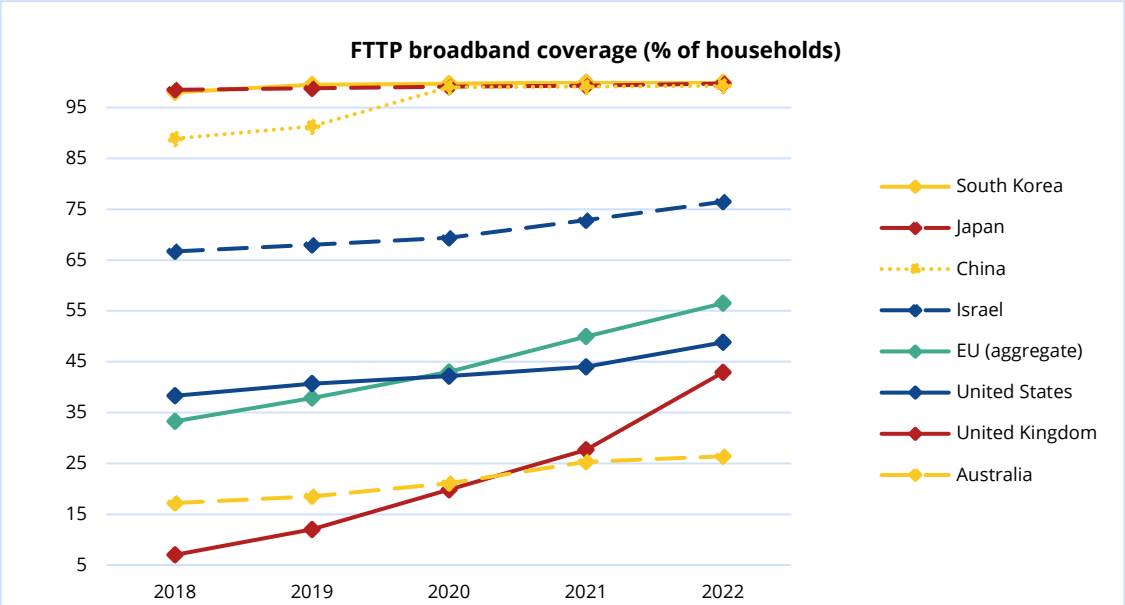
Figure 2. Digital infrastructure scoreboard



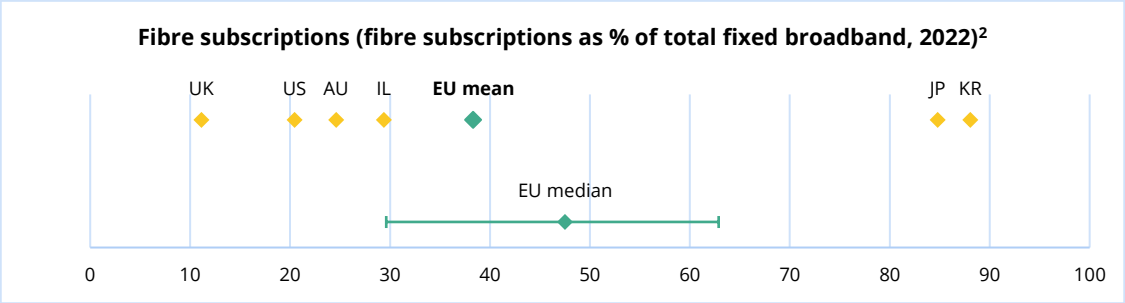
Source: Omdia (estimates based on operator data).

[1] Data for Australia and Israel are unavailable.

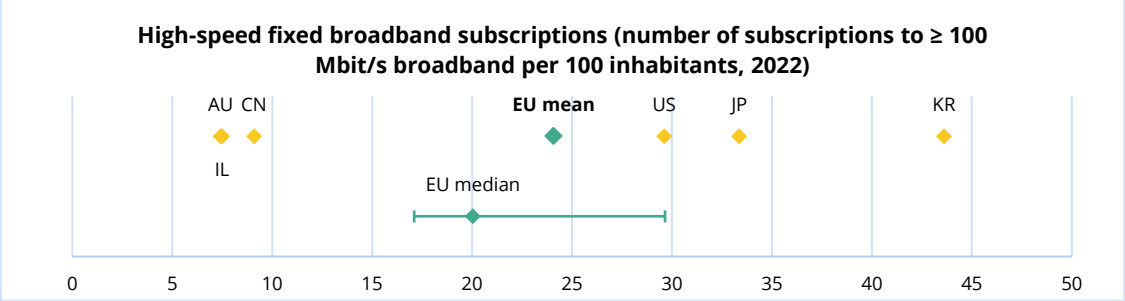
[17] Fiber Broadband Association (2024). *Fiber Preferred by Nearly Two-Thirds of U.S. Consumers*, available at: https://fiberbroadband.org/2024/01/04/fiber-preferred-by-nearly-two-thirds-of-u-s-consumers.



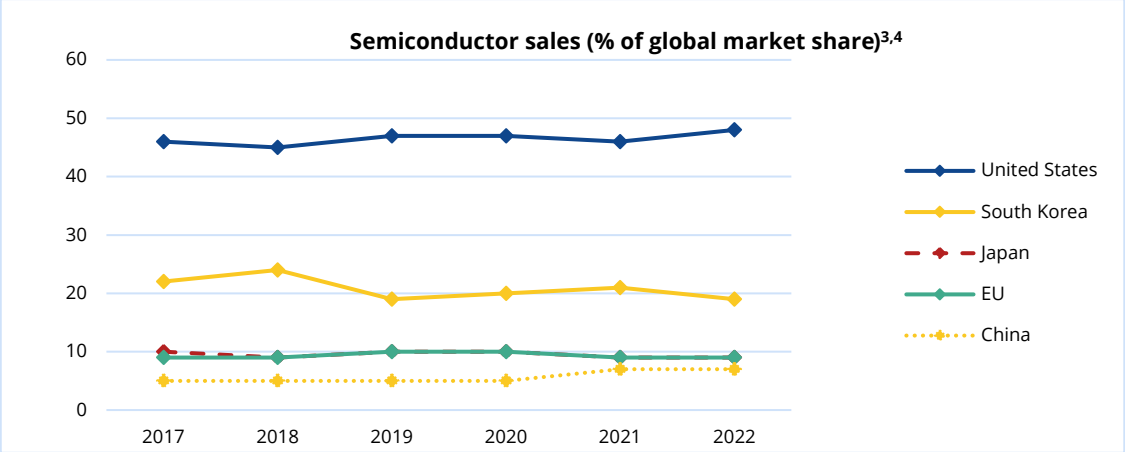
Source: Omdia's Fiber Development Index 2023 and Broadband Coverage in Europe 2022 (Omdia and Point Topic).



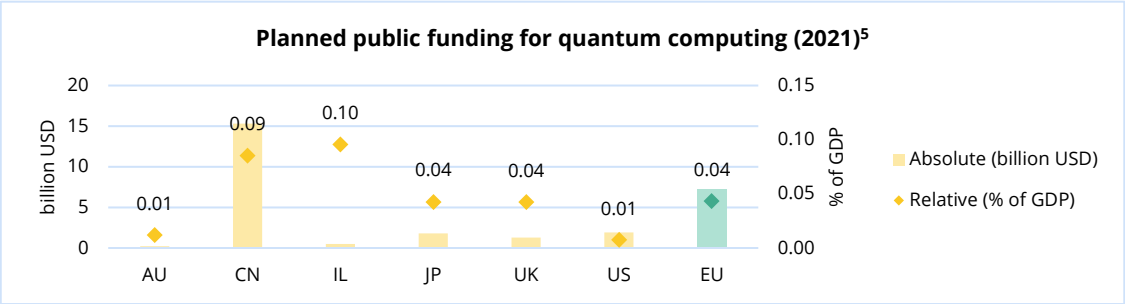
Source: OECD Broadband Portal.
[2] Data for China are unavailable.



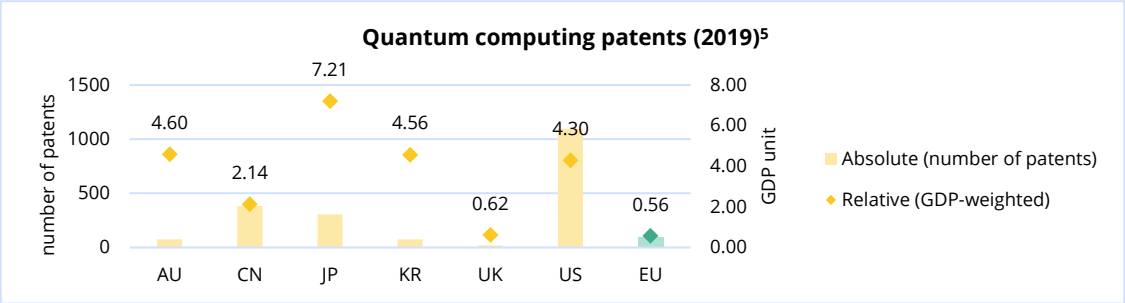
Source: OECD Broadband Portal.



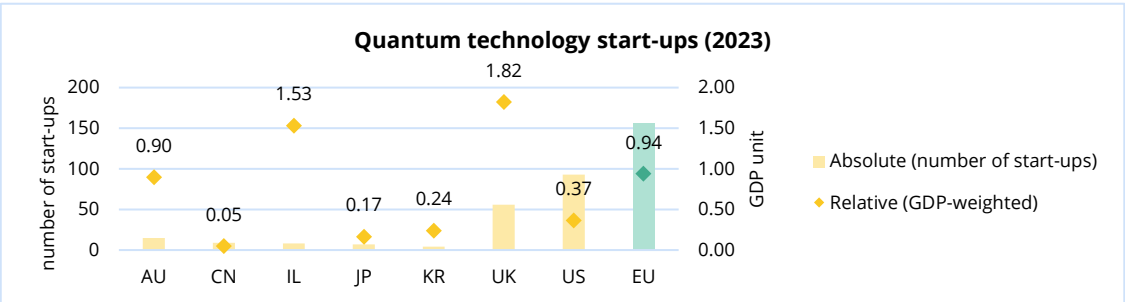
Source: World Semiconductor Trade Statistics (WSTS), Omdia, and Semiconductor Industry Association (SIA) estimates.
[3] Data for Australia, Israel and the UK are unavailable.
[4] The indicator is based on the location of the firm's headquarters (rather than manufacturing location). See methodological note in *Annex I* for more details.



Source: McKinsey Quantum Technology Monitor 2023.
[5] Data for South Korea are unavailable.



Source: Quantum Consortium.
[5] Data for Israel are unavailable.

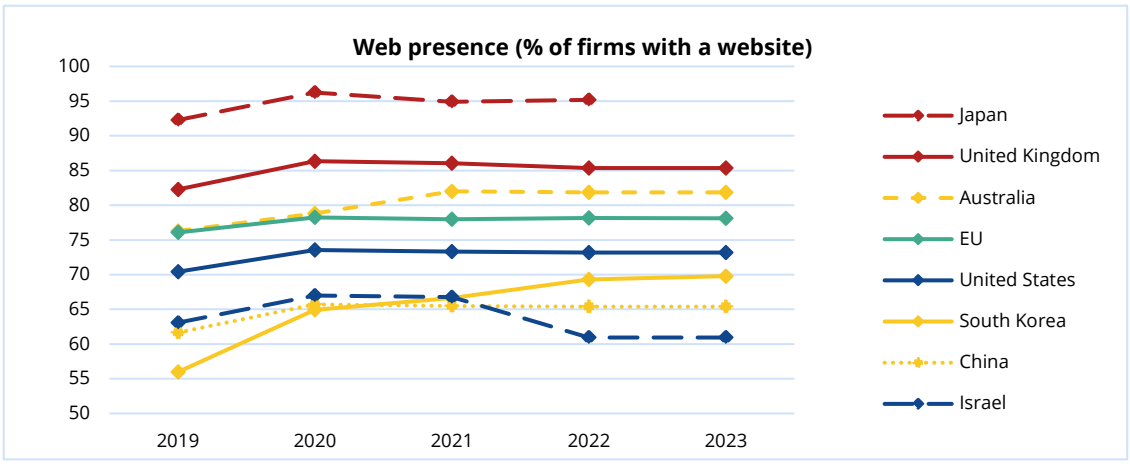


Source: Dealroom.

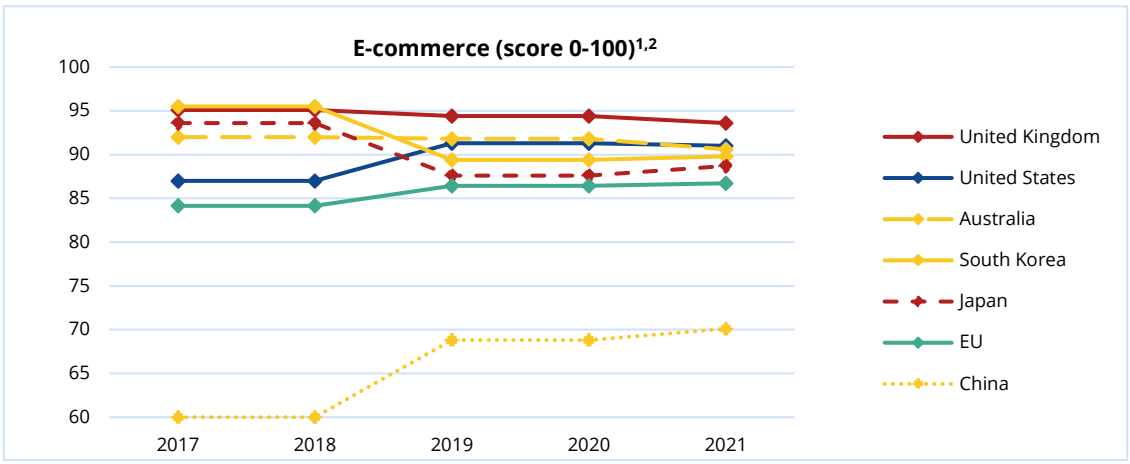
3.4. Digital transformation of businesses

The EU is positioned in the middle (in terms of web presence) and closer to the low end (for e-commerce) in proxies for the basic digital intensity of businesses. EU performance is uneven in relation to the adoption of advanced technologies. The EU's average score is lowest in relation to the composite index for the adoption of emerging technologies. Looking at specific technologies, the EU average ranks in the low-to-mid range for cloud computing purchases. In terms of AI adoption, according to Eurostat, an average of 8 % of EU businesses used AI in 2023. However, breaks in time series and missing recent data for some countries in international datasets prevent robust comparisons with non-EU counterparts. EU performance in relation to other AI-related proxies – namely, the concentration of AI talent and AI venture capital investments – is relatively modest, and places the EU roughly in the middle of the sample. Lastly, the EU has the third-highest absolute number of unicorns (start-ups valued at or above 1 billion USD), although this figure drops significantly when the score is weighted by GDP.

Figure 3. Digital transformation of businesses scoreboard



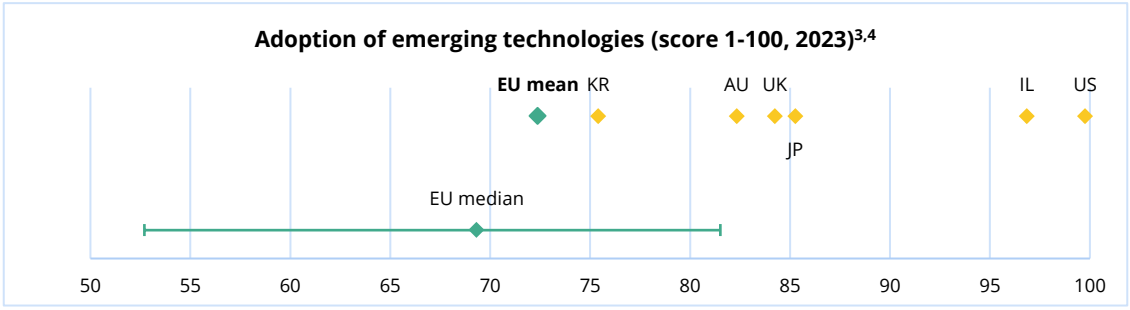
Source: Network Readiness Index, based on World Bank Executive Opinion Survey 2021.



Source: The Economist Inclusive Internet Index, based on the UNCTAD B2C E-Commerce Index.

[1] Data for Israel are unavailable.

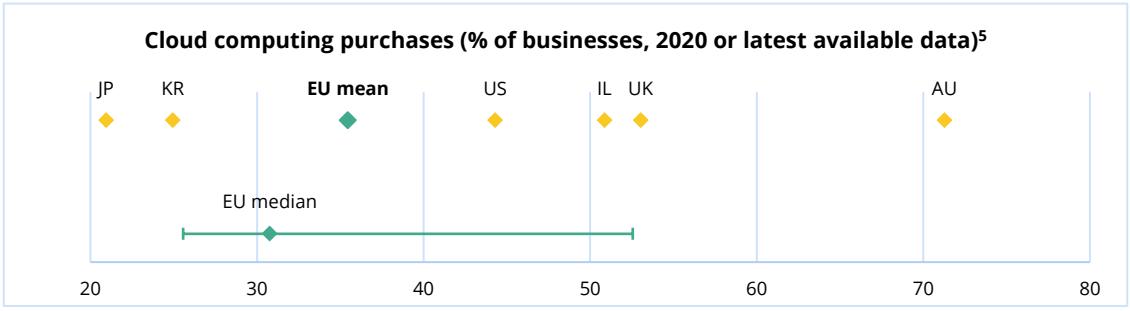
[2] The e-commerce composite index measures an economy's preparedness to support online shopping, and comprises four indicators: (1) account ownership at a financial institution or with a mobile money service provider; (2) individuals using the internet; (3) Postal Reliability Index; and (4) secure internet servers. See the methodological note in *Annex I* for more details.



Source: Network Readiness Index, based on the World Bank Executive Opinion Survey 2021.

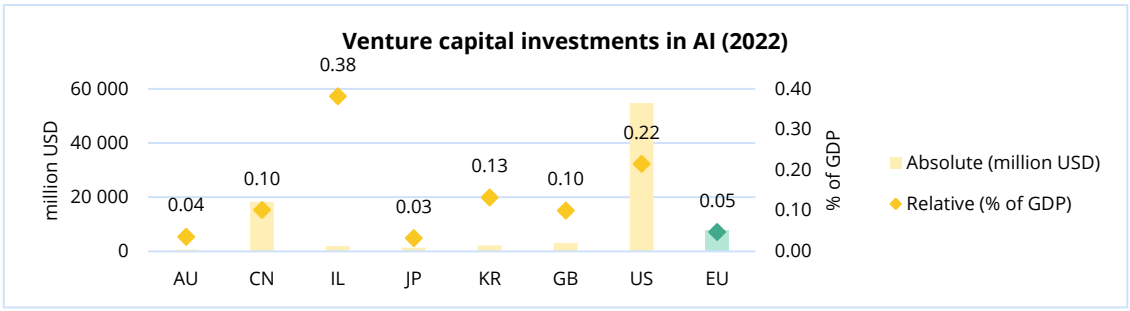
[3] Data for China are unavailable.

[4] The indicator refers to average responses in relation to five different emerging technologies (artificial intelligence, robotics, app- and web-enabled markets, big data analytics, and cloud computing), e.g. 'In your country, to what extent are companies adopting Artificial intelligence?'. See the methodological note in *Annex I* for more details.

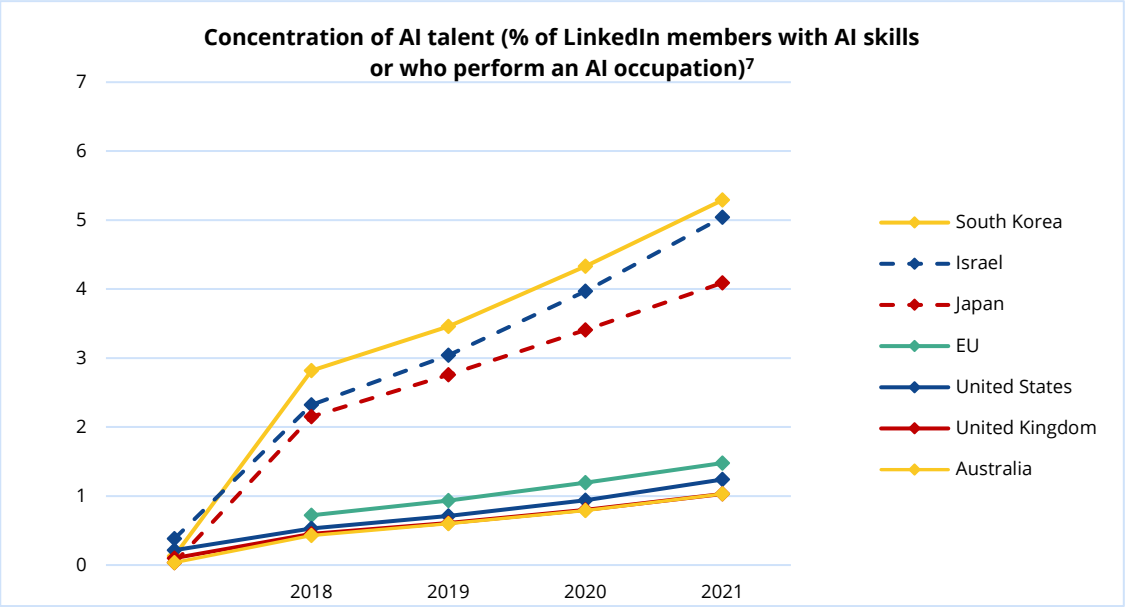


Source: OECD ICT Access and Usage by Businesses.

[5] Data for China are unavailable; data for 2020 are missing for Japan and the US, so data from 2019 and 2018, respectively, are used.

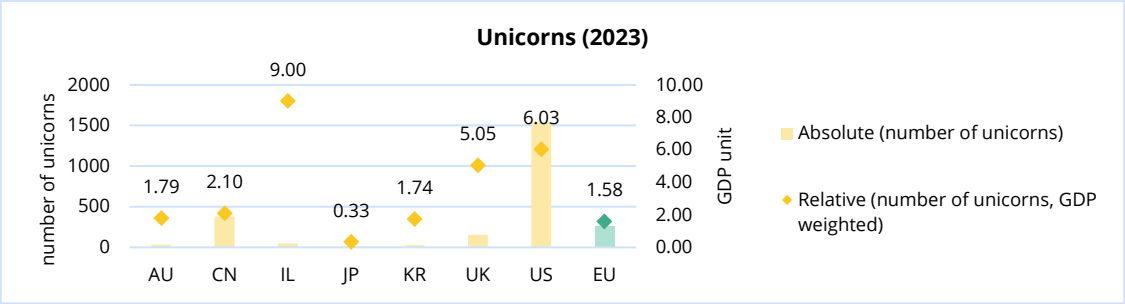


Source: OECD AI Policy Observatory.



Source: OECD AI Policy Observatory.

[7] Data for China are unavailable.

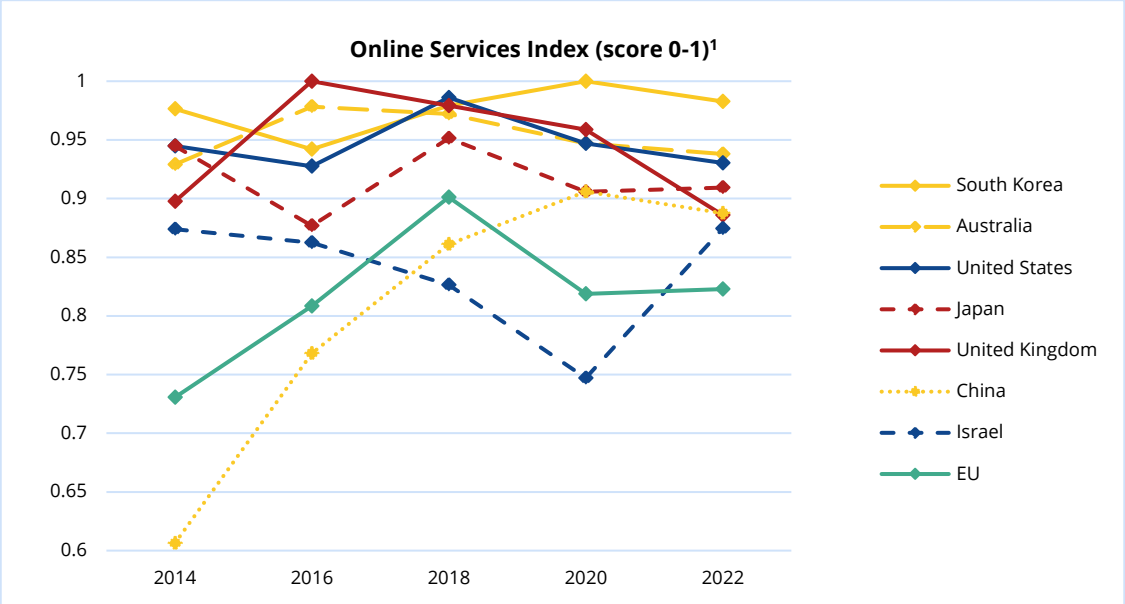


Source: Dealroom.

3.5. Digital public services

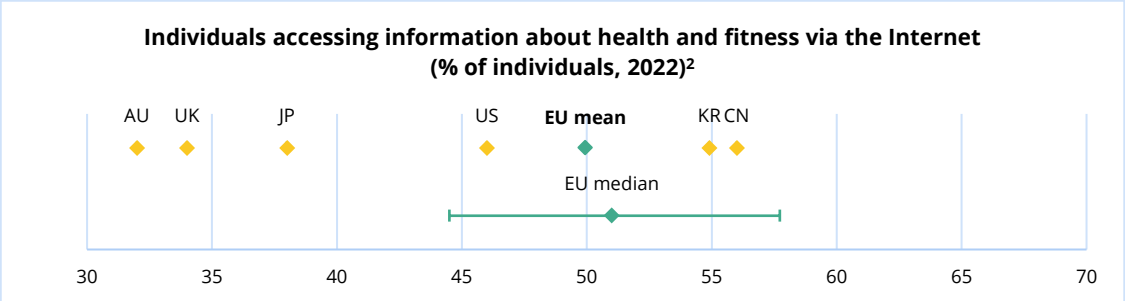
Despite experiencing various ups and downs over time (not least due to probable data collection bias, due to being survey-based), all countries in the sample score relatively high on the Online Services Index, and the differences between them are rather small. However, the EU average score is relatively low. More than 50 % of people in the EU access information about health via the internet (a demand-side proxy for the use of online services) – above most of the benchmark countries. The scoreboard also includes a table showing which countries enable access to e-health records/e-health services, and have implemented an eID system. The EU Member States are generally at the forefront in these respects.

Figure 4. Digital public services scoreboard



Source: UN E-Government Development Index (EGDI).

[1] The indicator is based on researchers' evaluation of the scope and quality of online services accessible through government websites in the native language (including the national portal, e-services portal and e-participation portal, as well as the websites of relevant ministries such as education, labour, social services, health, finance and the environment, where applicable). See the methodological note in *Annex I* for more details.



Source: The Economist Inclusive Internet Index.

[2] Data for Israel are unavailable.

	Access to e-health records or provision of e-health services (2022)	Provision of an eID system (2023)
Australia	Yes	Yes
China	No	No
Israel	n.d.	Yes
Japan	Yes	Yes
South Korea	Yes	Yes
United Kingdom	Yes	No
United States	Yes	No
EU	In 26 out of 27 MS	In 21 out of 27 MS

Source: The Economist Inclusive Internet Index and Digital Decade e-Health composite index; International Telecommunication Union and eID Digital Monitoring Dashboard (validated by authors' own research).

3.6. Key takeaways

The quantitative analysis first of all highlights the EU's internal diversity, as the distribution of scores among EU Member States tends to be wide, often surpassing the differences between the EU average and the scores of the benchmark countries. Most of the time, the EU average consistently ranks around the middle across different policy areas, as opposed to the benchmark countries, which excel in some measures and lag behind in others.[18] The EU stands out in the sample as a mid-to-high or mid-to-low performer only in a few indicators (high for fibre roll-out, and low for advanced digital skills, the number of unicorns per capita, and advanced technology uptake by businesses). In relative terms, 'Digital skills' is a weaker dimension for the EU compared with most of the sample countries (although the EU never ranks last in any of these indicators).

[18] This is also likely to be due to the aggregation of 27 scores for the average EU score, thus balancing out the strengths and weaknesses of its individual Member States.

4. Countries in review: country fiches

The next sections of the report dive deeper into country-level analysis, comparing each country's performance with that of the EU across the cardinal points of the DDPP and its KPIs, and examining each country's national policy background and frameworks (including specific policy actions taken by public authorities in the realm of digitalisation). The seven benchmark countries are covered in alphabetical order (Australia, China, Israel, Japan, South Korea, the United Kingdom, and the United States). Each country fiche is structured around three main areas:

1. *Background and progress in digitalisation* provides an overview of quantitative data to place the analysis into context.

2. *Policy context* zooms in on the policy framework (including policy priorities and the agencies responsible for digitalisation) and selected policy actions across the four cardinal points of the DDPP, based on expert interviews and policy mapping (see *Chapter 2* for more details).

3. *Conclusions and lessons learned* summarises the key takeaways.

Several caveats should be emphasised: first, the country fiches provide an exploratory glimpse into the position and policy approach of the countries selected, but should not be treated as attempts to comprehensively map the policy framework in each country. Furthermore, some biases are inevitably engrained in the analysis, due to the limited data collected (1-3 interviews and 5-8 core policy initiatives per country), e.g. in terms of balance in the coverage of each policy area (which are skewed towards the key interests of the interviewees) or the evaluation of progress (optimistic or pessimistic). Lastly, the fiches provide a snapshot in time of the country's progress, as well as its present and future-looking strategies and policies; a more in-depth examination of historical and institutional developments (including why certain countries emerge as leaders in particular areas) is beyond the scope of this analysis.

4.1. Australia

4.1.1. Background and progress in digitalisation

Australia is a large territory with a relatively small economy, although it is one of the richest among the benchmark countries as measured by GDP per capita (second only to the US), and the most developed (highest HDI score in the sample). Its R&D investments and ICT exports are below EU's average score.

Table 1. Australia: contextual data

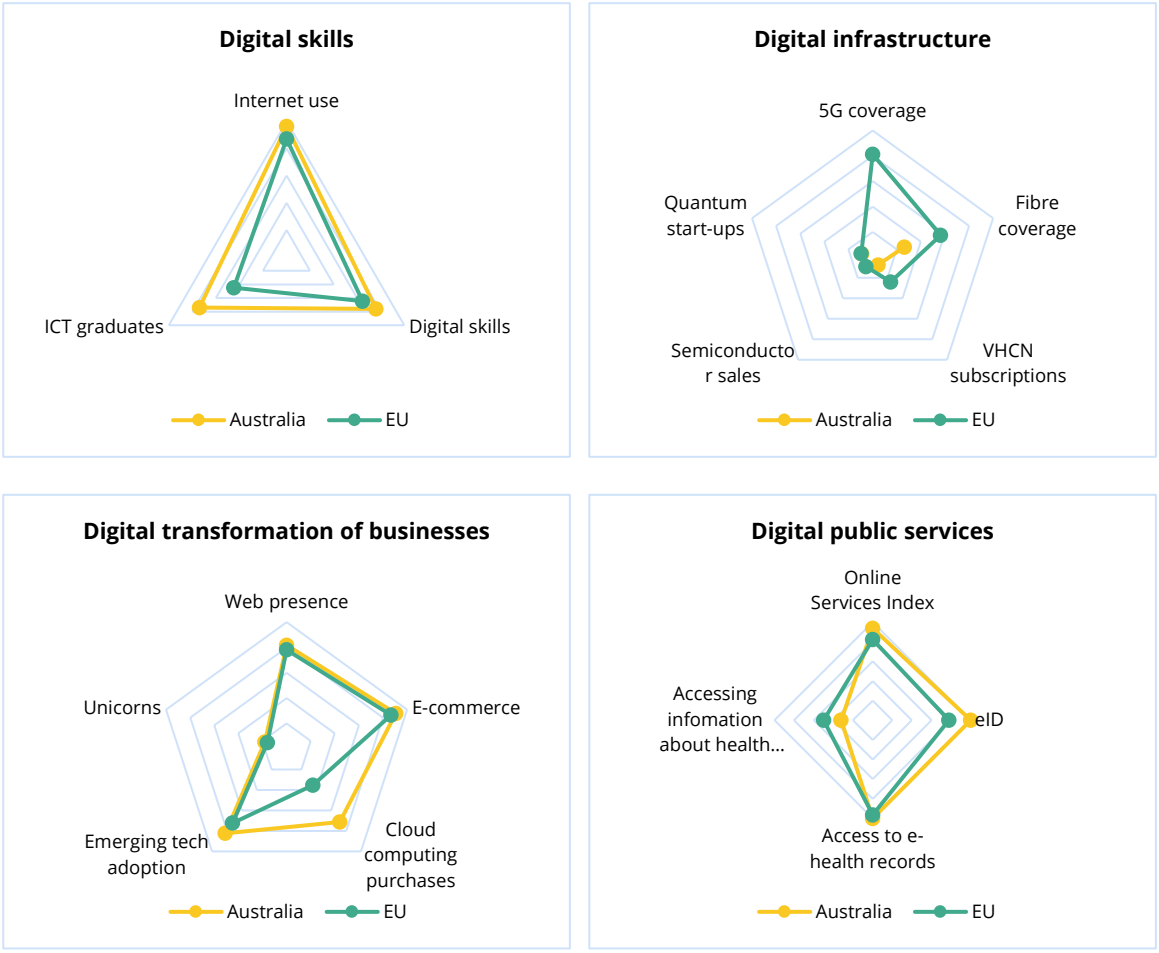
	Australia	EU		Australia	EU
Population (millions)	26.0	446.7	**Human Development Index (score 0-1)**	0.95	0.90
GDP (billion USD)	1,675	16,641	**R&D expenditure (% of GDP)**	1.8 %	2.3 %
GDP per capita (USD, PPP)	62,625	54,248	**ICT service exports (% of service exports)**	10.1 %	16.8 %

Source: compiled by the authors, based on the data collected (see *Annex I*).

Australia excels in its level of digital skills, and has the highest share of ICT graduates among all of the benchmark countries. Although the country's 5G roll-out is relatively advanced, fibre coverage and high-speed broadband subscription rates remain low.

Business indicators are at similar levels to those in the EU, although they diverge in the use of cloud computing services (where they are higher than the EU). Australia is among the highest scorers in the Online Services Index, which measures the quality of digital public services (in which Australia is second only to South Korea).

Figure 5. Australia: digitalisation dashboard



Source: compiled by the authors, based on the collected data (see *Annex I*).
Note: no data are available for Australia with regard to the '5G coverage' and 'semiconductor sales' indicators.

4.1.2. Policy context

Australia has long had sound foundations to be a leading digital economy globally. In particular, high levels of internet connectivity, education, as well as 'tech-savviness' and high propensity to adopt new technology, have helped to elevate Australia's position to that of one of the best performers in digitalisation, according to many international rankings.[19] Australia's policy framework is also one of the broadest and most comprehensive among the benchmark countries, with numerous policy actions across all key policy areas. Its key priorities, as defined in the 'Digital Economy Strategy',[20] correspond to the EU's DDPP. These include:

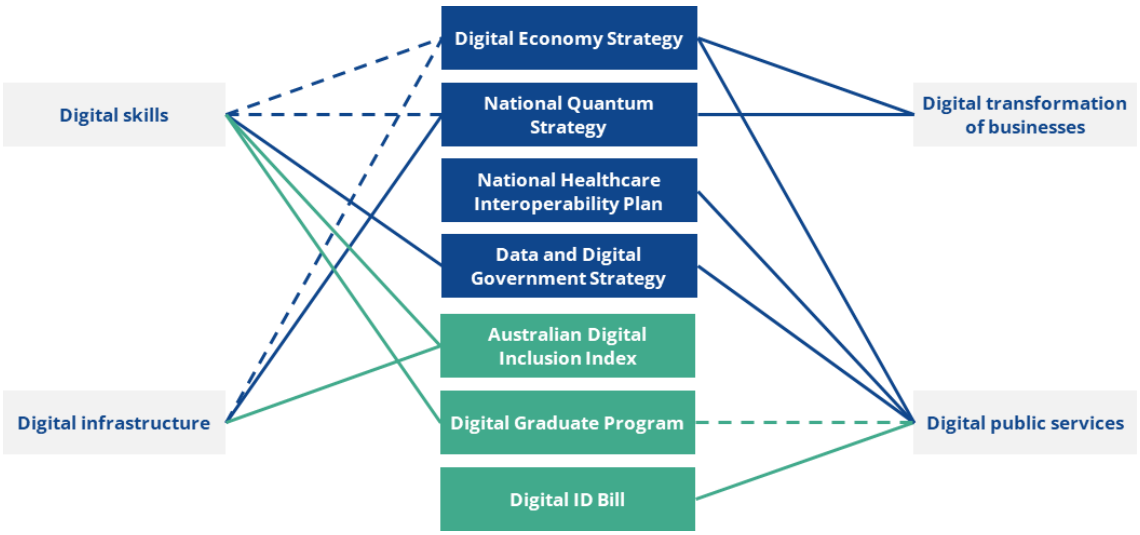
- Skills and inclusion;
- Digital infrastructure;

[19] See, for example, the CISCO Digital Readiness Index, available at: https://www.cisco.com/c/m/en_us/about/corporate-social-responsibility/research-resources/digital-readiness-index.html#/country/AUS.
[20] Digital Economy Strategy 2030, available at: https://apo.org.au/sites/default/files/resource-files/2021-05/apo-nid312247.pdf.

- Cybersecurity, safety and trust;
- Systems and regulation; and
- Trade and international engagement.

Despite Australia's progress, some challenges to digital development remain, most of them connected to the country's size (a small economy with a large area that is difficult to connect). This is why Australia has historically looked outwards towards international partners with which to cooperate and learn from, especially the Anglo-Saxon countries, but also the EU.[21] Furthermore, the small size of the country's population, combined with its relatively high geographical and economic diversity, has triggered responses at the level of its federal states that aim to exploit niches in which they might excel (e.g. the development of AI and co-bots in mining in Western Australia).[22]

Figure 6. Australia: policy map – examples of policy actions corresponding to the four cardinal points of the DDPP



Source: compiled by the authors, based on policy mapping (see *Annex II*).
Note: national strategies are marked in blue, policy initiatives in green, and funding programmes in yellow. Solid lines represent high relevance to a given cardinal point; dashed lines indicate secondary relevance.

Australians excel in terms of their level of **digital skills** (especially advanced skills, as measured by the rate of tertiary graduates in ICT – see above). Although no integrated digital skills strategy has been identified, digital education is an important component of overall education plans at all levels (school, university, vocational, and lifelong education). For example, Jobs and Skills Australia[23] provides skills demand projections and can offer users personalised suggestions for professional development for the digitalising world of work.[24] Based on these projections, the National Careers Institute[25] can help people to transition to more in-demand jobs (including through training). Recently, it has focused in particular on 'twin transition' jobs.[26] Emphasis is also placed on the transition from education to the labour market. For example, the Digital Graduate Program offers entry-level positions for university graduates (in digital or technical fields) in the Australian Public Service

[21] For example, one interviewee mentioned looking up to Germany for Industry 4.0 solutions, or building on the EU's DigComp for the development of a skills qualification framework (expert interviews, 2023-2024).
[22] Expert interviews, 2023-2024.
[23] Jobs and Skills Australia, available at: https://www.jobsandskills.gov.au/.
[24] Expert interviews, 2023-2024.
[25] National Careers Institute, available at: https://www.dewr.gov.au/nci.
[26] Expert interviews, 2023-2024.

(APS).[27] The government is also investing in PhD allowances for pathways relating to new technologies, in order to help PhD scholars to transition from academia to business.[28] Lastly, the area of skills is closely related to digital inclusion. Most notably, the Digital Inclusion Index tracks various metrics (digital literacy, access, affordability, etc.) across years and profiles (including income, age, rural/urban populations, and First Nation[29]/non-First Nation identities), which are used to plan responses and solutions.[30]

The deployment of **digital infrastructure** has been particularly challenging, given the country's large size compared with its small population, mostly concentrated in several large urban areas.[31] As reported by experts, due to a long-standing bi-partisan effort, connectivity has improved significantly over the years.[32] Nevertheless, the roll-out has been costly and long, and many remote communities still cannot enjoy high-speed internet access.[33] According to international data, the share of high-speed broadband subscriptions in Australia is lower than in any other benchmark country (see above).

Progress in the **digital transformation of businesses** appears mixed. On the one hand, Australians are reportedly, on average, proficient consumers of online services such as banking.[34] Australia also appears to have good foundations for the development of the digital economy – especially (digital) skills levels. On the other hand, Australia's business-related outcomes are moderate, and experts pointed out several obstacles hindering further progress. First, the economy is dominated by SMEs, while there is a lack of large companies that could lead ambitious technology development projects.[35] Second, while the level of research and development is high, there is a missing link between science and market adoption – partly due to the limited availability of venture capital – and, as a result, a large share of start-ups are 'emigrating' to other markets.[36] While blanket digitalisation investments or policy initiatives are absent or limited in this sphere,[37] the government does fund industries to provide ideas or pilot cases in selected areas[38] and promotes certain technologies such as AI or quantum computing. For example, the National Quantum Strategy focuses on addressing the core challenges, including connecting talent, research and businesses through research funding and commercialisation incentives.

Lastly, **digital public services** in Australia are highly developed and widely used.[39] The myGov platform offers access via web and mobile to 15 digital government services, and serves 25 million active accounts (as of January 2023).[40] Nevertheless, some more far-reaching initiatives, especially the e-healthcare reform, have been met with a degree of backlash from society, spurred by concerns over data security and privacy.[41] This backlash

[27] Digital Graduate Program, available at: https://www.digitalprofession.gov.au/career-development/emerging-talent-programs/digital-graduate-program.
[28] Expert interviews, 2023-2024.
[29] First Nation refers to people who have identified themselves, or have been identified by a representative (for example, their parent or guardian), as being of Aboriginal and/or Torres Strait Islander origin. See: Profile of First Nation peoples, available at: https://www.aihw.gov.au/reports/australias-welfare/profile-of-indigenous-australians.
[30] Digital Inclusion Index, available at: https://www.digitalinclusionindex.org.au/key-findings-and-next-steps/.
[31] Expert interviews, 2023-2024.
[32] This has been led by a public enterprise, the National Broadband Network (NBN), established in 2009. See: https://www.nbnco.com.au/.
[33] Expert interviews, 2023-2024. See also the Digital Inclusion Index, available at: https://www.digitalinclusionindex.org.au/key-findings-and-next-steps/.
[34] Expert interviews, 2023-2024.
[35] Expert interviews, 2023-2024.
[36] Expert interviews, 2023-2024.
[37] For example, the Digital Business Plan has invested USD 796.5 million in facilitating digitalisation, but focuses on pre-conditions such as digital infrastructure and skills, fit-for-purpose regulatory frameworks, and digital engagement with the government by businesses. See: https://www.dfat.gov.au/about-us/publications/trade-and-investment/business-envoy-april-2021-digital-trade-edition/towards-2030-positioning-australia-leading-digital-economy-and-society.
[38] e.g. AI for mining; see the Digital Economy Strategy 2030, available at: https://apo.org.au/sites/default/files/resource-files/2021-05/apo-nid312247.pdf, p. 7.
[39] Expert interviews, 2023-2024.
[40] Critical National Infrastructure: the myGov User Audit, available at: https://my.gov.au/content/dam/mygov/documents/audit/mygov-useraudit-jan2023-report-summary.pdf.
[41] Expert interviews, 2023-2024.

has led the government to introduce an opt-out option, and reflects a general culture of distrust towards authority, as far as (detailed) personal data are concerned.[42] Furthermore, digital identity legislation has been a priority for the government, and the Digital ID Bill (2023) has re-introduced a comprehensive plan for eID roll-out, based on a more secure, double-blind authentication process.[43] Responding to public concerns and the culture of distrust noted above, the system is based on an opt-in model, but the take-up of the eID scheme has gradually increased (to 2.5 million users, as of January 2023).[44] More broadly, the digitalisation of public services is led by a dedicated body – the Digital Transformation Agency – based on an overarching and detailed plan, the Data and Digital Government Strategy (see the box *Policy in focus,* below).

Policy in focus: the Data and Digital Government Strategy

The Strategy recognises several challenges of digital public administration, including cybersecurity and limited public trust, as well as the prevalence of outdated and legacy technologies, siloed or duplicated data, and the general need for better data to inform evidence-based policymaking.[45] It is built around five broad missions:

- Delivering for all people and business, including initiatives related to accessibility standards and open data;
- Simple and seamless services, including eID roll-out and the modernisation of the national digital health infrastructure;
- Government for the future, including the incorporation of new technologies into public services and maximising the use of data to evaluate public policy;
- Trusted and secure, including data ethics and data privacy frameworks, and a cybersecurity strategy; and
- Data and digital foundations, including data governance and the digital preparedness of the public service workforce.

Each mission is operationalised in a 'roadmap' outlining specific initiatives to be implemented in a strict timeline.[46]

4.1.3. Conclusions and lessons learned

Australia has one of the most comprehensive digitalisation policy frameworks among the benchmark countries, with strategies and initiatives spanning all key policy areas, clearly articulating key challenges, setting clear targets, and detailing specific actions to be taken to achieve these. The present political priorities appear to focus most closely on: (1) improving digital skills and digital inclusion; and (2) enhancing digital public services through an integrated approach. In particular, the digitalisation of public administration is wide-reaching, focusing on the provision of e-services, but also on broader themes such as digital skills among public servants, cybersecurity, the integration of new technology, and the use of data for policy evaluation.

4.2. China

4.2.1. Background and progress in digitalisation

China is the second most populous country in the world (marginally surpassed by India), and the second biggest economy (after the US). It is the only developing, or middle-income, economy among the benchmark countries, with wealth and development indicators (GDP per capita, HDI) significantly below the EU average, and lower R&D investments and ICT service exports.

[42] Expert interviews, 2023-2024.
[43] Expert interviews, 2023-2024.
[44] Critical National Infrastructure: the myGov User Audit, available at: https://my.gov.au/content/dam/mygov/documents/audit/mygov-useraudit-jan2023-report-summary.pdf.
[45] Data and Digital Government Strategy: The data and digital vision for a world-class APS to 2030, available at: https://www.dataanddigital.gov.au/sites/default/files/2023-12/Data%20and%20Digital%20Government%20Strategy%20v1.0.pdf.
[46] Data and Digital Government Strategy: Implementation Roadmap, available at: https://www.dataanddigital.gov.au/sites/default/files/2023-12/Data%20and%20Digital%20Roadmap%20v1.0.pdf.

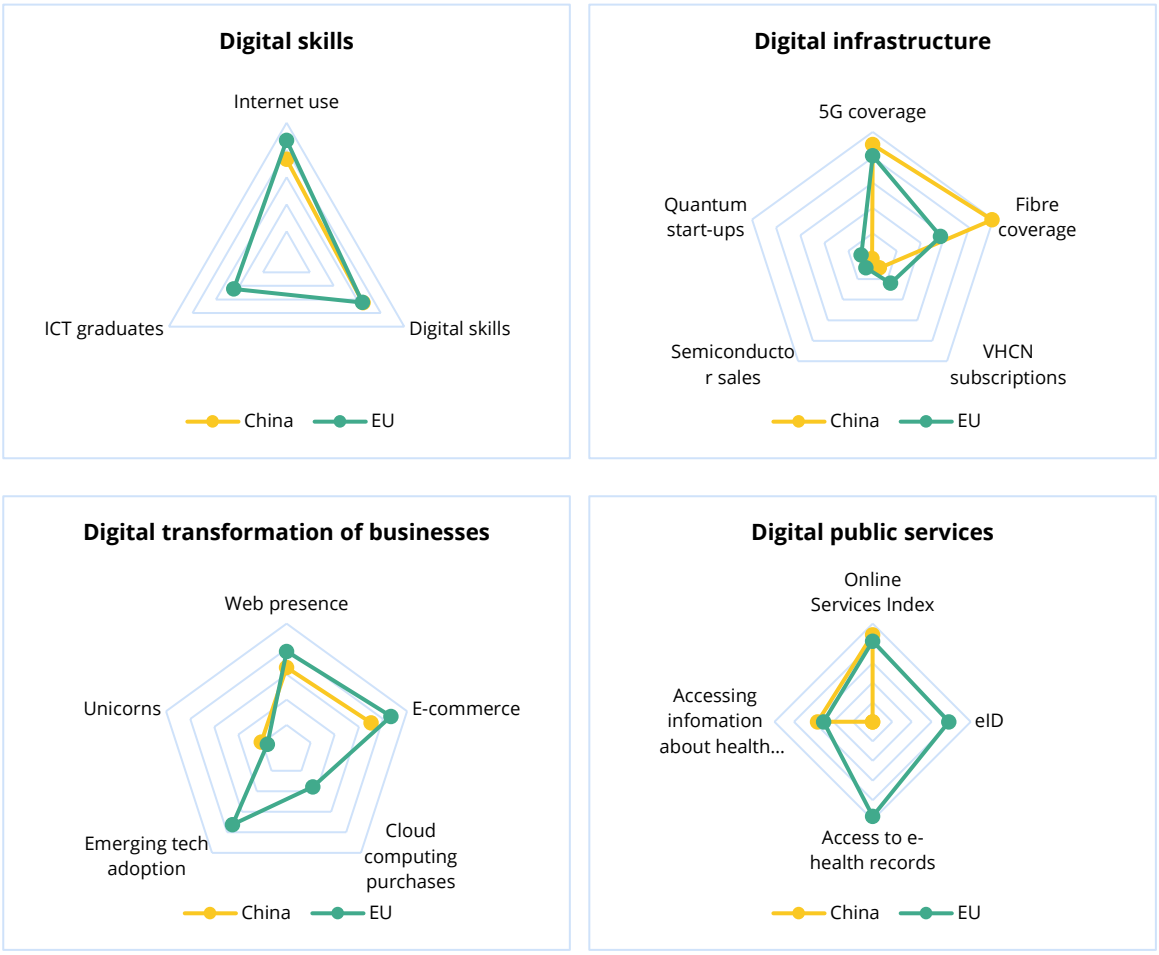
Table 2. China: contextual data

	China	EU		China	EU
Population (millions)	1,412.2	446.7	**Human Development Index (score 0-1)**	0.77	0.90
GDP (billion USD)	17,963	16,641	**R&D expenditure (% of GDP)**	1.8 %	2.3 %
GDP per capita (USD, PPP)	21,476	54,248	**ICT service exports (% of service exports)**	10.1 %	16.8 %

Source: compiled by the authors, based on the data collected (see *Annex I*).

Data for China is missing from international sources for several key proxies across the cardinal points of the DDPP. In those indicators that are covered, China either scores lower than the EU average (especially with regard to digital infrastructure, except for fibre coverage) or around the same (in relation to digital skills, the basic digital intensity of businesses, and digital public services).

Figure 7. China: Digitalisation dashboard



Source: compiled by the authors, based on the data collected (see *Annex I*).
Note: no data are available for China in relation to the 'ICT graduates', 'fibre subscriptions', 'emerging tech adoption' and 'cloud computing purchases' indicators.

4.2.2. Policy context

Digitalisation policy in China centres around two notions or objectives: (1) cybersecurity, understood broadly as preventing the potential 'harm that might be inflicted through digitally enabled means on economic, political and social stability'; and (2) informatisation, meaning

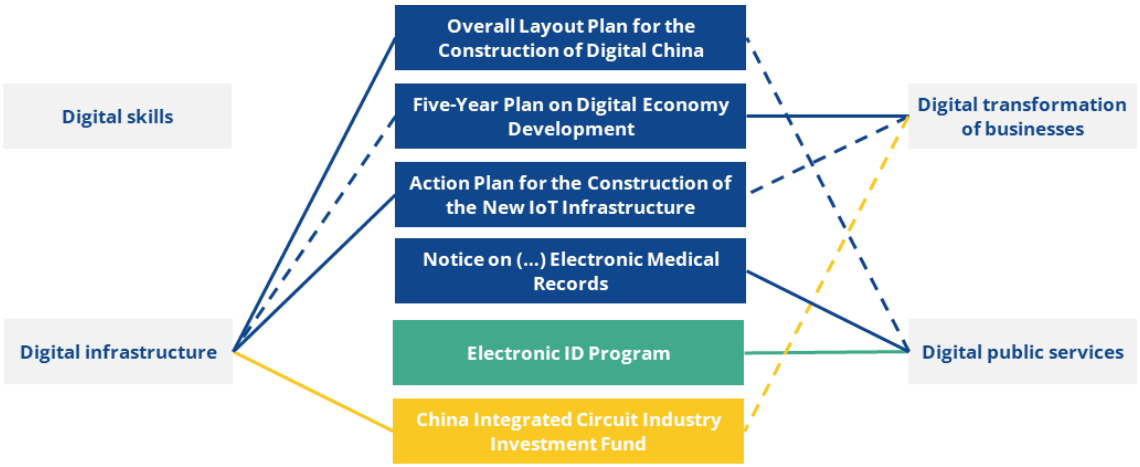
'the introduction of information technologies into economic, social and political processes in order to enhance their functioning, promote development and sustain growth'.[47] While technological progress has, for some time, been recognised by the Chinese leadership as paramount to economic growth, digitalisation has become a matter of the highest political priority in the last decade, marked by the establishment of the Central Commission for Cybersecurity and Informatization (CCCI) in 2014.[48] The CCCI is a coordination body, centralising all digital policymaking (which was previously fragmented across multiple ministries), and chaired by China's president Xi Jinping himself.[49]

China's approach to strategy formulation follows the 'Russian doll' structure, whereby the overarching plan – presently the '14th Five-Year Plan for National Informatization (2021–2025)' – is issued by the CCCI, and outlines a wide array of policy priorities. Next, levels of 'sub-plans' are created by ministries or coordinating bodies within their areas of responsibility, to operationalise these priorities into more specific policy objectives and actions.[50] While China's informatisation strategy is wide-reaching and spans multiple policy areas, several critical and/or unique themes can be identified in the Chinese policy context, along two key axes:

- *International relations*. China's digitalisation policy is shaped, to a large extent, by its ideological conflict and power struggle with the US (and, to a lesser degree, with Europe) for global technological leadership. China's dependence on foreign trade and its reliance on international supply chains (including those for semiconductors), combined with geopolitical tensions, have pressured the country to become more independent on the one hand (digital or technological sovereignty), as well as more central to the global digital scene (digital leadership). At the same time, China has been increasing its influence in the Global South. This has been achieved, for example, through the 'Digital Silk Road' initiative, which provides assistance for the development of digital connectivity (e.g. 5G, submarine and overland fibre-optic cables, data centres, etc.), but also emerging technologies (such as quantum computing or AI).[51]
- *Domestic considerations*. In broad terms, there is a general belief among Chinese technocrats that broad technological progress is a solution to most social and economic challenges, although the need to direct this progress in order to add value in economic and social terms (as opposed to the mere financialisation of the digital sector) is also increasingly recognised. Simultaneously, in the area of cutting-edge technologies, the government has taken a central planning role, prioritising particular technologies (including 5G, AI, or biotech) and committing large top-down investments to develop these, rather than facilitating a more market-driven growth. While such an approach (i.e. the concentration of scarce resources in priority areas) is deemed justified by some experts due to China's relatively early stage of development, there is a lingering risk that resources may be misallocated towards sub-optimal technologies.[52]

[47] Creemers, R. (2022). *China's Digital Policies in Its New Era*. EU Cyber Direct – EU Cyber Diplomacy Initiative, available at: https://eucd.s3.eu-central-1.amazonaws.com/eucd/assets/t2c-qGbv/china-s-digital-policies-in-its-new-era.pdf, p. 3. See also: Creemers, R. & Triolo, P. (2022). *Analyzing China's 2021–2025 Informatization Plan: A DigiChina Forum.* DigiChina, available at: https://digichina.stanford.edu/work/analyzing-chinas-2021-2025-informatization-plan-a-digichina-forum/.
[48] Also translated as 'Central Cyberspace Affairs Commission'.
[49] Expert interviews, 2023-2024.
[50] Expert interviews, 2023-2024.
[51] Expert interviews, 2023-2024.
[52] Expert interviews, 2023-2024.

Figure 8. China: policy map – examples of policy actions corresponding to the four cardinal points of the DDPP



Source: compiled by the authors, based on policy mapping (see *Annex II*).
Note: national strategies are marked in blue, policy initiatives in green, and funding programmes in yellow. Solid lines represent high relevance to a given cardinal point; dashed lines indicate secondary relevance.

In the area of **digital skills**, several digitalisation strategies include components relating to skills, but a single digital education plan does not exist.[53] No specific programmes on the improvement of digital skills have been identified at national level either, although some initiatives are implemented at local level by local authorities (e.g. smartphone training for the elderly), education institutions (e.g. extracurricular classes at universities), and even service providers (e.g. training programmes by broadband providers to facilitate the use of the internet).[54] Furthermore, the state has been investing extensively in advanced digital skills, and particularly in education – including state-funded education abroad – as well as academic and applied research in (selected) emerging technologies.[55]

The measures of **digital infrastructure** development included in this study place China at the low end in comparison to other benchmark countries and to the EU. However, the experts interviewed emphasised that – especially given its current level of development – China is very well connected, having made rapid and extensive progress in recent years.[56] Indeed, according to data from Omdia, 5G coverage in China increased from 17 % in 2019 to 90 % in 2022, and China is now moving into 6G research.[57] Similarly, the roll-out of fibre broadband has almost been completed, covering nearly all of China's population (even though the take-up of high-speed internet remains low). The deployment of digital infrastructure has been laid out, among other policy plans, in the 'Overall Layout Plan for the Construction of Digital China'. This plan involves a limited number of state-owned companies competing with one another for public funds to roll out services across China's regions (a situation described as 'managed competition').[58] In addition to basic connectivity, China is implementing strategies aimed at the development of more advanced technology – for example, the '3-year Action Plan for the Construction of the New Internet of Things Infrastructure' outlines China's ambition to advance the integration of the digital with the physical (e.g. through smart transportation, smart agriculture, smart manufacturing, smart construction, smart homes, etc.). Lastly, the China Integrated Circuit Industry Investment

[53] Expert interviews, 2023-2024.
[54] Expert interviews, 2023-2024.
[55] For example, Chinese research on blockchain has grown rapidly, and China published the greatest number of blockchain papers in the world in 2019. See: Wang, Q., Su, M., & Li, R. (2020). Is China the world's blockchain leader? Evidence, evolution and outlook of China's blockchain research. *Journal of Cleaner Production*, *264*, 121742.
[56] Expert interviews, 2023-2024.
[57] Expert interviews, 2023-2024.
[58] Expert interviews, 2023-2024.

Fund aims to further China's semiconductor manufacturing capabilities (see the box *Policy in focus,* below).

Policy in focus: the China Integrated Circuit Industry Investment Fund

This USD 45 billion[59] fund invests in selected companies operating in semiconductors and related industries, to develop China's integrated circuit industry ecosystem and explore potential business opportunities in the sector. The fund maintains a minority shareholding in over 70 companies. Many of these companies are themselves investment funds dedicated to funding semiconductor research, development and manufacturing.

While the Fund's first investment phase focused on chip manufacturing, its second phase (known as 'Big Fund II') appears to have increased investment in key links of the industry chain, including chip design, equipment, components and raw materials.

According to Chinese observers, the Fund strengthens China's semiconductor industry chain.[60] Even though it is considered successful in some respects, the Fund has also faced a series of scandals, including the misappropriation of funds (especially by local governments), fraud and failed investments, often leading to bankruptcies. Overall, questions have arisen with regard to the Fund's efficiency, not least in the context of a significant failure to meet its target (detailed in the 'Made in China 2025' plan) of having 58 % of the chips used domestically to be made in China by 2020, and 80 % by 2030. In 2021, chips manufactured within China's borders accounted for only 16 % of the chips used in the country.[61]

With regard to the **digital transformation of businesses**, Chinese progress appears somewhat uneven. On the one hand, as emphasised by the experts consulted, China is the only country (except for the US) that hosts large online services platforms (such as Alibaba or WeChat).[62] These have been paramount in increasing the uptake of digital solutions, which have become almost inevitable in the everyday life of most Chinese. However, the Chinese leadership's view of these platforms has shifted somewhat from seeing them as a core driver of development to 'nice-to-have' disruptions that provide only limited enduring improvements to economic progress (and involve a degree of the transfer of gains to foreign investors).[63] Instead, China has re-focused on two other priority areas. By far the most important of these is the development and adoption of cutting-edge technologies (such as AI), building on another of China's success stories – its industrial ecosystem, including hardware and software giants (Huawei, Xiaomi), which provides low-cost but reliable and advanced products. Another, less prominent, policy pathway is the digitalisation of SMEs, which envisions the incorporation of more established technologies into traditional sectors (blockchain and e-commerce into services, automation and 3D printing into manufacturing and construction, satellite technology into agriculture, and so on), as indicated in the '5-year Plan for Digital Economy Development'.

Lastly, the development and adoption of **digital public services** is uneven. Most public services (including business licencing, issuance of IDs, taxation, healthcare) are delivered by provincial or local governments, and thus vary across the country, particularly with respect to the urban-rural divide. Other characteristic features of China's approach to government digitalisation include:

- *Piloting and scaling up.* Large cities often introduce pilot projects (creating yet more fragmentation and diversity) that can then be scaled up.[64] For instance, digital IDs have been tested since 2018 and are currently accepted in more than 15 major cities across China. The Electronic ID Program aims to increase the coverage of these schemes. Likewise, healthcare providers across the country have introduced

[59] Assets under management.
[60] Global Times (2023). *China's Big Fund invests heavily in semiconductors as nation speeds up efforts to make breakthroughs*, available at: https://www.globaltimes.cn/page/202312/1303068.shtml.
[61] See, for example, The Straits Times (2022). *Graft scandal casts long shadow over China's chipmaking ambitions*, available at: https://www.straitstimes.com/asia/east-asia/graft-scandal-casts-long-shadow-over-chinas-chipmaking-ambitions.
[62] Expert interviews, 2023-2024.
[63] Expert interviews, 2023-2024.
[64] Expert interviews, 2023-2024.

various electronic health record systems, most of which are not integrated or interoperable. The 'Notice on further promoting the digitalization of Medical Institutions with Electronic Medical Records as the core' aims to facilitate the further digitalisation of healthcare and system integration.

- *Cooperation with industry.* State-owned platform giants are often involved in the roll-out or integration of digital public services, given their extremely high penetration rates in society. For example, China's Electronic ID Program assumes the involvement of banks and tech companies to enhance the utility of eIDs.
- *Public service efficiency.* The management and utilisation of data, through the National Data Bureau and local 'data management offices', is expected to improve policymaking, while apps for tracking the day-to-day work of public servants aim to ensure the efficient functioning of the public service system (paired with 'review and complaints' systems, via which citizens can rate service quality).[65]
- *Ideological education.* Developed by the Alibaba Group, '*Xuexi Qiangguo'* is the flagship education or propaganda app, designed to teach the political thinking of Xi Jinping.[66]

4.2.3. Conclusions and lessons learned

China's progress in digitalisation has been marked by the dominance of large enterprises in both the service and manufacturing sectors. These giants are state-owned, and while they enjoy a degree of financial support and regulatory protection, they are also exposed to a degree of competition – either through internal 'managed' competition (e.g. with regard to connectivity) or through exposure to international markets (e.g. platform services). More broadly, the policy framework is shaped by international pressures on the one hand (concerns over digital sovereignty, the race for global technological supremacy), and by domestic challenges on the other (digital preparedness as a precondition for sustained growth).

4.3. Israel

4.3.1. Background and progress in digitalisation

Israel is a small country with a small economy, but with wealth and development levels comparable to the EU average. It has, by far, the highest rates of R&D investment and ICT services exports in the sample.

Table 3. Israel: contextual data

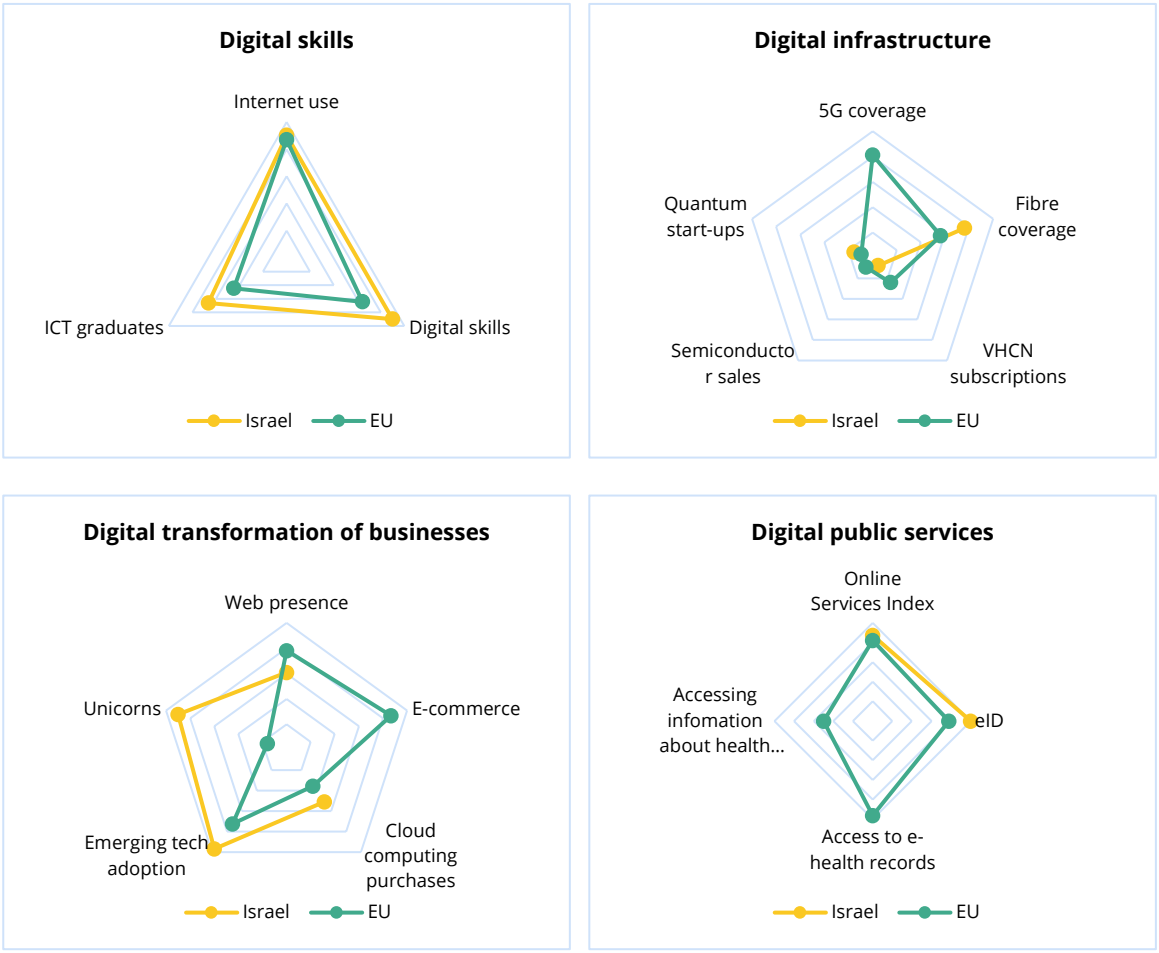
	Israel	EU		Israel	EU
Population (millions)	9.6	446.7	**Human Development Index (score 0-1)**	0.92	0.90
GDP (billion USD)	522	16,641	**R&D expenditure (% of GDP)**	5.4 %	2.3 %
GDP per capita (USD, PPP)	49,509	54,248	**ICT service exports (% of service exports)**	52.5 %	16.8 %

Source: compiled by the authors, based on the data collected (see *Annex I*).

[65] Expert interviews, 2023-2024.
[66] Expert interviews, 2023-2024. See also: South China Morning Post (2019). *China's most popular app is a propaganda tool teaching Xi Jinping thought*, available at: https://www.scmp.com/tech/apps-social/article/2186037/chinas-most-popular-app-propaganda-tool-teaching-xi-jinping-thought.

Israel has the highest score for digital skills in the sample, and second highest for ICT graduates (only ranking behind Australia). It is also home to the highest number of unicorns (GDP-weighted) among the benchmark countries, although it lags behind in some measures of digital infrastructure, both mobile and fixed. No data are available on the Israeli e-health system.

Figure 9. Israel: Digitalisation dashboard



Source: compiled by the authors, based on the data collected (see *Annex I*).
Note: no data are available for Israel with regard to the '5G coverage', 'semiconductor sales', 'e-commerce', 'access to e-health records', and 'accessing information about health online' indicators.

4.3.2. Policy context

Proclaiming itself the 'start-up nation', Israel appears well-positioned to exploit the advantages of the digital revolution. Nevertheless, some salient policy and societal challenges persist, among them the key priority of Israel's flagship strategy, 'Digital Israel' – tackling the digital divide, and improving equity with regard to the benefits derived from digitalisation.[67]

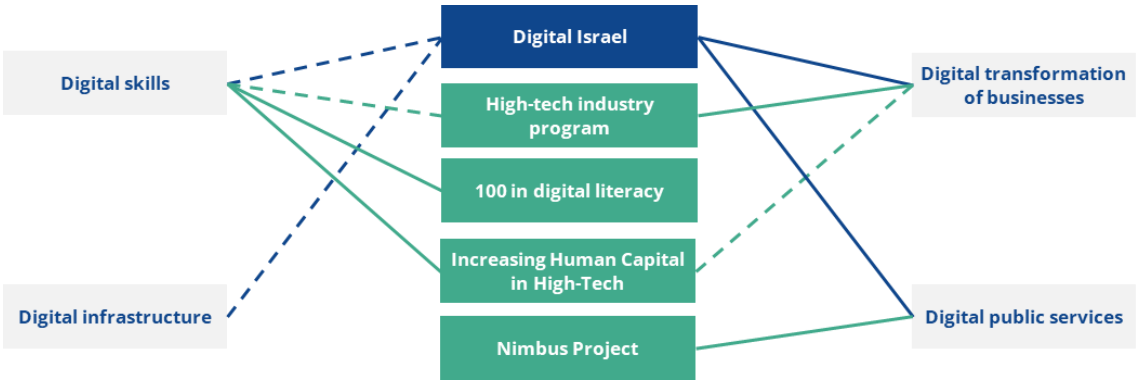
Responsibility for digital policies in Israel is distributed between ministries and agencies (including the Ministry of Social Equality; Ministry of Economy; Ministry of Innovation, Science and Technology; Ministry of Education; and the Israeli Innovation Authority).[68]

[67] The Digital Israel National Initiative: The National Digital Program of the Government of Israel, available at: https://www.gov.il/BlobFolder/news/digital_israel_national_plan/en/The%20National%20Digital%20Program%20of%20the%20Government%20of%20Israel.pdf.
[68] Expert interviews, 2023-2024.

Nevertheless, some inter-ministerial bodies have also been created to facilitate certain aspects of digitalisation. For example, the Digital Israel Bureau has been established to facilitate the development of inter-ministerial digital programmes along 'horizontal areas' of the 'Digital Israel' initiative (such as procurement, regulation, or the realisation of rights).[69] The Israel National Digital Agency is another umbrella body, tasked with facilitating the digitalisation and modernisation of the ministries themselves (and public services in general).[70]

These efforts have tried to solve one of the key obstacles in (digital) policymaking – namely, high political instability and turnover, which hinders both long-term strategic planning and coordination across government.[71] Sustainable investment has been also identified as a necessary precondition for government agencies to develop digitalisation strategies in the long term (rather than relying on one-off project funding to finance narrow initiatives, which is the more prevalent method).[72]

Figure 10. Israel: policy map – examples of policy actions corresponding to the four cardinal points of the DDPP



Source: compiled by the authors, based on policy mapping (see *Annex II*).
Note: national strategies are marked in blue, policy initiatives in green, and funding programmes in yellow. Solid lines represent high relevance to a given cardinal point; dashed lines indicate secondary relevance.

The picture of **digital skills** in Israel is diverse. On the one hand, Israel is the top scorer in measures of basic digital skills, and has second-highest share of ICT graduates among the benchmark countries (see above). On the other hand, the population is split between the majority of highly skilled and early digital adopters, and a minority of digitally under-skilled or illiterate. The latter group include in particular the elderly and ethnic and religious minorities, including the Arab and the ultra-Orthodox communities (who may be educated overall, but avoid using technology by choice). Programmes such as '100 in digital literacy' have targeted these communities and, through local governments, provided them with basic digital education and encouraging the use of technology.[73] But policy actions have also been targeted towards facilitating the acquisition of advanced digital skills; for example, the Committee for Increasing Human Capital in High-Tech has been established to implement the goal set in government guidelines to increase the percentage of high-tech employees

[69] The Digital Israel National Initiative: The National Digital Program of the Government of Israel, available at: https://www.gov.il/BlobFolder/news/digital_israel_national_plan/en/The%20National%20Digital%20Program%20of%20the%20Government%20of%20Israel.pdf.
[70] Expert interviews, 2023-2024.
[71] Expert interviews, 2023-2024.
[72] Expert interviews, 2023-2024.
[73] See, for example, Al Monitor (2022). Israel advances digital literacy project for ultra-Orthodox, available at: https://www.al-monitor.com/originals/2022/04/israel-advances-digital-literacy-project-ultra-orthodox.

in the economy's workforce to 15 % by 2026[74] (in addition to its secondary goal of increasing the employment of underrepresented populations in these jobs).[75]

The evidence gathered for the purposes of this study is insufficient to comprehensively assess Israel's progress in deploying **digital infrastructure**. No large-scale infrastructure projects or policy plans have been identified, although according to public sources, the Ministry of Communication is supporting the roll-out of both 5G networks[76] and fibre broadband.[77] The ministry reports that (as of the end of June 2023), approximately 83 % of households in Israel had access to fibre-optic infrastructure, and it is expected that by 2027, all households will be able to connect to fibre broadband.[78] Nevertheless, the take-up of 5G and high-speed broadband (including fibre) in Israel remain low, according to international data (see above), and the ministry itself acknowledges 'the infrastructural disparity between Israel and the world'.[79]

Progress in the **digital transformation of businesses** is double-edged. On the one hand, Israel has the lowest score among the benchmark countries for the basic digital intensity of businesses proxy (namely, web presence; see above). On the other hand, technological innovation is a key driver of economic growth in Israel, with the highest number of unicorns (in relation to GDP) among the benchmark countries, and with high-tech industry accounting for 15 % of Israel's GDP and 43 % of its exports, according to national sources.[80] Israel also scores higher than the EU with regard to the adoption of emerging technologies and cloud computing purchases. The policy focus seems to be on the former – promoting innovation and high-tech industry, for example, through the aforementioned Committee for Increasing Human Capital in High-Tech or the 'High-tech industry program' ('A program to promote innovation, encourage the growth of the high-tech industry and strengthen technological and scientific leadership'[81]). Both emphasise the need to train and attract talent to Israel's high-tech industry, while the latter also provides a set of tax and regulatory incentives for capital investments and start-up launches.

Recent efforts to improve **digital public services** have revolved around centralisation and data exchange between entities. In the area of healthcare, the country's three (private) healthcare providers have been connected with one another through a single (government-led) digital system to facilitate data sharing. A data platform (Israel's National Health Research Platform – *TIMNA*), has been also established to enable researchers to access unique databases and conduct research on the healthcare system.[82] Similar trends are underway in the government itself – the siloed systems created by different arms of the government (e.g. social security or tax authorities) are gradually being merged into a single, shared system. This process is coordinated by the Israel National Digital Agency (see the box *Policy in focus,* below). These merged systems are accessible through the gov.il platform[83], which can be also entered via the Government Identification System (GovID).[84]

---

[74] The percentage in 2021 was 14 %.

[75] Report by the Committee for Increasing Human Capital in High-Tech, available at: https://www.gov.il/BlobFolder/news/rfp20221110/he/increasing%20human%20capital%20in%20high%20tech%20Nov%202022.pdf.

[76] See: 5th Generation, available at: https://www.gov.il/en/departments/topics/5th-generation/govil-landing-page.

[77] See: Optic Fibre, available at: https://www.gov.il/en/departments/topics/optic_fiber/govil-landing-page

[78] Ministry of Communications (2023). Israel is connecting – and now the fiber optic revolution is coming to Hevron as well. https://www.gov.il/en/departments/news/22082023.

[79] Ministry of Communications (2023). Israel is connecting: The 5G revolution and increased competition and diversity in the communications market are underway. https://www.gov.il/en/departments/news/26022023_1.

[80] Israel Innovation Authority's Annual Innovation Report, cited in the report by the Committee for Increasing Human Capital in High-Tech, available at: https://www.gov.il/BlobFolder/news/rfp20221110/he/increasing%20human%20capital%20in%20high%20tech%20Nov%202022.pdf.

[81] 'A program to promote innovation, encourage the growth of the high-tech industry and strengthen technological and scientific leadership', available at: https://www.gov.il/he/departments/policies/most_policy20210801.

[82] Expert interviews, 2023-2024.

[83] gov.il, available at: https://www.gov.il/en.

[84] Around 50 % of Israel's adult population is said to have registered with the GovID (expert interviews, 2023-2024).

Lastly, tailored digital leadership training programmes have been provided to public servants (mostly those in executive positions) to facilitate digital transformation within public authorities.[85]

Policy in focus: the Israel National Digital Agency

This agency has been established to coordinate the government's efforts to digitalise. Its key roles include:[86]

- Designing strategies and policies for the government, including measurement and evaluation;
- Assisting government departments with digitalisation (including skills training, digital leadership, knowledge sharing, etc.);
- Providing services and infrastructure, including portals shared across ministries and agencies, the citizen-facing e-gov platform, as well as cybersecurity; and
- Inter-organisational and/or sectoral coordination of projects in the digital sphere.

The Agency's flagship project since 2021 has been Nimbus, which aims to provide public cloud services to the government. This EUR 1.1 billion project involves Amazon Web Services (AWS) and Google as cloud services providers. They are set to build data centres in the country that will enable the government to move its computer systems on to a cloud-based platform in order to improve its processes and data security.

4.3.3. Conclusions and lessons learned

Overall, Israel exhibits some unique strengths in the digital 'race'. These include its highly skilled workforce and the extraordinary share of tech start-ups in the country's economy. Israel's policies appear to be largely targeted at further nurturing these strengths, while also bridging the gap between the tech-savvy and the digital illiterate (which often follow gender, age, and ethnic/religious lines). Nevertheless, the digitalisation policy framework in Israel appears generally 'lighter' than in most of the countries studied, with relatively fewer and smaller (albeit strategically targeted) policy initiatives.

4.4. Japan

4.4.1. Background and progress in digitalisation

The size of Japan's economy is equal to around one-quarter of the EU's economic output. It has a lower *per capita* GDP, but a similar level of development to the EU average (as measured by the HDI). Japan's level of investment in research and development is slightly higher than the EU average, although it is not a prominent exporter of ICT services.

Table 4. Japan: contextual data

	Japan	EU		Japan	EU
Population (millions)	125.1	446.7	**Human Development Index (score 0-1)**	0.93	0.90
GDP (billion USD)	4,231	16,641	**R&D expenditure (% of GDP)**	3.3 %	2.3 %
GDP per capita (USD, PPP)	45,572	54,248	**ICT service exports (% of service exports)**	6.1 %	16.8 %

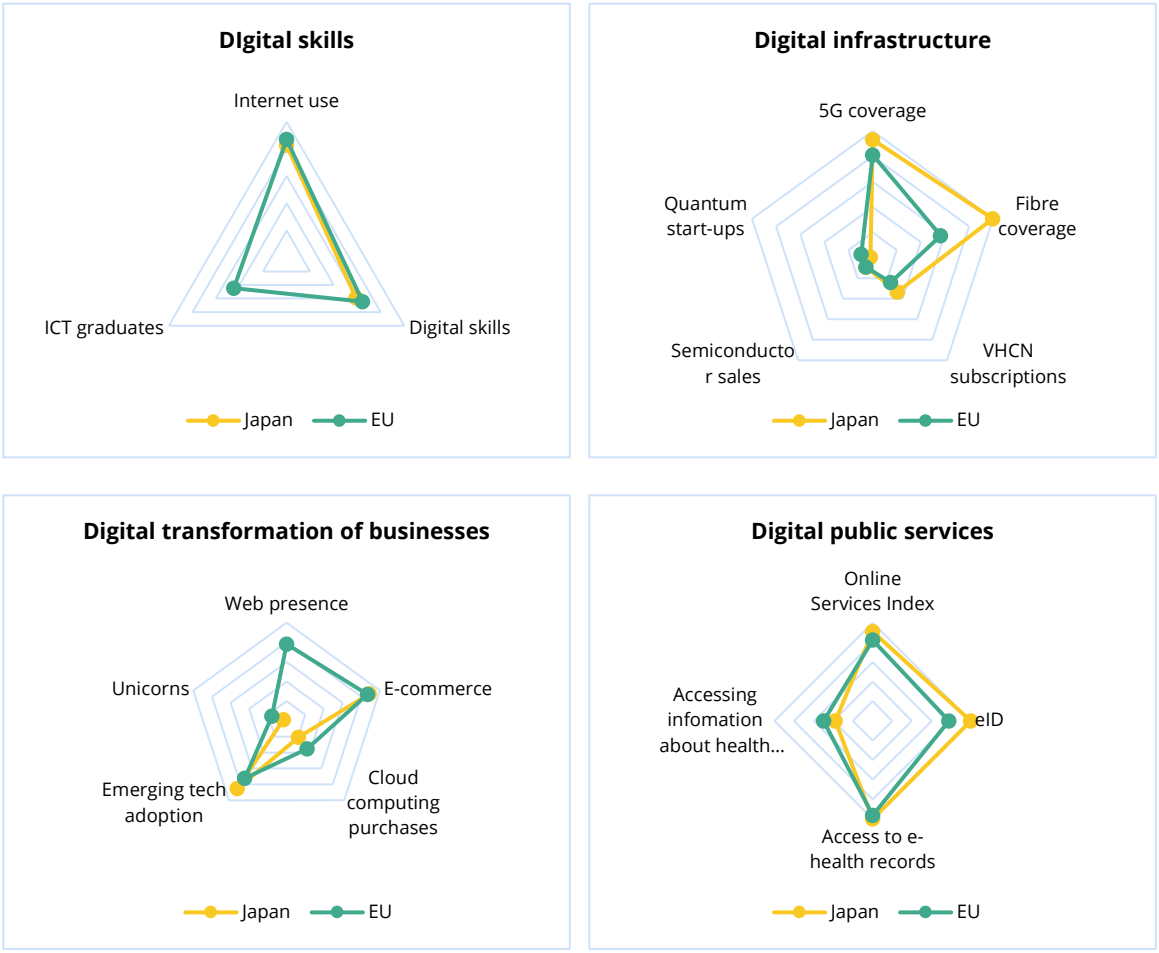
Source: compiled by the authors, based on the collected data (see *Annex I*).

According to international data, Japan's population is closely behind that of the EU in terms of digital literacy and internet use. It has one of the most highly developed digital infrastructures among the benchmark countries (both mobile and broadband). The EU performs better in the area of business (especially with regard to the number of unicorns

[85] Expert interviews, 2023-2024.
[86] Expert interviews, 2023-2024.

and the use of emerging technologies). Digital public services are comparably well-developed.

Figure 11. Japan: digitalisation dashboard



Source: compiled by the authors, based on the data collected (see *Annex I*).
Note: no data are available for Japan with regard to the 'ICT graduates' and 'web presence' indicators.

4.4.2. Policy context

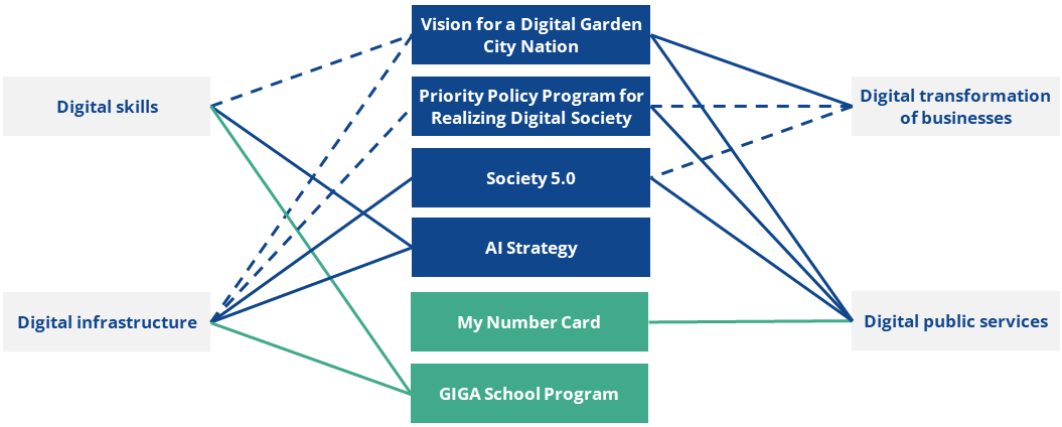
According to the experts interviewed, there is a widespread perception in Japan that its digitalisation efforts and progress has been inferior compared with those of other countries (especially others in the region, including South Korea, China and Singapore).[87] Therefore, digitalisation has been high on the political agenda. Among the most important actions has been the creation of the Digital Agency in 2021[88]. This body is responsible for all strategies relating to digitalisation, and for the adoption of a comprehensive strategy, the 'Vision for a Digital Garden City Nation'[89], aimed at leveraging digitalisation for development across multiple policy domains. This agency, established in 2021, has been expected to play a central role in Japan's overall digitalisation strategy. However, according to some, in reality it focuses primarily on digitising public services, and its ability to address broader digitalisation challenges (and thus, its perceived effectiveness) is limited.[90] As a result, government decision-making in the digital field is divided among the Digital Agency; the

[87] Expert interviews, 2023-2024.
[88] Digital Agency, available at: https://www.digital.go.jp/en.
[89] Vision for a Digital Garden City Nation: Achieving Rural-Urban Digital Integration and Transformation, available at: https://www.japan.go.jp/kizuna/2022/01/vision_for_a_digital_garden_city_nation.html.
[90] Expert interviews, 2023-2024.

Ministry of Internal Affairs and Communications (MIC); the Ministry of the Economy, Trade and Industry (METI); and the Ministry of Education, Culture, Sports, Science and Technology (MEXT). In addition, each government ministry and agency, as well as local governments, may also have their own separate policies in place.[91]

Among the key challenges or 'push' factors that have spurred digital policy action over recent years are population decline and an ageing society; the urban-rural divide and de-population of rural areas; the deteriorating competitiveness of Japan in global markets (both in business terms and in terms of its capacity to attract foreign talent); and the impact of the COVID-19 pandemic.[92] At the same time, insufficient digital infrastructure (particularly in rural areas and smaller cities), as well as the general deterioration of public (physical) infrastructure developed during Japan's period of rapid economic growth from the 1960s throughout the 1980s, coupled with a scarcity of digital talent (including among the policymakers who implement digitalisation policies) have been identified as key obstacles to Japan making faster progress.[93]

Figure 12. Japan: policy map – examples of policy actions corresponding to the four cardinal points of the DDPP



Source: compiled by the authors, based on policy mapping (see *Annex II*).
Note: national strategies are marked in blue, policy initiatives in green, and funding programmes in yellow. Solid lines represent high relevance to a given cardinal point; dashed lines indicate secondary relevance.

Looking at Japan's policy background across the DDPP cardinal points, experts point to low levels of **digital skills** as one of the key bottlenecks in Japan's digitalisation efforts (despite relatively high scores in cross-country comparison – see above). There is no national strategy that focuses explicitly on digital skills. Rather, there are several national strategies that include digital skills as components (including the 'AI Strategy', the item 'Investing in People' item in the 'Grand Design and Action Plan for a New Form of Capitalism 2023', and the 'Securing of Digital Human Resources' priority within the 'Vision for a Digital Garden City Nation'). In addition, digital education has been gradually integrated into school curricula, and includes AI lessons.[94] The 'GIGA School Program' has become a flagship project, which aims to provide digital infrastructure and tools (devices) for schools and students. At the level of higher education, a certification system and model curriculum have been developed to enable students in all fields to acquire literacy-level education in mathematics, data science and AI.[95]

[91] Expert interviews, 2023-2024.
[92] Expert interviews, 2023, and the results of policy mapping (see *Annex II*).
[93] Expert interviews, 2023, and the results of policy mapping (see *Annex II*).
[94] Expert interviews, 2023-2024.
[95] Mathematics/Data Science/AI Education Program Certification System, available at: https://www.mext.go.jp/a_menu/koutou/suuri_datascience_ai/00001.htm.

Digital infrastructure in Japan is relatively advanced, with widespread 5G network coverage and high take-up rates for high-speed broadband (see above). The 'Building digital infrastructure' priority area in the 'Vision for a Digital Garden City Nation' includes ambitious targets, such as 99 % 5G coverage by 2030, 99.9 % fibre coverage by 2027, and the completion of the network of submarine cables around Japan (the so-called 'Digital Garden City Superhighway') by 2025. Progress towards these targets has been steady. While connectivity in rural areas remains a challenge, this relates more to data infrastructures and digital literacy (prerequisites for access to digital services and digital opportunities such as work and entrepreneurship) rather than to physical (digital) infrastructure. In addition, the government has been funding 'soft' infrastructures such as co-working spaces for teleworkers, including those in rural areas.[96]

Progress towards the **digital transformation of businesses** in Japan remains a challenge. Policymakers have recognised that Japanese companies are slow to make full-scale digitalisation efforts, and many are hampered by legacy systems.[97] Experts have also suggested that many businesses in both urban and rural areas are lagging behind in the digital revolution, often using outdated tools such as fax machines, stamps and seals (instead of signatures) and floppy disks. The new government (incumbent since 2021) has been encouraging a switch to modern systems – for example, through the certification of digitally advanced companies, tax incentives to promote investments in digitalisation, or the streamlining of bureaucratic procedures; however, the outcomes of these efforts are not yet apparent.[98] While AI has been on the political and policy agenda, Japan's 'AI Strategy' focuses mostly on skills and research aspects (e.g. the training of AI specialists, improving research data infrastructure) and does not tackle the commercialisation of AI or its adoption by businesses.

Likewise, the **digitalisation of public services** in Japan has been relatively slow, according to the experts interviewed, who agreed that public e-services are underdeveloped, fragmented and underused (although this appears to be contradicted by Japan's high scores on the Online Service Index – see above).[99] The Digital Agency's 'Priority Policy Program for Realizing Digital Society' has set out the key priorities in this sphere, which can be divided into: (1) efficiency improvements within central and local governments (e.g. the digitalisation of procedures, the use of AI by public servants, the upgrading of infrastructure, and so on); and (2) the provision of services for citizens and businesses, including identity verification through My Number Card, access to medical services, the integration of data into the education system, and the use of digital solutions for disaster risk management.[100] In particular, facilitating the use of My Number Card has been a pressing issue for the current government. Though the scheme has been in place since 2016, the initial take-up rate was low[101] and its roll-out was marred by data leaks and registration errors, whereby thousands of identification numbers were incorrectly linked to unrelated medical information.[102] Furthermore, the functionalities and integrations that the scheme allows are limited, and it primarily remains a *physical* identification card with a limited 'e-' component.

[96] Expert interviews, 2023-2024.
[97] Digital Governance Code, available at: https://www.meti.go.jp/shingikai/mono_info_service/dgs5/pdf/20201109_e01.pdf.
[98] Expert interviews, 2023-2024.
[99] Expert interviews, 2023-2024.
[100] Priority Policy Program for Realizing Digital Society, available at: https://www.digital.go.jp/assets/contents/node/basic_page/field_ref_resources/bc5a569f-71d0-44d9-b5c9-cc9b59405507/47b4badd/20231228_en_priority_summary_01.pdf.
[101] Although initial take-up was low, it had climbed to over 77 % in 2023. DigWatch (2023). Japan's digital ID system faces inspection amidst data leaks and errors, available at: https://dig.watch/updates/japans-digital-id-system-faces-inspection-amidst-data-leaks-and-errors.
[102] See, for example, DigWatch (2023). *Japan's digital ID system faces inspection amidst data leaks and errors*, available at: https://dig.watch/updates/japans-digital-id-system-faces-inspection-amidst-data-leaks-and-errors.

While Japan's progress across the four key policy areas is mixed, its **comprehensive strategic approach to digitalisation** is worthy of attention. In particular, its flagship 'Vision for a Digital Garden City Nation' outlines a detailed plan for wide-reaching digitalisation, while 'Society 5.0' provides an almost philosophical vision of a modern digital society – a rather infrequent element in most countries' policy frameworks (see the box *Policy in focus,* below).

Policy in focus: 'Vision for a Digital Garden City Nation (2021-2026)'
The Vision has been enacted in recognition of the need for a comprehensive plan that embraces the growing development of digital technology (rather than taking *ad hoc* and patchwork measures). It encompasses four main priority areas:

- Digital infrastructure, including finalising the roll-out of 5G and fibre broadband, completing a digital superhighway of submarine cables, and building regional data centres;
- Digital skills, including training across multiple areas of education (school, university and vocational education, as well as in public services);
- The integration of rural areas, including the implementation of new service initiatives across local governments (e.g. mobile clinics to eliminate medical disparities between regions); providing necessary ICT environments (e.g. in schools); and revitalising local economies though digitalisation (e.g. through the promotion of remote working or by connecting local SMEs with national and global markets); and
- Digital inclusion, encompassing support systems to ensure that 'no-one is left behind', regardless of their age, gender, or location.

Policy in focus: Society 5.0
Society 5.0 is a vision for 'a human-centred society that balances economic advancement with the resolution of social problems by a system that highly integrates cyberspace and physical space'. Realising Society 5.0 is expected to tackle some of Japan's most pressing problems, such as underpopulation, an aging society, and the deterioration of public infrastructure. For example, in the area of healthcare, the strategy envisions the connectivity of medical records, remote medical practices, and the use of AI and robots in nursing facilities. Autonomous taxis and buses are expected to improve the country's lagging public transportation (especially in rural areas). Sensors, AI and robots could inspect and maintain physical infrastructure (such as roads, bridges, tunnels and dams). Lastly, the promotion of online services (such as banking) can encourage the development of the digital economy.

4.4.3. Conclusions and lessons learned

Overall, Japan is struggling with regard to some key aspects of digitalisation, such as skills, the digitalisation of businesses, and e-public services. Nevertheless, particularly since the appointment of the country's current government in 2021, digitalisation has become a salient political priority in Japan. It is treated as an all-encompassing trend to be addressed across multiple policy areas, as evidenced by the creation of a central digitalisation agency and a comprehensive digital strategy. At the same time, selecting and nurturing certain digital solutions is expected to resolve specific macroeconomic and demographic challenges that are particularly prevalent in Japan (an ageing society, depopulation and economic stagnation).

4.5. Republic of Korea

4.5.1. Background and digitalisation progress

The Republic of Korea, known as South Korea, is a relatively small country with a total GDP roughly 10 times smaller than that of the EU, but has a similar level of development, as measured by GDP per capita and the HDI. Korea also has one of the highest levels of R&D spending across the countries studied (second only to that of Israel).

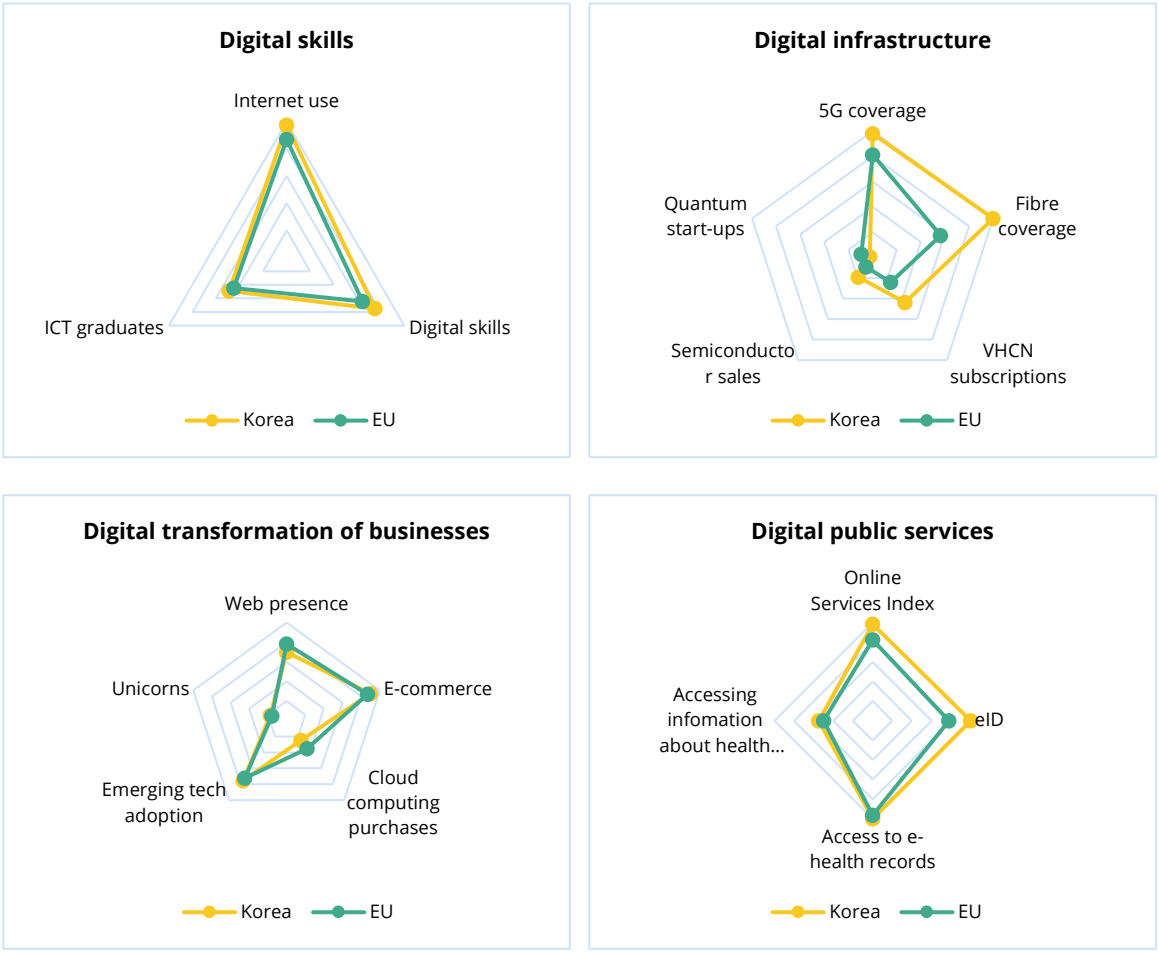
Table 5. South Korea: contextual data

	South Korea	EU		South Korea	EU
Population (millions)	51.6	446.7	**Human Development Index (score 0-1)**	0.93	0.90
GDP (billion USD)	1,665	16,641	**R&D expenditure (% of GDP)**	4.8 %	2.3 %
GDP per capita (USD, PPP)	50,070	54,248	**ICT service exports (% of service exports)**	9.1 %	16.8 %

Source: compiled by the authors, based on the data collected (see *Annex I*).

With regard to its digitalisation progress, South Korea's performance is evenly matched with that of the EU in the areas of digital skills and the digital transformation of businesses. However, it excels in comparison to the EU in the area of infrastructure development (as a global leader in 5G and the deployment of high-speed broadband), as well as in the digital delivery of public services.

Figure 13. South Korea: digitalisation dashboard



Source: compiled by the authors, based on the data collected (see *Annex I*).

4.5.2. Policy context

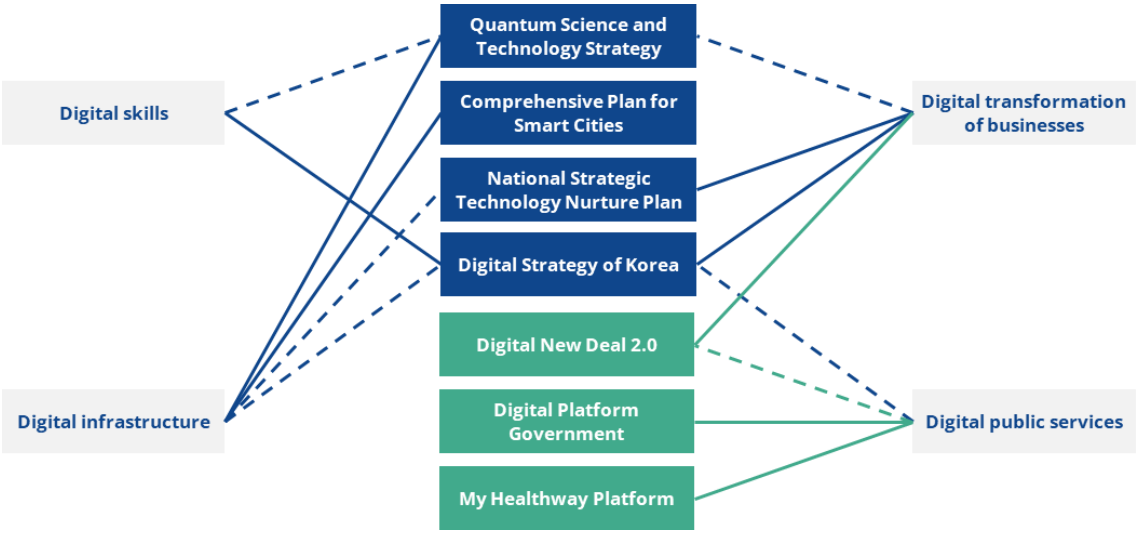
Digitalisation policy in South Korea has been largely coordinated through public-private partnerships, whereby the government acts as a planner and facilitator (including through

financing), and market actors function as the implementers of the strategy. The country's approach to digital policy has been described by experts as 'aggressive, active, and future-oriented', and based on comprehensive and detailed, 'military-style' plans.[103] According to experts, several intrinsic enablers of such an approach include a technocratic government (in which ministers tend to be highly educated experts in their fields), the relatively low politicisation of the process, a broad consensus regarding the high-level strategic approach, and diligent policy formulation processes based on extensive data gathering.[104] The Ministry of Science and ICT is large and wide-reaching, and constitutes the key branch of government responsible for flagship digitalisation strategies and policy initiatives.

From a policy perspective, the key high-level topics within the sphere of digitalisation in South Korea include:

- National security, including in particular economic and technological independence (especially from the neighbouring 'giants' – China and Japan);
- Twin transition, i.e. the coupling of digital and green innovations to achieve sustainable growth; and
- Smart cities as the pinnacle of safe, secure and interconnected digital and physical infrastructure.

Figure 14. South Korea: policy map – examples of policy actions corresponding to the four cardinal points of the DDPP



Source: compiled by the authors, based on policy mapping (see *Annex II*).
Note: national strategies are marked in blue, policy initiatives in green, and funding programmes in yellow. Solid lines represent high relevance to a given cardinal point; dashed lines indicate secondary relevance.

When examining areas of policy that correspond to the cardinal points of the DDPP, South Korea does not appear to have a comprehensive strategy specific to **digital skills**. However, most strategies that focus primarily on businesses and/or infrastructure tend to include skills aspects (e.g. the 'Digital New Deal 2.0' involves supplying smart devices and equipment to classrooms, while the 'Quantum Science and Technology Strategy' recognises the need to nurture quantum education and research in order to train quantum computing experts). Overall, the level of digital skills in South Korea is relatively high, and the percentage of the population that uses the internet is the highest among the countries studied, at 98 %. Some experts have also noted that for its highly skilled tech workforce, South Korea has historically relied significantly on experts with foreign experience

[103] Expert interviews, 2023-2024.
[104] Expert interviews, 2023-2024.

(graduates of Western universities or former employees of large tech companies, usually US-based), which has facilitated additional innovation spillover and absorption.[105]

South Korea is the leader among the benchmark countries in terms of **digital infrastructure** deployment (including mobile and fixed connectivity). With almost 100 % 5G coverage, South Korea is now turning its attention towards 6G.[106] Fibre and high-speed broadband coverage and use (as well as the everyday use of the internet) are, likewise, the highest among the studied countries. Building on this progress, policymakers in South Korea are shifting their focus to the 'deeper' connectivity of digital and physical infrastructures to create 'smart cities', at the same time facilitating the twin transition. Smart cities would, among other things, incorporate 'smart' energy grids (interconnected systems of renewable energy sources, electric cars and other systems, driven by AI), and facilitate data flows, including in the public safety sphere (e.g. first responses to emergencies) or traffic control (see the box *Policy in focus,* below).

Policy in focus: the Comprehensive Plan for Smart Cities

South Korea's government unveiled its five-year roadmap for smart city development in June 2019. The roadmap consists of 14 tasks divided among four main strategic points:

(1) Design and improve Korea's smart city model through the implementation of the two national pilot smart city projects (Sejong and Busan);
(2) Support technological and capacity development in relevant sectors to build the basis for future smart city development (e.g. through grants for municipalities to develop and demonstrate smart solutions to tackle urban problems);
(3) Nurture the ecosystem for smart city innovation through the improvement of regulations, support for start-ups and the promotion of cooperative governance (including through the Smart City Regulatory Sandbox (2020), which temporarily removes regulations so that various innovative technologies and services introduced in smart cities can be freely demonstrated or commercialised under certain conditions); and
(4) Develop international cooperation and networking in order to share South Korea's experience in developing smart cities with the world (through the newly created K-City Network, KCN).[107]

Despite the relative recency of the plan and of the 'smart city' concept, South Korea has been working on related ideas since 2008, when it first developed a plan and implemented legislation relevant to the creation of 'ubiquitous cities' or U-Cities. Thus, elements of smart city infrastructure have been developing over the years in several urban centres, including Incheon, Daejeon and Seoul.[108]

Digital transformation of businesses remains a challenge in South Korea. In terms of the preparedness of business for the digital age (including web presence and e-commerce capabilities, as well as adoption by firms of new technologies such as AI), the country's score is relatively low, compared with those of other countries studied. Historically, South Korea's export-oriented manufacturing sector has been the primary driver of the country's economic development. While this has innovated (e.g. through automation and the use of industrial robots[109]), some experts have suggested it faces a 'software gap', whereby it lags behind and relies on foreign players for the integration of innovative software solutions (including AI).[110] Furthermore, the economy has been historically dominated by a handful of very large firms, while the start-up and SME scene (considered crucial for innovation) have lagged behind. The government's approach to tackling this problem has largely been based on developing public-private partnerships or 'hybridised industrial ecosystems'.[111] These partnerships involve the government as a planner, large companies as main implementors, and SMEs and start-ups as subcontractors and suppliers (e.g. this is a

[105] Expert interviews, 2023-2024.
[106] Expert interviews, 2023-2024.
[107] Korea's Smart City brochure, available at: https://smartcity.go.kr/wp-content/uploads/2022/09/2023-Smart-city-brochure.pdf.
[108] Smart City Korea, available at: see also: https://smartcity.go.kr/en/.
[109] See, for example, International Federation of Robotics, available at: https://ifr.org/news/korea-hits-new-record/.
[110] Expert interviews, 2023-2024.
[111] Expert interviews, 2023-2024. See also: Kim, S.Y. (2019). Hybridized industrial ecosystems and the makings of a new developmental infrastructure in East Asia's green energy sector. *Review of International Political Economy, 26*(1), 158-182.

popular approach in developing 'smart', AI-based energy grids). This approach has been considered by some to be one the key success factors for digitalisation in South Korea in general.[112]

Furthermore, at the **intersection of business and infrastructure**, Korea inspires to become, for example, the global hub for the quantum economy in 2035, and to develop a 1,000-qubit quantum computer using South Korean technology by the early-2030s, as indicated in the country's 'Quantum Science and Technology Strategy' (along other goals, such as boosting quantum computing investments and research, and nurturing more quantum technology companies). Likewise, the 'National Strategic Technology Nurture Plan' aspires to advance 12 strategic technology fields, based on the government-private sector-academia cooperation nexus: semiconductor and display; secondary cells; leading-edge mobility; next-generation nuclear energy; leading-edge biotechnology; aerospace and marine; hydrogen technologies; cybersecurity; AI; next-generation communications; leading-edge robotics and manufacture; and quantum.

Lastly, **digital public services** have been reported to be at a high level and widely used (a fact confirmed by South Korea's high Online Services Index score).[113] National ID numbers are heavily relied upon, not only as the primary tool for citizens to access services, but also a measure for the authorities to track developments (e.g. verifying the eligibility of individuals for military service).[114] In general, due to the security threat from North Korea, the safety of critical infrastructure and government oversight have been considered paramount. Recent policy developments have focused on reducing data silos and facilitating better flows of data between ministries and between central and local governments, as well as between the government and private actors delivering public services (through the 'Digital Platform Government' strategy). Similarly, in the healthcare sector, the focus has been on improving the provision and use of medical data, including defining data standards and connecting the data scattered and segmented across medical and public institutions (through the 'My Healthway Platform').

4.5.3. Conclusions and lessons learned

South Korea has emerged as a global leader in digitalisation, based on a significant supply of high-skilled workforce (often trained abroad); government-supported, export-oriented manufacturing giants (with a focus on hardware advanced by technology); and a long-lasting push for the most advanced and wide-reaching digital infrastructure. South Korea relies on somewhat detailed planning at a central level, and the implementation of policies through public-private partnerships. It has laid out fairly ambitious plans for the future (including 'smart cities', the roll-out of 6G and cutting-edge technologies), although is not immune from challenges and bottlenecks – especially in relation to the digitalisation of businesses and nurturing the development of start-ups and SMEs in the digital field.

4.6. United Kingdom

4.6.1. Background and progress in digitalisation

The UK's economy is significantly smaller than that of the EU bloc, although it is similar or slightly above the EU average in terms of its level of per capita wealth and development. Measures of R&D investment and, in particular, ICT service exports are lower than the EU average.

[112] Expert interviews, 2023-2024.
[113] Expert interviews, 2023-2024.
[114] Expert interviews, 2023-2024.

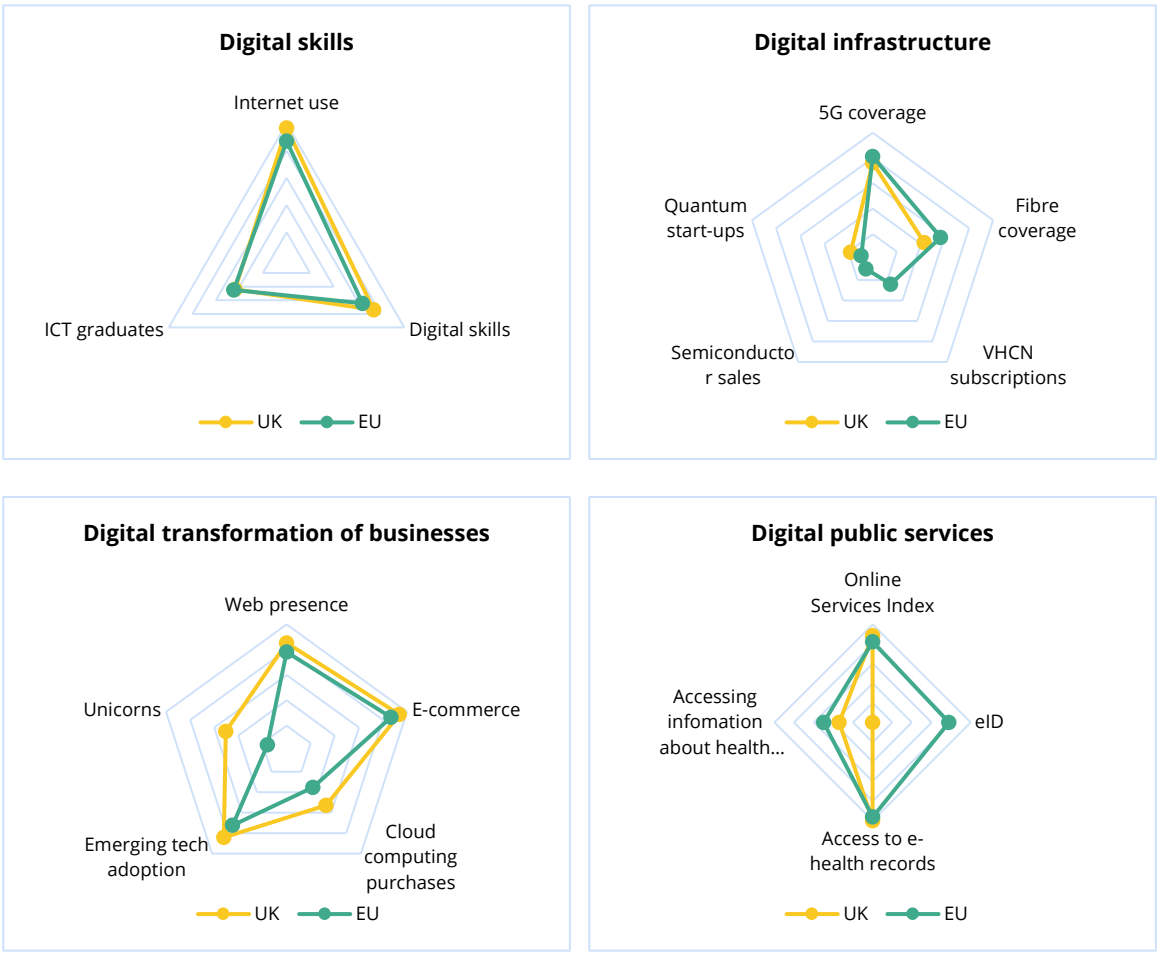
Table 6. United Kingdom: contextual data

	UK	EU		UK	EU
Population (millions)	67.0	446.7	**Human Development Index (score 0-1)**	0.93	0.90
GDP (billion USD)	3,070	16,641	**R&D expenditure (% of GDP)**	1.7 %	2.3 %
GDP per capita (USD, PPP)	54,602	54,248	**ICT service exports (% of service exports)**	8.6 %	16.8 %

Source: compiled by the authors, based on the data collected (see *Annex I*).

The digitalisation performance of the UK is mixed. It scores somewhat higher on basic skills proxies, but not on advanced skills. The country trails behind the EU on most digital infrastructure development markers (although some data are missing). The digital transformation of businesses appears relatively advanced compared with that of the EU. Digital public services are assessed as being roughly on a par with those in the EU, although the UK is yet to roll out a nationwide eID scheme.

Figure 15. United Kingdom: digitalisation dashboard



Source: compiled by the authors, based on the data collected (see *Annex I*).
Note: no data are available for the UK with regard to the 'VHCN subscriptions' and 'semiconductor sales' indicators.

4.6.2. Policy context

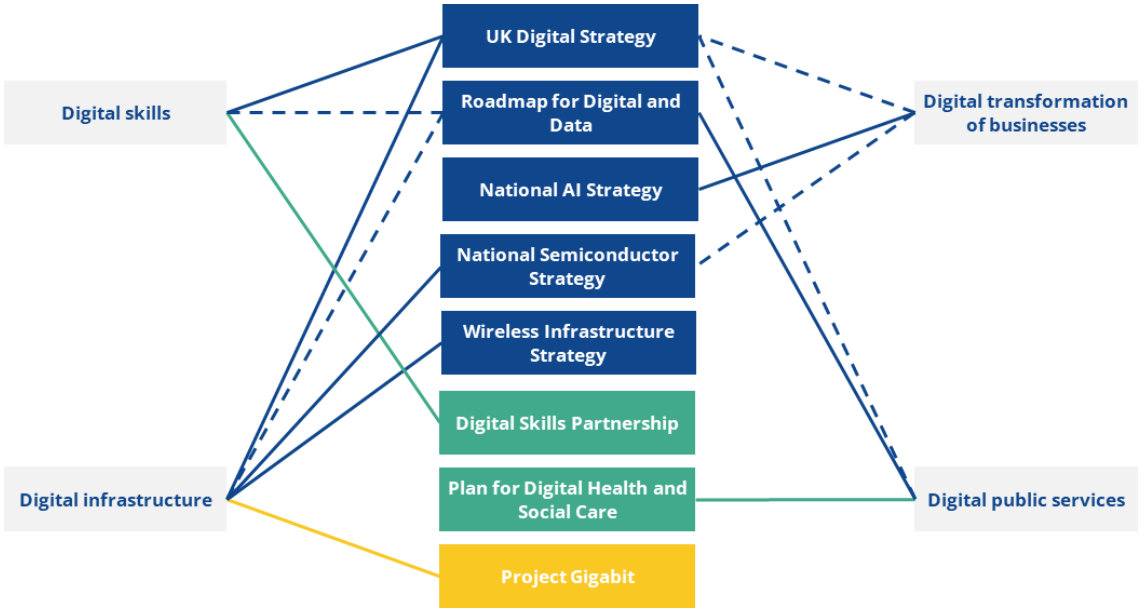
The UK's digitalisation policy framework rests on the key premise of 'strengthen[ing] its position as a Global Science and Tech Superpower'.[115] The government recognises the UK's legacy and advantages in pursuing technology-driven growth, extending from science (some of the world's leading universities) to business (a high number of unicorns). The role of policy in facilitating this growth is emphasised, and the UK's policy framework includes a wide array of strategies and initiatives spanning many policy areas, the 'UK Digital Strategy' being the key overarching plan. Recently created (in February 2023), the Department for Science, Innovation and Technology (DSIT) holds primary responsibility for most aspects of digital policy,[116] although other bodies are also active, including the Cabinet Office (with respect to digital public services and cybersecurity). Furthermore, each department has agencies that report to it, which may be responsible for the day-to-day implementation of policy (e.g. 'Building Digital UK' manages the UK's fibre broadband roll-out programme, Project Gigabit).[117]

The key trends in the UK's digitalisation policy approach include:

- *Pro-innovation regulation (short-term).* Since 2018-2019, there has been a notable shift towards and emphasis on 'soft' interventions in the high-tech sphere, i.e. providing sound regulatory frameworks that encourage innovation and competition, as well as (voluntary) standards and codes of practice for the development and adoption of emerging technologies, without overly distorting the markets. For example, the 'Plan for Digital Regulation'[118] and 'Pro-innovation Regulation of Technologies Review: Digital Technologies'[119] lay down guidelines as to how to regulate emerging technologies, while the Regulatory Horizons Council[120] advises the government regarding the implications of technological innovation. This shift in approach is arguably related to political fluctuations – for example, in the past, 'heavier' state interventionism and the nationalisation of certain markets (e.g. broadband services) had been proposed. In general, a degree of consistency in policymaking has been identified as a necessary precondition for progress.[121]
- *(Re-)positioning the UK in the world (medium-/long-term).* In the context of Brexit, the UK is taking steps to replace some EU regulatory frameworks with its own, for example with regard to the regulation of data protection. More broadly, the UK is striving to 'find its place and role in the world', including forging international partnerships and carving niches (e.g. in the field of semiconductors – see below for more details).

[115] UK Digital Strategy, available at: https://www.gov.uk/government/publications/uks-digital-strategy/uk-digital-strategy.
[116] This includes ministerial positions responsible for Science, Innovation and Technology; Data and Digital Infrastructure; Science, Research and Innovation; AI and Intellectual Property; and Tech and the Digital Economy. See: *Department for Science, Innovation and Technology*, available at: https://www.gov.uk/government/organisations/department-for-science-innovation-and-technology.
[117] Expert interviews, 2023-2024.
[118] *Digital Regulation: driving growth and unlocking innovation*, available at: https://www.gov.uk/government/publications/digital-regulation-driving-growth-and-unlocking-innovation.
[119] *Pro-innovation Regulation of Technologies Review: Digital Technologies*, available at: https://www.gov.uk/government/publications/pro-innovation-regulation-of-technologies-review-digital-technologies.
[120] *Regulatory Horizons Council (RHC)*, available at: https://www.gov.uk/government/groups/regulatory-horizons-council-rhc.
[121] Expert interviews, 2023-2024.

Figure 16. Unites Kingdom: policy map – examples of policy actions corresponding to the four cardinal points of the DDPP



Source: compiled by the authors, based on policy mapping (see *Annex II*).
Note: national strategies are marked in blue, policy initiatives in green, and funding programmes in yellow. Solid lines represent high relevance to a given cardinal point; dashed lines indicate secondary relevance.

With regard to **digital skills**, the UK's 'basic digital skills' scores are mediocre, while it trails in the last place among the benchmark countries for the 'advanced digital skills' proxy (ICT graduates). This digital skills shortage is recognised in policy documents, too.[122] Nevertheless, there is no official and comprehensive digital skills strategy in the UK, which has been a consistent point of grievance for some stakeholders.[123] Instead, digital skills are mentioned across the topical digitalisation policies (e.g. the National AI Strategy or National Semiconductor Strategy), and – most importantly – addressed by the Department for Education in education policies and curricula development.[124] In this context, digital education is being rolled out at all levels, from secondary level (computer science) to technical and further education (e.g. through Institutes of Technology, which cooperate closely with industry[125]), to higher education (e.g. through dedicated scholarship programmes) and lifelong learning (typically delivered through individual dedicated programmes).[126] Furthermore, local initiatives such as local Digital Skills Partnerships in eight English regions provide extra-curricular activities to foster both basic and more advanced digital skills.

The policy push to deploy advanced **digital infrastructures** has been somewhat slow (with fibre roll-out targets pushed back from 2025 to 2030), but has been consistent and is generally considered efficient.[127] Most notably, the Gigabit Project offers direct public funding (equivalent to EUR 5.7 billion) for the deployment of fibre in hard-to-reach areas, based on competitive bids. This has been one of the flagship projects of the current government, in line with its pro-innovation, pro-competition and 'hands-off' regulatory approach to technology (see above). It has introduced and reinforced an competitive element in broadband services market, moving away from its historical monopoly (the BT Group).[128] With regard to the UK's mobile networks, the government is aiming to achieve

[122] See: *UK Digital Strategy*, available at: https://www.gov.uk/government/publications/uks-digital-strategy/uk-digital-strategy.
[123] Expert interviews, 2023-2024.
[124] Expert interviews, 2023-2024.
[125] *Institutes of Technology*, available at: https://www.institutesoftechnology.org.uk/.
[126] Expert interviews, 2023-2024.
[127] Expert interviews, 2023-2024.
[128] Expert interviews, 2023-2024.

95 % coverage of 4G by 2025 and 'nationwide coverage of standalone 5G to all populated areas of the UK by 2030' (as stated in the 'Wireless Infrastructure Strategy'), although 5G roll-out is not supported by large infrastructure funding and focuses on the regulatory framework (including planning, measurement, reporting, affordability, etc.) and the development of use cases. It has been further emphasised that infrastructure coverage does not always go hand-in-hand with take-up (for example, the UK has the lowest share of fibre subscriptions among the countries studied), and policy might also need to consider how to make better use of the available technology.[129] Lastly, the UK's approach to fostering the semiconductor industry is worthy of examination (see the box *Policy in focus,* below).

Policy in focus: the UK's National Semiconductor Strategy

This strategy addresses the well-recognised risk of supply chain disruptions in the semiconductor industry. Nevertheless, it also acknowledges that, unlike the US and the EU, the UK does not have a significant share of global semiconductor manufacturing and is not well-placed to compete with East Asian, American and European manufacturing capabilities. Instead, the UK is 'better positioned to pursue alternative opportunities within the sector'; namely, 'focusing on our strengths in R&D, design and IP, and compound semiconductors'.[130] In other words, the UK is focusing on strengthening its domestic capacity in those niches in which it can gain a competitive advantage (scientific development), rather than trying to 'outbid' the large subsidy programmes in the US and the EU.[131] At the same time, to improve the resilience of its supply chains, the UK relies mostly on strengthening bilateral relationships with 'like-minded governments', including the UK-US Technology Partnership, the UK-South Korea agreement on supply chain resilience, and the UK-Japan Digital Partnership.

The UK scores highly in measures of the **digital transformation of businesses**, particularly the number of unicorns. However, policy interventions in this area are somewhat modest. Some targeted initiatives do exist – for example, Innovate UK (the national innovation agency) supports the development and commercialisation of new products and constitutes a 'test lab' for the adoption of emerging technologies.[132] To facilitate the basic digital intensity of SMEs, the 'Help to Grow: Digital' programme was put in place, offering free advice to firms and vouchers to co-finance software, but has since been discontinued due to low take-up.[133] Overall, the government focuses more on indirect support through regulation that supports market-driven adoption and the development of technology (in line with the 'hands-off' approach discussed above). For instance, the National AI Strategy focuses on high-level issues, such as nurturing 'the AI ecosystem' (including AI skills) and creating an effective AI governance framework (e.g. AI standards, pro-innovation regulation).

Despite the UK's relatively high score in the Online Services Index, the country's **digital public services** have been reported as a work in progress. The 'Roadmap for Digital and Data' aims (among other things) to create a single point of access to e-government services by 2025, and to put in place systems for better data sharing and use among government departments. No eID scheme is in place, and previous attempts to introduce national ID systems have been unpopular – although a new bill may introduce a means for verifying digital identity.[134] Finally, the 'Plan for Digital Health and Social Care' sets targets for the National Health Service (NHS) with regard to the use of electronic health records (100 % use by NHS trusts by March 2025), NHS app registration (75 % of adults to be registered

[129] Expert interviews, 2023-2024.

[130] *National Semiconductor Strategy*, available at: https://www.gov.uk/government/publications/national-semiconductor-strategy/national-semiconductor-strategy#summary-of-actions-the-government-is-taking.

[131] Expert interviews, 2023-2024.

[132] Expert interviews, 2023-2024. See also: *Innovate UK*, available at: https://www.ukri.org/councils/innovate-uk/; and *UK Innovation Strategy: leading the future by creating it*, available at: https://www.gov.uk/government/publications/uk-innovation-strategy-leading-the-future-by-creating-it.

[133] Expert interviews, 2023-2024. See also: *Final opportunity for businesses to access Help to Grow: Digital scheme*, available at: https://www.gov.uk/government/news/final-opportunity-for-businesses-to-access-help-to-grow-digital-scheme.

[134] Expert interviews, 2023-2024. See also: *The Data Protection and Digital Information (No. 2) Bill 2022-23*, available at: https://commonslibrary.parliament.uk/research-briefings/cbp-9746/.

by 2024), as well as the deployment of digital monitoring and supportive technologies and 'virtual beds'.

4.6.3. Conclusions and lessons learned

The UK is an 'incumbent' digital power with a long-standing tradition of academic R&D, applied science and a digital start-up scene. Although lagging behind in certain aspects of digitalisation – notably, those in which government intervention is most expected, such as digital infrastructure and public services – it excels in others, especially the development and adoption of advanced technologies. The current policy approach aims to reinforce these capacities at the intersection of academia and business through 'pro-innovation' regulation, focusing on creating a conducive environment for bottom-up initiatives and organic growth.

4.7. United States

4.7.1. Background and progress in digitalisation

The US is the largest and one of the wealthiest (in *per capita* terms) economies globally, with a high focus on research and development (hosting some of the best universities in the world) and business and innovation (it is home to the leading global big tech firms).

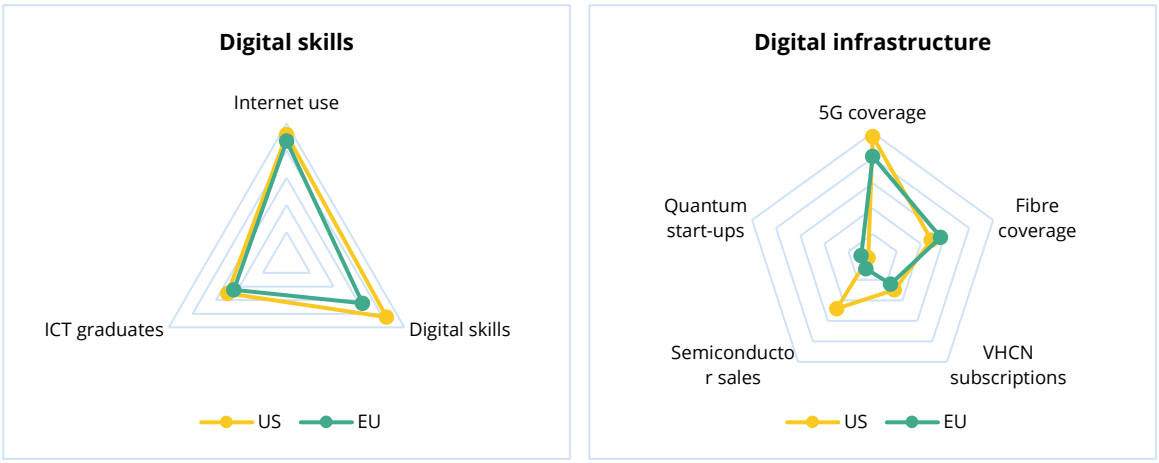
Table 7. United States: contextual data

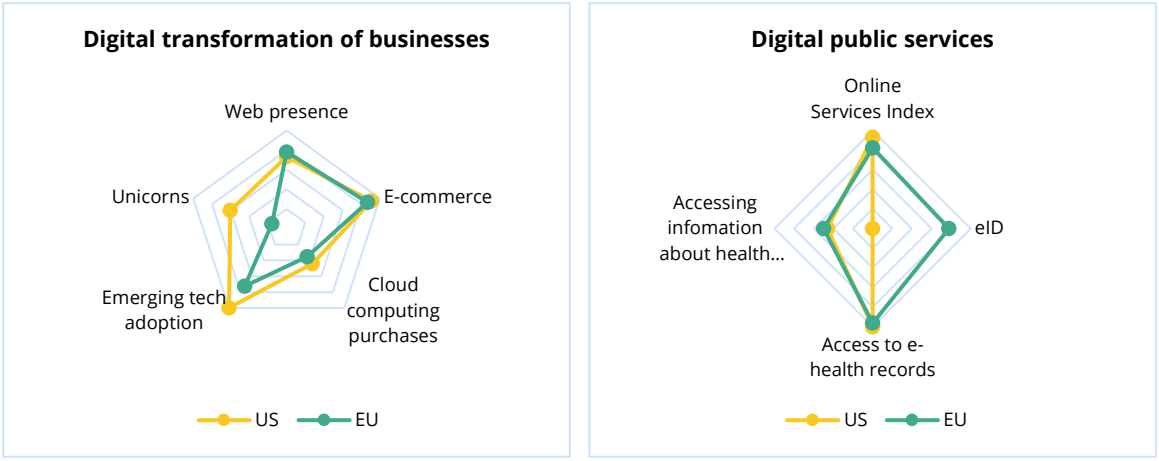
	US	EU		US	EU
Population (millions)	333.3	446.7	**Human Development Index (score 0-1)**	0.92	0.90
GDP (billion USD)	25,462	16,641	**R&D expenditure (% of GDP)**	3.4 %	2.3 %
GDP per capita (USD, PPP)	76,398	54,248	**ICT service exports (% of service exports)**	7.1 %	16.8 %

Source: compiled by the authors, based on the collected data (see *Annex I*).

Looking at overall digitalisation performance, compared with the EU, the US excel in particular in certain areas related to digital infrastructure – 5G coverage and semiconductor market share (although not fibre coverage or subscriptions), as well as in the digitalisation of businesses – particularly the number of unicorns per capita. The US lags behind the EU in terms of nation-wide eID roll-out.

Figure 17. United States: digitalisation dashboard





Source: compiled by the authors, based on the data collected (see *Annex I*).

4.7.2. Policy context

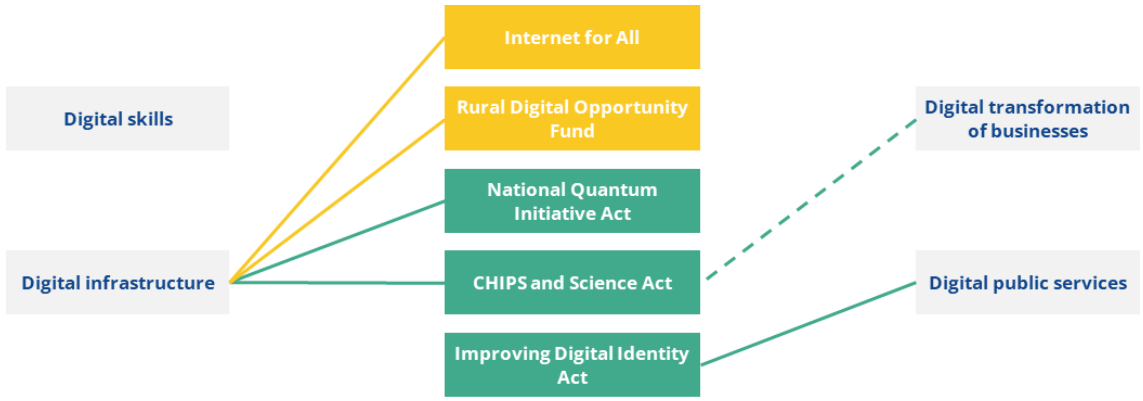
The underlying premise of US digital policy is to sustain the country's global leadership across cutting-edge technologies and digital services markets, building on substantial and long-standing investments in R&D in digital technologies and synergies between defence and civil technologies. This stance has been motivated by geopolitical security concerns since the Cold War and, more recently, rivalry with China (as evidenced by export bans on specific technologies) as well as economic development objectives (as exemplified by fiscal incentives for the manufacturing of semiconductors in the US). The development of other digital areas relies more on market forces combined with minimal regulatory intervention ('soft' law, limited industrial policy, targeted interventions) and the country's federal structure (in which individual states are responsible for education, infrastructure, most public services, etc.).

Therefore, a coherent overall strategy such as 'digitalisation' (as in the EU) and/or 'informatisation' (as in China) that covers multiple policy areas is not explicitly elaborated at federal level.[135] In line with this, the policy mapping conducted for this study did not reveal any major national-level strategies that set broad and long-term priorities and targets for any of the major areas of digitalisation (corresponding to the cardinal points of the DDPP). Policy action tends to focus on large policy initiatives and/or funding programmes, mainly targeted at supporting market actors in the development of physical infrastructure (broadband) or increasing manufacturing capacities in sectors of strategic importance (semiconductors). These actions often involve rapid interventions with direct and immediate effects on the (market) actors concerned, including tax cuts and subsidies. In addition, there does not appear to be one agency (or a handful of agencies) in charge of coordinating digitalisation policies – instead, specific initiatives are often led by temporary *ad hoc* offices such as the CHIPS Program Office or the National Quantum Coordination Office (NQCO).

Overall, several key challenges have been identified with regard to the US strategic approach to digitalisation. Internally, the politicisation of the debate and political disagreements stall most legislative actions. Externally, competition with China is a challenge (although it can also act as a driver, incentivising progress and prompting policy interventions). An overall dilemma in policy circles has also been emphasised, as to whether regulatory intervention within the fields of technology and digital innovation is necessary or even possible (given the rapid evolution of the market and technological innovations).[136]

[135] Expert interviews, 2023-2024.
[136] Expert interviews, 2023-2024.

Figure 18. United States: policy map – examples of policy actions corresponding to the four cardinal points of the DDPP



Source: compiled by the authors, based on policy mapping (see *Annex II*).
Note: national strategies are marked in blue, policy initiatives in green, and funding programmes in yellow. Solid lines represent high relevance to a given cardinal point; dashed lines indicate secondary relevance.

Looking at specific policy areas, the nurturing of **digital skills** remains a challenge. Digital education is not addressed at federal level, although several state-level policy initiatives have been identified (e.g. the 'Digital Literacy Program' and 'Pathways in Technology' programme in New York state, or the 'Digital Navigator Program' in Washington state). Insufficient levels of digital literacy and STEM skills; unmet demand for high-skilled tech workers and high reliance on an international workforce; a high entry level in terms of expertise and qualifications for many tech jobs, and the resulting social stratification and income divide between high-skilled and low-skilled have been identified as enduring problems in this field.[137]

Progress towards deploying **digital infrastructure** has been steady, driven by large funding programmes to incentivise private providers to extend high-capacity broadband infrastructures across the country (including in rural and remote areas), and to subsidise the cost of internet for households and communities (see the box *Policy in focus*, below).

Policy in focus: Internet for All

'Internet for All' is a USD 65 billion funding programme launched in 2022, consisting of 10 different grant schemes targeted at households, communities, tribal governments, internet providers and states. The programme (co-)finances various actions that aim to increase the coverage and take-up of high-speed internet. Examples include:

- The Affordable Connectivity Program subsidises high-speed internet bills for households.
- The State Digital Equity Planning Grant Program provides resources to community organisations to help scale digital literacy programmes.
- The Broadband Equity, Access, and Deployment (BEAD) Program is a flagship (USD 42.45 billion) programme that funds the deployment of infrastructure in underserved areas across the country. It succeeds the previous National Broadband Plan (2010-2020).[138]

Although there is a lack of comprehensive evaluations of these schemes, they are generally assessed as having been effective in promoting high-speed broadband coverage, although this is not yet reflected in the international data on fibre and high-speed broadband subscriptions (see above). Furthermore, their efficiency may be open to question, given the high costs of implementation, described by some experts as an approach of 'throwing money at the problem'.[139]

The **digital transformation of businesses** in the US is largely market-driven and is not addressed at the federal legislative level, although debates are ongoing around the potential

[137] Expert interviews, 2023-2024.
[138] Internet for All, available at: https://www.internetforall.gov/.
[139] Expert interviews, 2023-2024.

regulation of AI (with regard to the safety, security and trustworthiness of AI systems)[140]; big tech (in the light of competition or anti-trust law); and digital platforms (*vis-à-vis* freedom of expression online and the moderation of online content).

At the intersection of these two policy areas (infrastructure and business), there is a notable policy push in relation to economic competitiveness and the national security dynamics between the United States and China with regard to 5G and semiconductor technologies. The bans imposed by the US on a Chinese company (Huawei) in the sphere of 5G, as well as its heavy intervention in the semiconductor industry, can be seen as steps in this 'battle for leadership in technological dominance'.[141] In particular, interventions at both at federal and state level to boost US semiconductor manufacturing capacity have arguably been among the most attention-grabbing digitalisation polices globally (see the box *Policy in focus,* below).

Policy in focus: CHIPS Acts

At the federal level, the USD 52.7-billion CHIPS and Science Act provides investments to strengthen the US semiconductor industry semiconductor research, including USD 39 billion in manufacturing incentives, USD 13.2 billion for R&D and workforce development, USD 500 million for international ICT security and semiconductor supply chain activities, and a 25 % investment tax credit for capital expenses relating to the manufacturing of semiconductors and related equipment. Other actions include promoting US innovation in the wireless supply chain and advancing US global leadership in technologies of the future (such as nanotechnology, clean energy, quantum computing and AI).[142]

At state level, the Texas CHIPS Act aims to leverage the state's investments in the semiconductor industry, to encourage semiconductor-related companies to expand in the state, and to further develop expertise and capacity within Texas higher education institutions and maintain the state's position as the nation's leader in semiconductor manufacturing. The Act establishes the Texas Semiconductor Innovation Consortium (TSIC) and the Texas Semiconductor Innovation Fund (TSIF), which manages a USD 698 million fund for semiconductor research, design and manufacturing projects and grants to business entities with an established presence within Texas, to encourage economic development related to semiconductor manufacturing and design.[143]

Lastly, **digital public services** in the US score highly in the UN's Online Services Index (see above),[144] with the USA.gov platform providing a single point of contact for many federal-level affairs.[145] However, some of the key e-services provided at federal level are assessed by the experts consulted as being either outdated (e.g. the Internal Revenue Service), or largely aspirational and not yet fully deployed (e.g. e-health) due to political inertia and the high costs of upgrading.[146] Public services are also fragmented and are delivered at state level. For example, various attempts have been made at federal level to provide a uniform ID system, and (after these failed) to create federal standards for digital identity systems (through the Improving Digital Identity Act). However, no country-wide eID system has been established to date, even though some states have policies in place to upgrade such a system – e.g. Washington state's Identity Access Management (IAM) Modernization; or to improve the delivery of digital public services overall – e.g. the New York State Digital Service Program.

[140] See, for example, the non-binding standards for AI issued by the White House in October 2023, available at: https://www.whitehouse.gov/briefing-room/statements-releases/2023/10/30/fact-sheet-president-biden-issues-executive-order-on-safe-secure-and-trustworthy-artificial-intelligence/.

[141] See, for example, van der Linden, R.W., & Łasak, P. (2023). The Ongoing Sino-US Trade War and Subsequent Tech War. In: *Financial Interdependence, Digitalization and Technological Rivalries: Perspectives on Future Cooperation and Integration in Sino-American Financial Systems* (pp. 93-102). Cham: Springer.

[142] CHIPS and Science Act Factsheet, available at: https://www.whitehouse.gov/briefing-room/statements-releases/2022/08/09/fact-sheet-chips-and-science-act-will-lower-costs-create-jobs-strengthen-supply-chains-and-counter-china/.

[143] Texas CHIPS Act Snapshot, available at: https://gov.texas.gov/uploads/files/business/Texas_CHIPS_Act_Snapshot.pdf.

[144] Expert interviews, 2023-2024.

[145] Available at: https://www.usa.gov/.

[146] Expert interviews, 2023-2024.

4.7.3. Conclusions and lessons learned

Overall, the US takes a relatively 'hands-off' approach to digitalisation policy, focused on market-driven progress, supported by 'mega' infrastructure projects providing generous funding, primarily to market actors, in sectors identified as being strategic (semiconductors, broadband). So far, the federal government has refrained from 'hard' regulation of the digital sphere, including of AI or digital platforms – in contrast to recent legislative developments in the EU, including the Data Act, the Digital Services Act, the Digital Markets Act, and the AI Act. Lastly, measures relating to digital upskilling and digital public services are mostly implemented at state level (if at all).

5. Digitalisation policy frameworks: a policy cookbook

In this chapter, we bring together the qualitative analysis of each country's policy framework (based on policy mapping and expert interviews; see *Chapter 4* of the report for detailed country fiches) from a comparative perspective. In particular, we:

- Describe the similarities and differences between the overall developments in digital policymaking in the benchmark countries (*Section 5.1*).
- Summarise and compare the key conclusions from the country-level analyses across the four cardinal points of the DDPP (*Section 5.2*).

5.1. Overall trends in approaches to digital policy

The overall digitalisation policy frameworks of the countries studied can be analysed in relation to four main aspects: (1) political salience and level of coordination; (2) degree of strategic foresight; (3) degree of interventionism; and (4) policy priorities.

First, there is a notable trend in several benchmark countries (including China, Japan, Israel and, to some extent, South Korea) of **high political salience and the coordination of digital policy making at the highest, inter-ministerial level**. In China, the Central Commission for Cybersecurity and Informatization (CCCI) coordinates all digitalisation efforts (known as 'informatisation'), and is chaired by China's president Xi Jinping himself. In Japan, digitalisation has been among the top priorities of the current government (with the prime minister, Fumio Kishida, being personally engaged in pushing forward many initiatives, such as the eID scheme), and the Digital Agency has been established to coordinate actions. In Israel, while most policy initiatives are implemented by government ministries, the Digital Israel Bureau has been established to facilitate the development of inter-ministerial digital programmes along 'horizontal areas' of the 'Digital Israel' initiative. Lastly, in South Korea and the UK, while no separate bodies have been set up, dedicated ministries (the Ministry of Science and ICT, and the Department for Science, Innovation and Technology, respectively) constitute the key government branches responsible for the countries' flagship digitalisation strategies and policy initiatives.

In a similar fashion, most countries exhibit a **high degree of strategic foresight** – typically having in place a comprehensive digitalisation strategic plan. These are usually structured in the manner of a 'Russian doll', with an overarching strategy at the highest level covering all or most of the DDPP's cardinal points (e.g. the Digital Economy Strategy in Australia, China's '14th Five-Year Plan for National Informatization', Digital Israel, Japan's 'Vision for a Digital Garden City Nation', the Digital Strategy of Korea, and the UK Digital Strategy), and 'sub-strategies' that specify and implement various sections of the grand plan (e.g. along ministerial lines). The US is an outlier in this respect – it appears to lack an overall coherent (formalised) digitalisation strategy, and instead takes *ad hoc* actions (if any) to address emerging challenges. Notably, strategic planning does not always go hand in hand with the setting of targets and monitoring: some countries (usually) specify policy targets, and sometimes even create extensive monitoring tools (e.g. the Digital Inclusion Index in Australia). Others, meanwhile (most notably China, at least at the level of the central administration), have tended to refrain from detailing specific targets and steps.

Digitalisation has also triggered varying responses in terms of the **level of interventionism** in each country. While countries such as Japan or Australia recognise the paramount role of the state in pushing forward the digitalisation agenda, others take a more 'hands-off' approach, intervening mostly through 'soft' measures (e.g. market incentives or regulatory reforms) to create a favourable overall environment conducive to innovation (most prominently in the UK), or intervening only in selected policy areas such as the start-up

environment and ethnicity/religious-based digital divide (Israel) or in relation to the semiconductor industry and broadband infrastructure (the US).

Related to the point above, **policy priorities** vary depending on each country's inherent geopolitical, macroeconomic and/or social contexts. While most countries' policy frameworks cover, explicitly or implicitly, the four DDPP cardinal points (except for the US, whose policy framework is very fragmented and selective), different weights might be assigned to the various areas. For example, the digital transformation of businesses is a salient point in Israel and Australia; in Japan, skills and infrastructure are key focal points; in South Korea, the focus is on infrastructure. Furthermore, some policy priorities of the benchmark countries focus on several of the EU DDPP's general objectives[147] that are not yet tracked by a KPI and thus not studied herein. These include cybersecurity and digital sovereignty (salient in China, Israel and South Korea); the twin transition and 'smart' infrastructure (South Korea); the digital divide (Australia, Israel); and international cooperation (Australia, the UK). Lastly, digitalisation is often perceived as a means to an end rather than a goal in itself, and is expected to help address some underlying challenges for each of the countries, such as tackling depopulation and economic stagnation (Japan), redefining social and urban dynamics (Japan, South Korea), or maintaining its position as a global power (China, the US).

5.2. Policy actions across the cardinal points of the DDPP

5.2.1. Digital skills

Overall, insufficient levels of both basic digital skills and advanced digital expertise are recognised by most countries as key bottlenecks in relation (faster) progress in digitalisation. Nevertheless, no comprehensive digital skills strategies have been identified across the benchmark countries. Instead, digital upskilling is usually a **component of other strategies**, including:

- *Education and curricular reforms*. Although a comprehensive review of such schemes is outside the scope of this study, several instances were noted in which the incorporation of ICT training or STEM topics into school and university curricula, as well as the supply of technology (devices) or infrastructure (e.g. high-speed broadband for schools), have been seen as a part of digital policy (e.g. in Japan and South Korea). Similarly, in Australia, digital skills are an important component of skills demand projections, and digital training is organised by public employment services to facilitate the transition from education to the labour market.
- *Other digitalisation strategies*. Strategies concerned with other aspects of digitalisation, including digital inclusion, the digital transformation of businesses, emerging technologies, and even digital infrastructures (e.g. the 'Internet for All' package in the US, which focuses on broadband roll-out, but also includes funding for basic digital skills training).

In particular, the development of **basic digital skills** is most often connected with policies aiming at bridging the digital divide. For example, the Australia's Digital Inclusion Index includes digital literacy measures; Israel's '100 in digital literacy' programme targets those ethnic minorities that are most likely to be digitally illiterate, providing them with basic digital education and encouraging the use of technology; the Digital Literacy Program in New York state offers basic digital training for the unemployed and new entrants to the job market.

[147] See Article 3 of the *Decision (EU) 2022/2481 of the European Parliament and of the Council of 14 December 2022 establishing the Digital Decade Policy Programme 2030*, available at: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32022D2481.

At the same time, strategies relating to the digital transformation of businesses or the development and/or adoption of emerging technologies (AI, quantum computing, etc.) more often than not include an element of **advanced digital skills formation**, usually connected with higher education systems and encouraging research in the targeted fields (e.g. the Quantum Science and Technology Strategy in South Korea, the National Quantum Strategy in Australia, Japan's AI Strategy, or the CHIPS and Science Act in the US).

5.2.2. Digital infrastructure

The countries studied have very **similar goals** (explicit or implicit) when it comes to the development of digital infrastructure, i.e. complete or near-complete coverage of the 5G network and coverage of all households with high-speed (usually fibre) broadband. Progress towards these goals has varied widely – for example, while Israel is advancing somewhat slowly, South Korea, having already achieved almost 100 % 5G coverage, is turning its attention towards the development of 6G. The cost and pace of progress are significantly predicated upon by geographical preconditions: large countries such as Australia, China and the US face much higher costs and complexity in infrastructure deployment. Curiously, policy priorities rarely focus on the take-up of services enabled by these new infrastructures (although in China, internet training is provided in rural areas to encourage its use, while the US subsidises broadband subscriptions for some users).

In most countries, the roll-out of 5G and broadband in urban areas and other densely populated centres is expected to be driven by **market forces**, requiring little to no policy intervention. It is the extension of such infrastructure to rural and remote communities (into which there are fewer incentives for commercial players to expand, due to high investment costs and low demand) that is on the policymakers' radar. Even so, policy interventions still tend to focus on incentivising such expansion by traditional service providers, whether this is through the funding of state-owned companies (Australia, China) or competitive bids (subsidies) for commercial providers (e.g. the UK and US).

The focus on other digital infrastructures is more country-specific. For example:

- *Semiconductors.* Both China and the US have large subsidy programmes in place (respectively, the Integrated Circuit Industry Investment Fund, approximately USD 45 billion; the CHIPS and Science Act, approximately USD 52.7 billion) to boost their semiconductor manufacturing capacity and ensure economic competitiveness and 'technological sovereignty'. In the light of these large subsidy programmes, some countries – notably, the UK – have taken alternative approaches to carve out niches in the semiconductor industry (e.g. in R&D) and/or rely on international partnerships to increase the resilience of their supply chain.
- *Quantum computing.* Targeted quantum computing strategies have been identified in Australia, South Korea and the US. In Australia and the US, these strategies are more ambiguous and bottom-up, and focus on providing funding for science, higher education and the commercialisation of quantum products. South Korea, on the other hand, has set specific 'tangible' targets such as developing a 1,000-qubit quantum computer using South Korean technology by the early-2030s, increasing its market share in the global quantum market to around 10 %, and developing a 100 km-scale quantum network in the 2030s.
- *Integration of physical and digital infrastructures.* In both South Korea (under the concept of 'smart cities') and Japan (building on the concept of Society 5.0), there is a focus on integrating the digital with the physical. For example, technology is seen as a facilitator of smart energy systems, efficient public transportation, healthcare services and emergency responses.

- *'Soft' infrastructures.* Investments in digital tools and systems (devices, data centres, cloud systems, and so on) are common in the public sphere, especially in schools. In addition, the Japanese government has been funding co-working spaces for teleworkers, including in rural areas, to support repopulation, reduce commuting, and incentivise new forms of work.

5.2.3. Digital transformation of businesses

In a similar manner to the digital skills framework, the digitalisation of businesses can be separated (in line with the logic of the DDPP) into the **basic digital intensity of businesses** and the **adoption and commercialisation of advanced technology**. Notably, these two areas do not always go hand-in-hand – for example, Israel excels in the field of ICT and high-tech start-ups, receives gets the lowest scores for web presence of businesses (a proxy for digital intensity). In Australia, the situation is reversed – while the consumption of digital services and the overall digitalisation of traditional markets is advanced, the country lags behind in high-tech ventures. Furthermore, the country-level analysis carried out for this study has uncovered two opposing obstacles to digitalisation in this sphere. Specifically, South Korea has identified underdevelopment in its SME scene and the concentration of economic power in the hands of industry giants as an obstacle to innovation, and is actively trying to stimulate the role of SMEs in supply chains. On the other hand, in Australia, the lack of venture capital-powered large tech companies is seen as a brake on innovation and the commercialisation of high tech.

In terms of policy response, as with the deployment of digital infrastructure, the digital transformation of businesses is considered to be largely driven by market forces – although the role of policymakers in improving the overall regulatory pro-innovation and pro-competition framework in order to facilitate progress is often recognised (particularly in the case of the UK). Furthermore, some **selective and targeted policy interventions** have been identified, usually aimed towards high-tech. In particular, attention is directed towards:

- *Artificial intelligence*. Although dedicated AI strategies were only identified in Japan (focusing on practical applications of AI, e.g. for disaster prevention) and the UK (a broad plan centred around AI talent, research and the regulatory framework), AI is an implicit priority in other countries too –, especially China, but also in Australia (where AI is applied, for example, in mining) and the US (home to the global leaders in the AI market). Furthermore, several countries have attempted to introduce (usually voluntary) AI ethical codes or guidelines – for example, the 'Blueprint for an AI Bill of Rights' in the US, Australia's 'AI Ethics Principles', or the UK's 'ethical principles and a pro-innovation regulatory environment' put forward in the National AI Strategy mentioned above.
- *Platforms*. In both China and the US, following in the footsteps of the EU, discussions have been ongoing about the potential regulation of platform giants, in related to anti-trust law as well as concerns over data privacy and freedom of expression.

5.2.4. Digital public services

Efforts directed towards the digitalisation of public administration have focused on two primary goals:

- *Public services (outward-looking).* The integration of online services into a single citizen-facing platform has been the overarching trend across the countries studied. In addition, comprehensive eID schemes have been identified in Australia, Israel and South Korea, where eID can be used to access most or all government online services. In Japan, although a chipped ID card with an identification number exists, its functionalities are somewhat limited. In some countries, full integration and

centralised identity verification is difficult or impossible, in particular due to the importance of state- or municipality-level administration (e.g. in China and the US).

- *Government efficiency (inward-looking).* Governments have also been looking into the digitalisation of procedures, the use of AI tools or cloud systems by public authorities, the upgrading of infrastructure and – most of all – improved data exchange between government divisions that have often historically been siloed, as well as the use of data to inform evidence-based policymaking. In healthcare systems, data exchange between different entities (hospitals, clinics or different private healthcare providers) has been also a key priority to ensure seamless access to information for medical staff.

Looking at the how, there is a notable trend of centralising digital aspects of government at the inter-ministerial level. Dedicated agencies have been created in Australia (the Digital Transformation Agency), Israel (the Israel National Digital Agency), and Japan (the Digital Agency) to coordinate data integration between ministries and agencies, to provide a shared infrastructure and platform, and to oversee the provision of e-services to citizens and businesses. Furthermore, the digital upskilling of government and public service staff has been an important component of digitalisation strategies. Lastly, governments have to ensure the security and privacy of the data stored. For example, data leaks and errors have hindered eID development in Japan, while in Australia, the government has had to revert to offering an option to opt out of a new e-healthcare system after backlash from society, spurred by concerns over data security and privacy.

6. Conclusions

This study aims to support the Commission in assessing the EU's digital performance in comparison to the benchmark countries – chosen as global best performers in digitalisation – in the context of the Digital Decade policy programme and intra-EU digitalisation tracking and measurement tools (DESI; the State of the Digital Decade report). The study involves both a quantitative analysis (focusing on digitalisation outcomes) and a qualitative assessment (with an emphasis on digitalisation policy frameworks) of the EU's position in comparison to the selected benchmark countries. The sections that following briefly summarise the study's key takeaways, taking into account the study's limitations (*Section 6.1*), and focusing on two key areas: digitalisation outcomes (*Section 6.2*) and digitalisation policy frameworks (*Section 6.3*).

6.1. Limitations of the study

When drawing conclusions and lessons learned from the collected and analysed data, clear account should be taken of the study's limitations. The study is exploratory in nature, presenting the first such attempt at a comparative overview of the EU and selected non-EU countries in the context of the DDPP.[148] The data collection and analysis activities associated with the report have been limited in both time and scope (concentrated during December 2023 and January 2024). As a result, the data collected (especially qualitative) are not to be considered comprehensive – between one and three interviews were conducted per country and, although the authors have aimed to include the most important policies in the analysis, the policy mapping inevitably misses some initiatives implemented in recent years by the countries studied. The exhaustiveness of the information presented is further constrained by the breadth of the report's thematic scope – digitalisation is a wide-ranging and cross-cutting theme in contemporary public policy, spanning multiple 'traditional' policy areas (such as education, industrial, social and R&D policy).

Lastly, not only the quantity but also the quality of the data collected needs to be scrutinised. Here, key limitations include:

- *Data access*. The availability of comparable, comprehensive and reliable international statistics which, in addition, correspond closely to the EU KPIs designed to track the DDPP targets, is extremely limited. Therefore, most data included in the analysis constitute proxies (which are, by their nature, imperfect), and even then, some issues remain in relation to methodology (e.g. reliance on survey data) or coverage (e.g. missing values).
- *Potential information bias*. The qualitative stream of research conducted in this study has relied heavily on interviews with academic experts and/or representatives of relevant public authorities (responsible for digital policy implementation). While the interviewees have undoubtedly been extremely well-informed about the topics in question, the sample size (one to three interviews per country) inevitably means that a degree of personal bias is ingrained within the results presented in this report, e.g. in terms of balance in the coverage of each policy area (skewed towards the key interests of the interviewees) or evaluation of progress (optimistic or pessimistic).

With these limitations in mind, some conclusions emerge from the analysis, which can provide salient learning points for researchers and policymakers.

[148] Although the International DESI (I-DESI) index was developed previously (see: European Commission (2020). *I-DESI 2020: How digital is Europe compared to other major world economies?,* available at: https://digital-strategy.ec.europa.eu/en/library/i-desi-2020-how-digital-europe-compared-other-major-world-economies), this did not cover all of the DDPP's cardinal points, and did not contain a qualitative analysis.

6.2. Digitalisation outcomes

The present study provides several takeaways with regarding digitalisation outcomes as a result of its cross-country comparison. With regard to the EU's position globally, the EU is, on average, competitive with the best-in-class countries (global digital leaders) across most indicators. The EU is also fairly consistent across different policy areas (the DDPP cardinal points): while some countries excel at some measures and lag in others, the EU hovers around the middle ground (which is also likely to be due to the aggregation of 27 scores into average values, and thus the balancing of the strengths and weaknesses of individual Member States). Nevertheless, some strengths (e.g. fibre roll-out) and weaknesses of the EU – for example, in the areas of digital skills (especially advanced digital skills), digital infrastructure (including 5G coverage, high-speed broadband uptake, semiconductor market share and quantum patents), and the digital transformation of businesses (particularly the number of unicorns per capita, and the take-up of advanced tech) – can be identified. Furthermore, the EU is a diverse bloc, and the distribution of EU Member States' scores generally tends to be wide – often wider than the differences between the EU average and the scores of the benchmark countries.

Several more technical takeaways can be also pointed out, regarding data reliability and comparability. In general, international statistics rarely correspond directly to the DESI indicators. Even where they do (e.g. 5G coverage, the use of AI), there are notable discrepancies between the international and EU data (which are likely to reflect methodological differences). Different international sources can also differ between one another, even when measuring the same phenomenon. Furthermore, some indicator scores (especially composite indexes based on data from surveys or interviews) must be interpreted with caution. For example, the scores of the benchmark countries in the Online Services Index are extremely close to one another (between 0.87 and 0.98), despite fairly large differences in the development and quality of e-government services, according to the experts interviewed in the context of this study. Lastly, the temporal aspect of the data must also be accounted for – in the context of rapid technological progress, countries may make huge leaps in certain indicators (e.g. countries can more than double their 5G coverage in the course of a single year). In such cases, last year's data may already be considered outdated.

These methodological considerations mean that data on digitalisation must be always evaluated with caution and within a clearly defined context. However, such limitations also point to the salient need for the diligent measurement and tracking of progress in these key fields, not only for the sake of accurate reporting, but also for well-informed policymaking.

6.3. Digitalisation policy frameworks

In conclusion, some lessons can also be drawn from the qualitative review of the benchmark countries' digitalisation policy frameworks:

- Digitalisation has become a salient topic not only in policy, but also in politics. In several countries, this issue (or selected components of it) is given the highest priority, and coordinated at inter-ministerial level.
- Successful digitalisation requires a long-term strategy based on foresight, continuous high levels of investment in R&D, and an effective capital market. The examples of the US's drive towards technological excellence since WWII or – more recently – the heavy prioritisation and large investments made in South Korea and China, show how such foresight can deliver long-term effects.
- While this prioritisation and political salience surely have a strong signalling effect, the short-term effects of specific policies are mostly unclear, given the lack of defined targets, little or no evidence regarding impact and/or the mere fact that most policies

are very recent and still ongoing, or only just developing. In a similar vein, diligent and systematic tracking of the progress of digitalisation is rare – the EU's DDPP stands out in this respect, setting clear numerical targets for the EU to achieve by 2030, and establishing a monitoring framework.

- The extent of digital policy frameworks varies between countries, ranging from long-term and all-encompassing strategies to fragmented and targeted *ad hoc* responses. In most cases, policy priorities in those countries studied in which comprehensive strategies do exist align broadly with the EU's DDPP monitoring framework. However, several priorities have been emphasised in the benchmark countries which, although relating to general objectives of the DDPP (such as digital inclusion, cybersecurity, the twin transition or sovereignty),[149] are not yet monitored by quantitative KPIs under the DDPP monitoring framework.
- Digitalisation is often perceived as a means to an end rather than a goal in itself, and is considered particularly crucial in fuelling economic growth in the digital era, but also in helping to solve broad, fundamental economic (e.g. competitiveness, sovereignty) and societal (e.g. demographics, equity) problems, as well as specific down-to-earth challenges such as disaster prevention using AI. It seems paramount, from a strategic point of view, not to lose track of these end goals.

Lastly, some common themes can be identified in terms of *how* digital policy is pursued:

- Some key preconditions are necessary for a successful policy framework. Perhaps no differently from most other policy fields, these have been identified across all or most countries – and include a degree of political consensus, as well as consistency and long-term planning (including long-horizon funding).
- The perceived role of the state varies between policy areas and/or countries (with some taking a more 'hands-on' approach, while others restrict themselves to ensuring a sound regulatory framework with little direct intervention). Overall, government action is important in setting the preconditions for digital transformation, including the development of fundamental research and innovation, fostering resilience and sovereignty, and facilitating high-quality education. In the realm of the four cardinal points of the DDPP, most direct policy attention appears to be directed towards improving digital public services and laying down digital infrastructure. Digital skills are conditional on a country's overall education system, and are rarely the targeted of dedicated policy actions, while the digital transformation of businesses appears to be perceived as a more organic and market-driven phenomenon that requires a favourable ecosystem (e.g. a pro-innovation regulatory framework), with less need for direct policy intervention.
- Nevertheless, there is a growing trend of interventionism in the context of those high technologies that are considered 'strategic' (5G, semiconductors), mostly fuelled by the technological race in the context of geopolitical fragmentation. While this race for digital supremacy is mostly led by China and the US, it is also spilling over or affecting other countries or blocs.

[149] See Article 3 of the Decision (EU) 2022/2481 of the European Parliament and of the Council of 14 December 2022 establishing the Digital Decade policy programme 2030, available at: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32022D2481.

Annexes

I. Final dataset

The dataset is provided in a separate Excel file, ‘Annex I. Final dataset’.

II. Policy inventory

The inventory is provided in a separate Excel file, ‘Annex II. Policy inventory’.

GETTING IN TOUCH WITH THE EU

In person

All over the European Union there are hundreds of Europe Direct information centres. You can find the address of the centre nearest you at: https://europa.eu/european-union/contact_en

On the phone or by email

Europe Direct is a service that answers your questions about the European Union. You can contact this service:

– by freephone: 00 800 6 7 8 9 10 11 (certain operators may charge for these calls),

– at the following standard number: +32 22999696 or

– by email via: https://europa.eu/european-union/contact_en

FINDING INFORMATION ABOUT THE EU

Online

Information about the European Union in all the official languages of the EU is available on the Europa website at: https://europa.eu/european-union/index_en

EU publications

You can download or order free and priced EU publications at: https://publications.europa.eu/en/publications. Multiple copies of free publications may be obtained by contacting Europe Direct or your local information centre (see https://europa.eu/european-union/contact_en).

EU law and related documents

For access to legal information from the EU, including all EU law since 1952 in all the official language versions, go to EUR-Lex at: http://eur-lex.europa.eu

Open data from the EU

The EU Open Data Portal (http://data.europa.eu/euodp/en) provides access to datasets from the EU. Data can be downloaded and reused for free, for both commercial and non-commercial purposes.

KK-02-24-421-EN-N

Publications Office
of the European Union

doi: 10.2759/908255
ISBN 978-92-68-14508-1