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BUILDING A JUST WORLD AND A SUSTAINABLE PLANET

Toolkit for Artificial Intelligence Readiness and Capacity Assessment

Artificial Intelligence for Inclusive Sustainable Development and Inequalities Reduction

Digital Economy Working Group

Report prepared under the Brazilian Presidency of the G20

Knowledge partner

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MINISTRY OF SCIENCE, TECHNOLOGY AND INNOVATION

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Introduction

The Context

Artificial Intelligence (AI) systems are increasingly being developed, deployed, and used across sectors and countries. While this creates tremendous opportunities across many domains – from transport and education to climate change, biomedical research, and health –, if suitable guardrails are not in place, AI risks reproducing and exacerbating societal biases, economic inequalities, and digital divides, among others.

The ability of countries to leverage AI for the good of their economies and societies requires some relevant endowment, including both physical and digital infrastructure, in addition to skilled human capital, among others. This entails having the availability of data (including local data), computing power, research capabilities, digital skills, and talent, in addition to relevant framework conditions, including the institutional settings in place and the dynamics of the business sector.

At present, AI developments are characterized by concentrated markets and by few big corporations and countries leading and having access to key enabling resources, including datasets, hardware, and software. Moreover, while global in reach, AI systems often fail to reflect the diverse linguistic, cultural, demographic, and geographical contexts in which they are developed, deployed, and used, raising concerns about their representativeness and inclusiveness.

The status quo risks perpetuating existing inequalities, increasing fragmentation, mistrust, and geopolitical competition. This places relatively more vulnerable populations and developing countries at a further disadvantage. Consequently, it has triggered the emergence of concepts such as "AI autonomy." This term refers to a nation's strategic autonomy, or its capacity to develop AI using its own infrastructure, datasets, workforce, and businesses. Furthermore, it involves the ability to independently regulate and decide on its own digital and AI path, in a quest to ensure inclusive growth and sustainable development.[1]

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1. Digital and AI autonomy may include control over AI supply chains, from datasets to hardware and software. The approach stems from the increasing fear that countries will be cut off from critical digital components (e.g., computer chips) or lack control over the international flow of citizens' data. In the absence of international cooperation and coordination, like that taking place in multilateral constituencies like the G20, these developments may nevertheless threaten interconnectivity and cause market fragmentation. For a more complete discussion, see, e.g., B. J. Larsen's "The geopolitics of AI and the rise of digital sovereignty," December 8, 2022, Brookings, https://www.brookings.edu/articles/the-geopolitics-of-ai-and-the-rise-of-digital-sovereignty (last visited on June 4, 2024).

These considerations concerning AI are reflected in the Brazilian G20 Presidency's priorities, which are organized around three main cores, as shown in Figure 1 below. These priorities aim to:

▶ Foster partnerships and cooperation among G20 member states in advancing AI development, deployment, and use that benefit all. This core highlights the need to share knowledge, resources, and good practices across borders to harness AI's potential for inclusive growth and sustainable development.

▶ Strengthen AI infrastructures and enhance local AI capabilities in all countries by ensuring equitable access to AI technologies, resources, and infrastructures. This core emphasizes the necessity of addressing the current concentration of AI capabilities in a few regions and the risk of exacerbating existing asymmetries and divides.

▶ Ensure digital and AI autonomy, or a nation's ability to regulate and determine its own digital and AI future, emphasizing the necessity for countries to maintain control over the governance of AI, their digital infrastructure, and AI capabilities, while at the same time stimulating digital innovation and pursuing international governance, coordination, regulatory interoperability, and cooperation to the greatest extent possible. This core underscores the need for inclusive policy development that respects diverse linguistic, cultural, demographic, social, and geographical contexts.

Figure 1 – Cores of the AI Ecosystem Development in the G20

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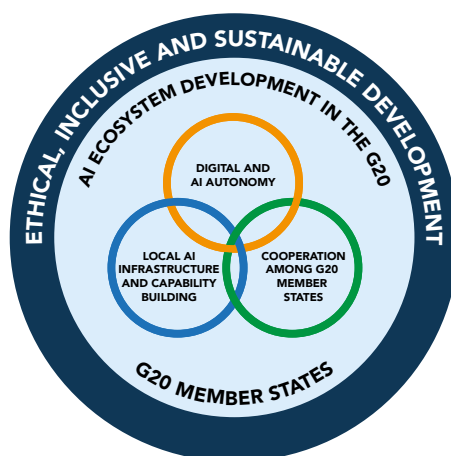
These three cores establish a foundation for a balanced, equitable, and universally accessible AI ecosystem, encapsulating globally agreed principles for safe, secure, and trustworthy AI development and deployment. This promotes sustainable outcomes and ensures that AI technologies advance the broader interests of global economies and societies, fostering inclusivity and fairness. This approach addresses both immediate and long-term technological, economic, and societal concerns, ensuring equitable benefits from AI advancements and mitigating potential harms.

G20 members play a pivotal role in leading collaborative efforts to harness the potential of AI for inclusive and sustainable development and to reduce inequalities, both within and among countries; and to have the autonomy to independently regulate and decide on their own digital and AI paths, to ensure inclusive growth and sustainable development. These efforts are vital to address disparities in digital infrastructure and capabilities and to enable access to technology.

Achieving important objectives such as reducing inequalities and pursuing inclusive and sustainable development requires tools that are able to help translate the "what" of policies into the "how" of actions. This is precisely what the present "G20 Toolkit for AI Readiness and Capacity Assessment" aims to do by helping G20 members and other countries assess how prepared they are to develop and deploy AI ethically and responsibly.

The initiative is part of the Brazilian G20 Presidency's endeavor to contribute to a safer, more secure, more trustworthy, and more promising future for AI systems globally. It aims to do this by **fostering global partnerships** that advance AI development for the benefit of all, **strengthening AI infrastructures and local AI capabilities**, and **ensuring digital and AI autonomy** within and among countries. The Brazilian G20 Presidency's strategy for AI development and adoption is structured around these three key priorities or cores, which effectively provide the essential underpinnings to achieve a more balanced, equitable, and accessible AI ecosystem.

The Toolkit

Against this background, the present Toolkit, developed under the leadership of the G20 Brazilian Presidency, proposes a comprehensive and **structured approach to gathering and analyzing relevant information** in support of the

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efforts of G20 members (and other countries) to assess their preparedness to develop, deploy, and use AI both ethically and responsibly.

The approach entails gathering relevant information through the administration of a questionnaire that builds on the Readiness Assessment Methodology (RAM) instrument developed by the United Nations Educational, Scientific and Cultural Organization (UNESCO), coupled with analysis leveraging quantitative data gathered from internationally recognized sources, including the International Telecommunication Union (ITU), the Organisation for Economic Co-operation and Development (OECD) and the World Bank. Overall, six key 'readiness and capacity' dimensions are addressed: 1) National Policies and Strategies; 2) AI Enabler Infrastructure (Technical and Infrastructural Dimension); 3) AI Capabilities (Scientific/Educational Dimension); 4) Legal/Regulatory (Legal Dimension); 5) Social/Cultural Dimension; 6) Workforce AI Capability (Economic Dimension), as shown in Figure 2. The readiness and capacity dimensions were adapted from the UNESCO RAM.[2]

Figure 2 – Toolkit Readiness Dimensions and Assessment Tools
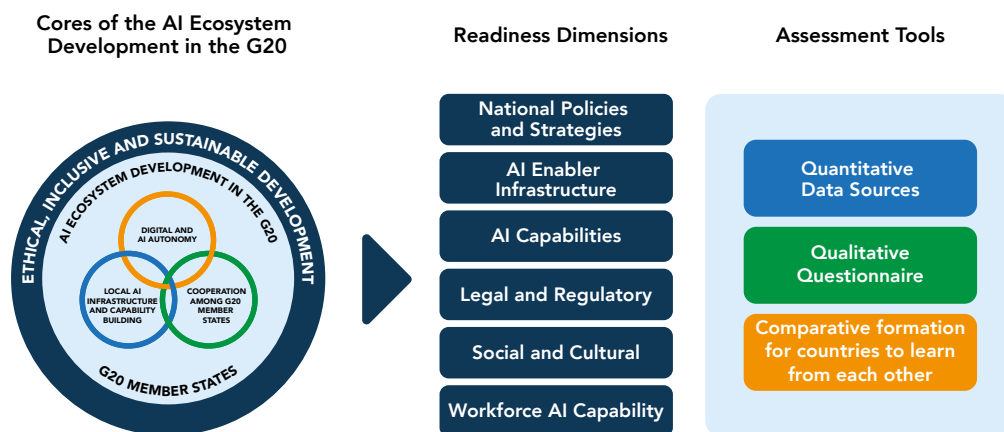
This hands-on tool was developed under the auspices of the Brazilian Presidency of the G20 in collaboration with the Ministry of Science, Technology and Innovation (MCTI), UNESCO, the Brazilian Presidency's knowledge partner on Artificial Intelligence, and the Brazilian Network Information Center (NIC.br)/ Brazilian Internet Steering Committee (CGI.br).

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2. Available at https://www.unesco.org/en/articles/readiness-assessment-methodology-tool-recommendation-ethics-artificial-intelligence

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Building on UNESCO's Readiness Assessment Methodology (RAM) instrument, the Toolkit's questionnaire aims to capture progress in relation to six readiness dimensions:

▶ **National Policies and Strategies**: Reflects how countries are structuring their institutional arrangements to support AI development and deployment.

▶ **AI Enabler Infrastructure**: Maps the technical and infrastructural capabilities that support AI, including internet connectivity, datacenters, and computing capabilities.

▶ **AI Capabilities (Scientific/Educational)**: Assesses the research and innovation landscape, educational initiatives, and the development of AI ethics-related capabilities.

▶ **Legal/Regulatory Dimension**: Reviews the existing legislative and regulatory measures concerning AI, focusing mostly on data protection, privacy laws, and overall governance.

▶ **Social/Cultural Dimension**: Considers the social and cultural implications of and for AI, including diversity, inclusion, and public engagement.

▶ **Workforce AI Capability (Economic Dimension)**: Looks at the labor market dynamics influenced by AI, including job creation and the impact on various industries.

Compared to the original UNESCO RAM approach, the present Toolkit features an expanded inclusiveness component. It collects additional data on the availability and distribution of technological and human resources essential for AI development. This enhancement aims to provide a deeper understanding of how equitable access to AI technology and its benefits can be ensured across different regions. By assessing these factors, the Toolkit helps identify gaps and opportunities in the global AI landscape, promoting a more balanced growth in AI capabilities. The ultimate goal is to foster environments where AI developments can thrive, supported by robust infrastructures and informed, skilled workforces.

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Objectives, Approach, and Components of the Toolkit

For the purpose of this Toolkit, 'Readiness' is understood as a dynamic status. Accordingly, this methodology aims to help countries understand where they stand at specific moments in their trajectory toward AI-powered economies and societies. Here, 'Capacity' refers to the ability to assess the existence or availability of relevant human capital, infrastructure, policies, and regulations needed to address the challenges posed by AI technologies and ensure that people and their interests are always at the center of AI development, deployment, and use.

Each of the six key 'readiness and capacity' dimensions is broken down into subcategories. These are analyzed using the qualitative information provided by countries through survey responses and assessed by leveraging available quantitative indicators and sub-indicators to gain a comprehensive view of the current status.

In addition to shedding light on where countries stand in relation to the six key dimensions identified, the Toolkit also facilitates knowledge sharing and enables the detection of key trends and the identification of good practices. It serves as a resource that G20 members and other countries can utilize to learn from each other and foster a more balanced, equitable, and accessible global AI ecosystem.

Main Results

In addition to developing the questionnaire that forms the core of the Toolkit, the Brazilian Presidency invited G20 members and guest countries within the Digital Economy Working Group (DEWG) to respond to the questionnaire. This facilitated an analysis of the readiness of countries to develop, deploy, and use AI ethically, aiming to reduce asymmetries and promote inclusive, sustainable development. To this end, the qualitative measures on the status of individual countries across the six dimensions provided by G20 members were enriched with quantitative data from available sources, including the OECD, the ITU, and the World Bank.

As a result of this collaborative effort, the current report offers a comprehensive overview of key trends and existing practices among G20 members and guest

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countries. It sheds light on the different stages and characteristics of their AI development, deployment, and use. The report also identifies potential structural, institutional, human capacity, and regulatory gaps, with a view to foster knowledge sharing and inform AI-related policymaking. This contributes to a more ethical global AI ecosystem centered on inclusiveness, equity, and accessibility.

The picture that emerges can be summarized as follows:

▶ Most G20 members are actively engaged in shaping their institutional frameworks to support AI development, deployment, and use, in line with their laws and regulations.

▶ Important gaps emerge in relation to investments in, access to, and deployment of relevant infrastructures and resources enabling AI development, including the availability of datacenters, cloud-based services, and computing capacity.

▶ Few G20 members have detailed strategies to measure total AI R&D spending and report accurate estimates. With this caveat in mind, substantial investments in AI research and innovation nevertheless emerge, such as funding for AI research centers, university programs, and public-private partnerships.

▶ AI-related innovation inputs and outputs differ importantly across countries. An important concentration emerges in terms of both scientific productions related to AI, as measured by publications and citations, and innovative outputs, as proxied by patents.

▶ The ethical, safe, secure, and trustworthy development, deployment, and use of AI systems are increasingly becoming a cornerstone of national AI strategies.

▶ Most G20 members have ongoing initiatives aimed at enhancing skills for the digital era, including digital skills, and incorporating AI into secondary and higher education.

▶ In terms of social and cultural dimensions, a need for the introduction or implementation of policies specifically addressing the gender gap and the environmental agenda and its relationship with AI emerges.

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The Toolkit for AI Readiness and Capacity Assessment embodies the strategic and comprehensive approach pursued by the Brazilian G20 Presidency to advance AI technologies in a manner that is ethical, inclusive, and globally coordinated. This initiative is also likely to encourage a continued commitment to innovation, ethical standards, and international cooperation, ensuring a future where AI technologies are harnessed responsibly and for the benefit of all on a global scale.

Recommendations

The following recommendations stem from the analysis presented in the report and are designed to support the three main axes for AI ecosystem development outlined by the Brazilian G20 Presidency:

▶ **Promote partnership and international collaboration**

Recommendation: G20 members are urged to prioritize the establishment of guidelines and interoperable frameworks to ensure the ethical, safe, secure, and trustworthy development and deployment of AI systems. These frameworks should safeguard human rights and enhance social welfare, facilitating a harmonized approach to AI ethics. This will enable G20 members and other countries to effectively address the challenges related to data protection, privacy, and other relevant components needed for putting AI at the service of economies and societies.

▶ **Enhance local AI infrastructure and capability building**

Recommendation: G20 members are encouraged to strengthen local AI infrastructures and enhance AI capabilities through substantial investments in technology, education, and upskilling initiatives. Special emphasis should be placed on fostering collaboration with and providing targeted support to low- and middle-income countries to bridge the digital divide, ensuring equitable access to critical AI resources like datasets and computing power. Promoting cooperation and the exchange of best practices will spur innovation and foster resilient AI ecosystems globally.

▶ **Develop regulatory frameworks to ensure digital and AI autonomy**

Recommendation: G20 members are encouraged to develop regulatory frameworks that ensure digital and AI empowerment. These frameworks should

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enable nations to independently manage their digital and AI infrastructures, conforming to international standards for the safe, secure, and ethical development and deployment of AI systems.

These targeted recommendations aim to utilize the diverse capabilities of G20 members to cultivate an AI ecosystem that is balanced and inclusive and supports ethical, inclusive, sustainable, and equitable growth on a global scale.

Sources, Caveats, and Current Limitations of the Present Report

As mentioned above, the information compiled in this report is based on:

- ▶ Available quantitative data sources spanning the six key readiness dimensions.

- ▶ Qualitative responses obtained from the questionnaire circulated to G20 members and guest countries.

In addition, this report has benefitted from the insights emerging from the G20 DEWG side event on "Harnessing AI for social equity and sustainable development," which took place in Brasilia on April 17, 2024.

While this G20 Toolkit offers valuable insights and guidance, it represents an initial assessment based on seventeen G20 members on the range of indicators that countries can use to evaluate the six key readiness and capacity dimensions. Data from seven guest countries are also included in the document.

Moreover, this report synthesizes qualitative and quantitative data obtained from responses provided by G20 members and guest countries and from publicly available data sources. It integrates diverse methodological approaches and data sets to offer a comprehensive overview of AI development across G20 member countries.

Finally, the aim of the present Toolkit is not to rank[3] or benchmark countries, but to help shed light on their readiness to ethically develop, deploy, and use AI, identify areas for collaboration and mutual learning, and identify possible good practices that may emerge.

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3. Global Index for Responsible AI presents a global rank and scores based on evidence for responsible AI in countries around the world. More information at: https://global-index.ai

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Assessing AI Readiness at the National Level: Overview of Policies and Strategies

The part of the toolkit focusing on national policies and strategies aims to capture the different settings that countries have established or are planning to establish to fulfill their strategic objectives and the different approaches chosen for the purpose, with a view to steering the ethical, safe, secure, and trustworthy development and deployment of AI systems.

Establishing clear national strategic objectives and institutional roles and responsibilities is one of the basic preconditions for sound AI governance and for enabling coordination across various policy dimensions that need to be addressed jointly for the successful deployment of AI. These range from technological infrastructure to regulatory frameworks, data governance, and capacity-building, among others (UNESCO, 2023b).

Institutional Arrangements and Mechanisms

Countries generally tend to task one or more institutions with coordinating the implementation of AI policies and the actions linked to the development, deployment, and use of AI systems; these institutional arrangements may differ significantly. Four out of seventeen responding countries reported that they have established central lead authorities, which may or may not be ministries, while twelve have adopted multi-institutional approaches.

In **Saudi Arabia**, the "Saudi Data and AI Authority [SDAIA] is the competent authority in the Kingdom concerned with data and AI. It is the national reference in all matters related to regulating, developing, and handling of data and AI; in addition, it is the lead authority in all matters related to operation, research, and innovation in the field of data and AI."[4]

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4. Information provided directly by the government of Saudi Arabia.

In many countries, even though there is no central AI authority, an institution or set of institutions is accountable for AI-related issues. In **France**, "there is a National Coordinator for AI, although each ministry has its own internal lines of responsibility."[5] In the **US**, "The White House coordinates AI policy, such as through the AI Executive Order, and this includes bodies such as the National AI Initiative Office, which plays a role in coordinating federal AI policy. The White House Office of Management and Budget sets the rules and standards for government's use of AI. Each federal agency acts within its authorities to govern sectoral uses of AI."[6] In **Canada**, the Treasury Board of Canada Secretariat (TBS) plays a central role in ensuring responsible AI in the public sector, whereby "the proposed Artificial Intelligence and Data Commissioner's work would include supporting and coordinating with other regulators to ensure consistent regulatory capacity across different contexts, as well as tracking and studying potential systemic effects of AI systems in order to inform administrative and policy decisions."[7] In **India**, for its part, the lead actor in this area is the Ministry of Electronics and Information Technology (MeitY).[8]

Despite similarities, countries' institutional arrangements may depend on existing structures and involve different entities with varied coordination mechanisms and responsibilities across leading institutions. Thus, the nature and purposes of government bodies involved in AI coordination vary across countries. In **Italy**, "according to the recently published bill (23 April 2024), the Governing bodies are the Agency for Digital (AgID), the National Cybersecurity Agency (ACN), and the Italian Data Protection Authority."[9] In **Australia**, "the Department of Industry, Science and Resources considers AI from a whole of economy perspective. The Digital Transformation Agency considers AI from a government perspective including governance and consultation across Australian government agencies."[10] In **Germany**, the Federal Ministry for Economic Affairs and Climate Action, the Federal Ministry for Science and Research, and the Federal Ministry of Labor and Social Affairs are all involved in AI-related policy actions. "In addition, the Federal Government is planning to establish a national supervisory structure for AI within 12 months after the

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5. Information provided directly by the French government.

6. Information provided directly by the US government.

7. Information provided directly by the Canadian government.

8. Information provided directly by the Indian government.

9. Information provided directly by the Italian government.

10. Information provided directly by the Australian government.

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entry into force of the EU AI Act."[11] In the **United Kingdom**, "the Department for Science, Innovation and Technology leads on overarching AI policy and is responsible for specific policy issues such as risk, compute capability, public sector adoption, regulation and more. Other departments lead on AI policy where there are interactions with other sectoral policy issues (e.g., education, justice, health, the environment)."[12]

In **Japan**, under the coordination of the Cabinet Office, the Digital Agency, Ministry of Internal Affairs and Communications, Ministry of Education, Culture, Sports, Science and Technology, Ministry of Economy, Trade and Industry, and other ministries are all involved in AI-related policy actions. The development of AI Guidelines for Business is managed by the Ministry of Internal Affairs and Communications and the Ministry of Economy, Trade and Industry.[13] In **Turkey**, the Ministry of Industry and Technology, Digital Transformation Office of the Presidency, and the Ministry's affiliated body, the Scientific and Technological Research Council of Türkiye, are working together in a collaborative environment to oversee the country's AI policy as well as the implementation of the National AI Strategy (2021-2025).

In **China**, the Ministry of Industry and Information Technology issued in 2017 the "Three Year Plan for Promoting Development of the New Generation Artificial Intelligence Industry" (2018-2020). In the following years, different ministries issued relevant AI documents and policies. "In 2018, the Ministry of Education issued the AI Innovation Action Plan for Higher Education. In 2019, the National Governance Committee for the New Generation Artificial Intelligence published the Governance Principles for the New Generation AI: Developing Responsible AI. In 2021, the National Governance Committee for the New Generation Artificial Intelligence released the Ethical Norms for the New Generation AI. In 2023, multiple ministries, including the Cyberspace Administration of China, introduced the Provisions on the Administration of Deep Synthesis of Internet-Based Information Services and issued the Interim Measures for the Management of Generative Artificial Intelligence Services."[14]

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11. Information provided directly by the German government.

12. Information provided directly by the government of the United Kingdom.

13. Information provided directly by the Japanese government.

14. Information provided directly by the Chinese government. Minor editorial adjustments were made in the original text.

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Finally, some countries have institutional structures to monitor different aspects of AI, which produce information that helps them implement their national strategies and/or address governance challenges. Two examples are the Observatory for Artificial Intelligence in Work and Society at the Federal Ministry of Labor and Social Affairs (AI Observatory) in **Germany** and the Labor IA initiative in **France**. **Brazil**, in turn, has the Brazilian Artificial Intelligence Observatory (OBIA). It "operates as a focal point in Brazil for monitoring and analyzing the evolution and impact of AI and collaborates with multisectoral partners, both domestic and international. The OBIA is the result of a strategic action within the context of the Brazilian Artificial Intelligence Strategy (Estratégia Brasileira de Inteligência Artificial [EBIA]) (...). OBIA emerges as a response to the need for monitoring and analyzing the advancements and impacts of AI in Brazil."[15] OBIA is also an action foreseen in the recently launched Brazilian AI Plan.

National Strategies and Policies for AI

Fifteen out of seventeen responding G20 members reported that they have developed national AI strategies. In two countries, national strategies were under development. Despite diverse approaches, countries' strategies emphasize common themes across their objectives and action lines, such as the availability of technical infrastructure research capabilities and skills development, which will be further addressed in the next sections.

Chart 1 | National AI Regulation
G20 Countries that reported to the presidency

1.1) Has your country issued a National Strategy, Policy, Action Plan, or equivalent for AI?

15	2

- 🟦 Yes
- 🟩 No, but under development
- 🟨 No, and not under development
- ⬜ NA

1.2) Does your country have institutional arrangements and mechanisms to govern AI development, deployment, and adoption?

12	4	1

- 🟦 Yes, single lead ministry/body/institution
- 🟩 Yes, multiple ministries/bodies/institutions
- 🟩 Yes, other governance arrangement
- 🟨 No ministry/body/institution is currently responsible

Source: AI Capacities in G20 Countries Survey.

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15. Information retrieved from: https://cetic.br/media/docs/publicacoes/6/20240514085413/iso-year-xvi-n-1-ia-development-in-brazil.pdf

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Figure 3 - AI National Strategies, Policies and Action Plans

G20 Members	Year	Title	Reference
Brazil	2021	Brazilian Artificial Intelligence Strategy (EBIA)	https://www.gov.br/mcti/pt-br/ acompanhe-o-mcti/transformacaodigital/ arquivosinteligenciaartificial/ebia-documento_ referencia_4-979_2021.pdf
	2024	Brazilian Artificial Intelligence Plan 2024-2028	https://www.gov.br/mcti/pt-br/acompanhe-o-mcti/noticias/2024/07/plano-brasileiro-de-ia-tera-supercomputador-e-investimento-de-r-23-bilhoes-em-quatro-anos
Canada	2017	Pan-Canadian Artificial Intelligence Strategy (PCAIS)	https://ised-isde.canada.ca/site/ai-strategy/en
China	2017	Next Generation Artificial Intelligence Development Plan	https://www.gov.cn/gongbao/content/2017/ content_5216427.htm?eqid=eac41aaa00089 4f30000000464638307
France	2018	National Strategy for Artificial Intelligence	https://www.entreprises.gouv.fr/fr/numerique/ enjeux/la-strategie-nationale-pour-l-ia
Germany	2018	National AI Strategy	https://www.ki-strategie-deutschland.de/home.html
India	2018	National Strategy on Artificial Intelligence	https://www.niti.gov.in/sites/default/ files/2023-03/National-Strategy-for-Artificial-Intelligence.pdf
Indonesia	2020	The Indonesian National Strategy on Artificial Intelligence	https://ai-innovation.id/images/gallery/ ebook/stranas-ka.pdf
	2023	Circular Letter of MCI Indonesia Number 9 Year 2023 on AI Ethics	https://jdih.kominfo.go.id/produk_hukum/view/ id/883/t/surat+edaran+menteri+komunikasi+ dan+informatika+nomor+9+tahun+2023
Italy	2024	Italian Strategy for AI 2024-2026	https://innovazione.gov.it/notizie/articoli/ strategia-italiana-per-l-intelligenza-artificiale-2024-2026/
Japan	2019	National AI Strategy	https://www8.cao.go.jp/cstp/ai/index.html

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G20 Members	Year	Title	Reference
Republic of Korea	2019	National Artificial Intelligence Strategy	https://www.msit.go.kr/bbs/view.do?sCode=user&mId=113&mPid=112&pageIndex=1&bbsSeqNo=94&nttSeqNo=2405727&searchOpt=ALL&searchTxt=%EA%B5%AD%EA%B0%80%EC%A0%84%EB%9E%B5
Turkey	2021	National Artificial Intelligence Strategy 2021-2025	https://cbddo.gov.tr/SharedFolderServer/Genel/File/TRNationalAIStrategy2021-2025.pdf
Saudi Arabia	2020	National Strategy for Data & AI	https://ai.sa/
Russia	2019	The National AI Development Strategy	https://ai.gov.ru/en/national-strategy/
United Kingdom	2021	UK National AI Strategy	https://assets.publishing.service.gov.uk/media/614db4d1e90e077a2cbdf3c4/National_AI_Strategy_-_PDF_version.pdf
United States	2023	Executive Order on the Safe, Secure, and Trustworthy Development and Use of Artificial Intelligence	https://www.whitehouse.gov/briefing-room/presidential-actions/2023/10/30/executive-order-on-the-safe-secure-and-trustworthy-development-and-use-of-artificial-intelligence/

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G20 Guest Countries	Year	Title	Reference
Denmark	2019	National Strategy for Artificial Intelligence	https://en.digst.dk/media/19337/305755_gb_version_final-a.pdf
Norway	2020	National Strategy for Artificial Intelligence	https://www.regjeringen.no/en/dokumenter/nasjonal-strategi-for-kunstig-intelligens/id2685594/
Portugal	2019	AI Portugal 2030 – Portuguese National Initiative on Digital Skills	https://www.portugal.gov.pt/download-ficheiros/ficheiro.aspx?v=%3D%3DBAAAAB%2BLCAAAAAAABACzMDQxAQC3h%2ByrBAAAAA%3D%3D
Singapore	2023	National AI Strategy 2.0	www.smartnation.gov.sg/nais/
Spain	2020	National Artificial Intelligence Strategy	https://portal.mineco.gob.es/RecursosArticulo/mineco/ministerio/ficheros/National-Strategy-on-AI.pdf
United Arab Emirates	2017	The UAE National Strategy for Artificial Intelligence	https://ai.gov.ae/wp-content/uploads/2021/07/UAE-National-Strategy-for-Artificial-Intelligence-2031.pdf
Uruguay	2020	AI Strategy for the Digital Government	https://www.gub.uy/agencia-gobierno-electronico-sociedad-informacion-conocimiento/comunicacion/publicaciones/estrategia-inteligencia-artificial-para-gobierno-digital/estrategia

Guidance on the Ethical Development and Use of AI

Fifteen out of seventeen countries reported that they have developed guidelines to address potential ethical challenges associated with the design and use of AI and recognize the need to update some of their policies to align with the UNESCO Recommendation on the Ethics of AI, promoting a more comprehensive approach to the ethical use of AI.

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Chart 2 | National AI Regulation: Ethical Concerns

G20 Countries that reported to the presidency

1.4) Has your country issued guidelines to address the ethical implications arising from AI development, deployment, and adoption?

15	2

■ Yes ■ No ■ NA

1.5) Does your government plan to implement the UNESCO Recommendation on the Ethics of AI (e.g., establishing a national AI Ethics Commission or other measures)?

11	1	5

■ Yes ■ No ■ NA
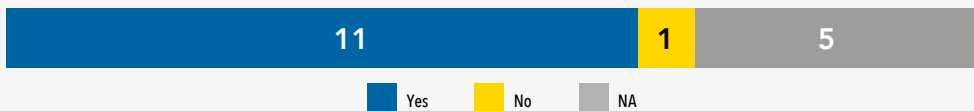
Source: AI Capacities in G20 countries Survey.

International Cooperation on AI

Several initiatives have been developed by countries to strengthen international cooperation on the subject of AI. Their main objective is to establish international norms and standards for the development, safety, and governance of AI, exchange experiences and best practices, and reduce the gaps in AI applications in developing countries.

With regard to the establishment of international norms and standards, **Australia** mentioned its participation in the UN High-Level Advisory Body on Artificial Intelligence, a multi-stakeholder entity with 36 experts from around the world that aims to "harness AI for humanity, while addressing its risks and uncertainties, as AI-related applications, algorithms, computing capacity and expertise become more widespread internationally"[16]. In the same vein, **Saudi Arabia** referred to the creation of the Global AI Summit, an international platform for advancing the discussion around the ethical and social aspects linked to the development of AI; the country also established the International Center for Artificial Intelligence Research and Ethics (ICAIRE), which is classified as a UNESCO Category II International Center.[17] The **United Kingdom** hosted the first AI Safety Summit in 2023 at Bletchley Park, focused on advanced AI risks.[18] **Turkey** has set "strengthening international cooperation" as a strategic priority for its National AI

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16. Information retrieved from: https://www.un.org/en/ai-advisory-body/about

17. Information provided by the Saudi Arabian government.

18. Information provided directly by the United Kingdom government.

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Strategy, emphasizing "active participation in global data governance, trustworthy and responsible AI studies", as well as engagement "in cross-border projects […], with a priority in the multi-annual financial frameworks of the European Union".[19]

As part of its national AI strategy, **Germany** works globally and with seven partner countries to contribute to "democratizing AI worldwide." The German government "promotes local AI innovation i.e. through access to open-source AI training data, strengthened AI skills and policy frameworks for responsible AI."[20]

With respect to the exchange of experiences and best practices around the development of AI, **China** "put forward a draft resolution to the UN General Assembly on Enhancing International Cooperation on Capacity-building of AI, with a view to promoting exchanges on AI technologies and best practices."[21] As mentioned, we also see initiatives aimed at tackling regional inequalities in the use and exploitation of AI. China's Global AI Governance Initiative "points out that efforts should be made to conduct international cooperation with and provide assistance to developing countries, to bridge the gap in AI and its governance capacity."[22] **Saudi Arabia** refers to its "multiple initiatives to promote international cooperation on AI such as Elevate: a global program that aims to use AI to reduce the gender gap by empowering more than 25,000 women globally."[23]

Finally, with regard to the priorities for international cooperation for the development of AI, we see, above all, convergence between countries. The main priority associated with the topic by the responding countries was "To mediate standards, safety, and risk management frameworks, to seek interoperability and alignment with norms," followed by "To strengthen international cooperation and assistance for developing countries to bridge the gap in AI and its governance capacity." Three priorities were identified equally by the countries: "To promote international collaboration on data, computing and talent to solve SDGs," "To strengthen information exchange and technical cooperation," and "To form a globally recognized governance framework and standard norms for AI based on full respect for national policies and practices." The least mentioned priority was "To share AI knowledge, and make AI technologies available to the public under open-source terms."

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19. Information provided by the Turkish government.
20. Information provided by the German government.
21. Information provided by the Chinese government.
22. Information provided by the Chinese government.
23. Information provided by the Saudi Arabian government.

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AI Governance Arrangements in G20 Guest Countries

G20 guest countries exhibit similar institutional arrangements, where a specific institution or a group of institutions typically takes the lead in coordinating various AI-related initiatives. In **Norway**, "the Ministry of Digitalisation and Public Governance is responsible for the overall governance of ICT policy in Norway, including AI. […] the different ministers are responsible for AI within their sector."[24] In the **United Arab Emirates**, "Artificial Intelligence was introduced as a dedicated ministerial portfolio in October 2017 with the appointment of the world's first minister of artificial intelligence. […] The UAE Artificial Intelligence, Digital Economy and Remote Work Applications Office, led by His Excellency Omar Sultan Al Olama, convenes the Council and coordinates between various stakeholders."[25]

In **Portugal**, in turn, the "Portugal INCoDe.2030 is an inter-ministerial action […] responsible for developing the National Artificial Intelligence Strategy (AI Portugal 2030), in cooperation with the Science and Technology Foundation (FCT), the National Innovation Agency (ANI), Ciência Viva and the Administrative Modernization Agency (AMA)."[26] The Council for Information and Communication Technologies in Public Administration (CTIC) and the Technical Commission 223 are two other important stakeholders in the Portuguese AI-governance structure. In **Denmark**, "the Danish Ministry of Digital Government and Gender Equality is the policy coordinating ministry in the government, whereas the Danish Agency for Digital Government has been designated as the national competent authority according to the EU Artificial Intelligence Act."[27] In **Singapore**, "The National AI Group is the main coordination body and works together with other agencies such as the InfoComm and Media Development Authority (IMDA), Digital Industry Singapore, Economic Development Board and Ministry of Trade and Industry."[28]

Finally, in **Spain** and **Uruguay**, there is a lead institution to AI. In **Spain**, this role belongs to the Ministry for Digital Transformation and of Civil Service, Secretariat of Digitalization and Artificial Intelligence (Spanish Agency for the Supervision of Artificial Intelligence AESIA: Supervision Body), and, in **Uruguay**, to the Agency for the Development of Electronic Management Government and Information and Knowledge Society (Agesic).

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24. Information provided directly by the Norwegian government.

25. Information provided directly by the government of the United Arab Emirates.

26. Information provided directly by the Portuguese government.

27. Information provided directly by the Danish government.

28. Information provided directly by the government of Singapore.

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AI-Enabling Infrastructure (Technical and Infrastructural Dimensions)

Without the relevant infrastructures, the development and deployment of AI-based solutions cannot be scaled up throughout countries.

Therefore, this dimension refers to the level of ICT and technical infrastructure in place, including the extent of Internet access and connectivity, the availability of datacenters, cloud computing capabilities, and supercomputers, among others. Given the critical importance of data for AI technologies, another aspect within this dimension relates to the availability of high-quality data and practices (UNESCO, 2023b).

Infrastructure and Connectivity

Internet access for all is a key component to ensure fairness and non-discrimination in the development, deployment, and use of AI. It is critical to tackle digital divides and ensure inclusive access to and participation in the development of AI, promoting "equity between rural and urban areas, and among all persons regardless of race, colour, descent, gender, age, language, religion, political opinion, national origin, ethnic origin, social origin, economic or social condition of birth, or disability and any other grounds, in terms of access to and participation in the AI system life cycle" (UNESCO, 2022, p.20).

Fixed Broadband Subscriptions

In the context of G20 members, although the highest number of subscriptions (per 100 inhabitants) to fixed broadband[29] were reported by countries in Europe (**France** 48.6, **Germany** 45.4), Asia (**Republic of Korea** 46.6, **China** 44.7), and North America (**Canada** 43.2), there are still large disparities among countries in these regions. Other G20 countries achieved intermediate levels, while some members reported lower levels of subscriptions.

It is important to highlight that this indicator covers only fixed broadband at the household level. To analyze other dimensions, like mobile connectivity and Internet usage in the workplace, additional indicators are needed.

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29. The number of subscriptions to fixed broadband is typically reported by telecom regulatory agencies and the indicator is calculated divided by population estimates. It covers a dimension similar to Internet penetration, generated by household surveys, by displaying the level of broadband connectivity at the household level.

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Chart 3a | Fixed broadband subscriptions

Per 100 inhabitants, 2023

Country	Value
FRA	48.6
KOR	46.6
DEU	45.4
CHN	44.7
SAU	43.6
CAN	43.2
GBR	41.0
JPN	38.5
USA	38.1
AUS	36.4
ITA	33.8
ARG	25.4
RUS*	24.6
BRA	22.9
TUR	22.5
MEX	20.5
IDN	4.8
ZAF	3.4
IND*	2.4
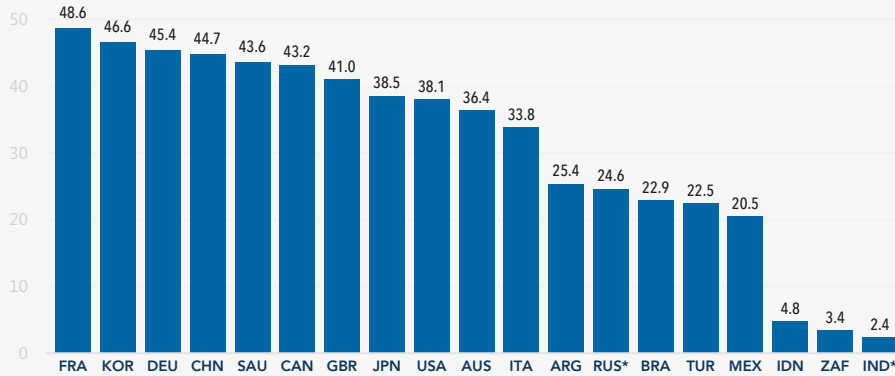
Source: ITU, 2023.
*RUS and IND refers to 2022.

Chart 3b | Mobile Broadband Subscriptions

Per 100 inhabitants, 2023

Country	Value
JPN	246.0
USA	185.0
SAU	169.0
ZAF	131.0
AUS	126.0
KOR	122.0
IDN	118.0
GBR	115.0
CHN	114.0
RUS*	110.0
FRA	109.0
ITA	98.4
BRA	97.5
DEU	94.4
MEX	93.5
CAN	87.8
TUR	84.5
ARG**	76.2
IND*	56.0
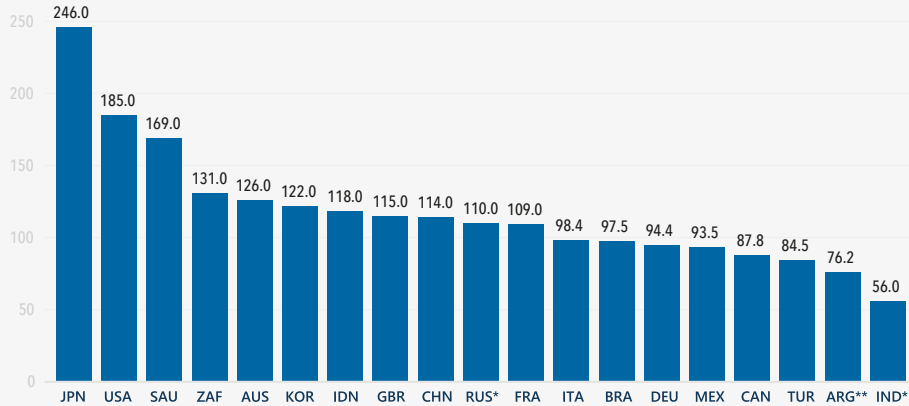
Source: ITU, 2023.
*RUS and IND refers to 2022. **ARG refers to 2021.

Internet Use

Regarding Internet usage, the gap between the G20 members at the top and the bottom of this distribution is narrower than that for subscriptions to fixed broadband, which is directly related to the fact that, in many countries, mobile

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connectivity plays a key role in guaranteeing service, especially to remote areas and lower-income households.

The proportion of individuals using the Internet is typically collected through face-to-face questionnaires applied in household sample surveys. The minimum age is not standardized, but most countries conduct individual interviews with individuals 10 years old and older. Internet use means having used the Internet at least once in the three months prior to the interview.

These figures provide further insight for the connectivity dimension. While **Saudi Arabia** has 43.6 fixed broadband subscriptions per 100 inhabitants, which places it in the middle of the distribution for that indicator, when it comes to actual computer usage, it ranks first with 100% of the population using the Internet.

Chart 4 | Individuals Using Internet

Percentage of individuals who used the Internet from any location in the last three month, 2023

Country	Percentage
SAU	100
KOR	97
USA*	97
GBR*	95
AUS*	95
CAN*	94
DEU	92
RUS	92
ARG	89
ITA	87
FRA	87
TUR	86
JPN*	85
BRA	84
MEX	81
CHN	77
ZAF*	75
IDN	69
IND**	43

Source: ITU, 2023.
* AUS, CAN, GBR, JPN, USA and ZAF data refers to 2022. ** IND data refers to 2020.
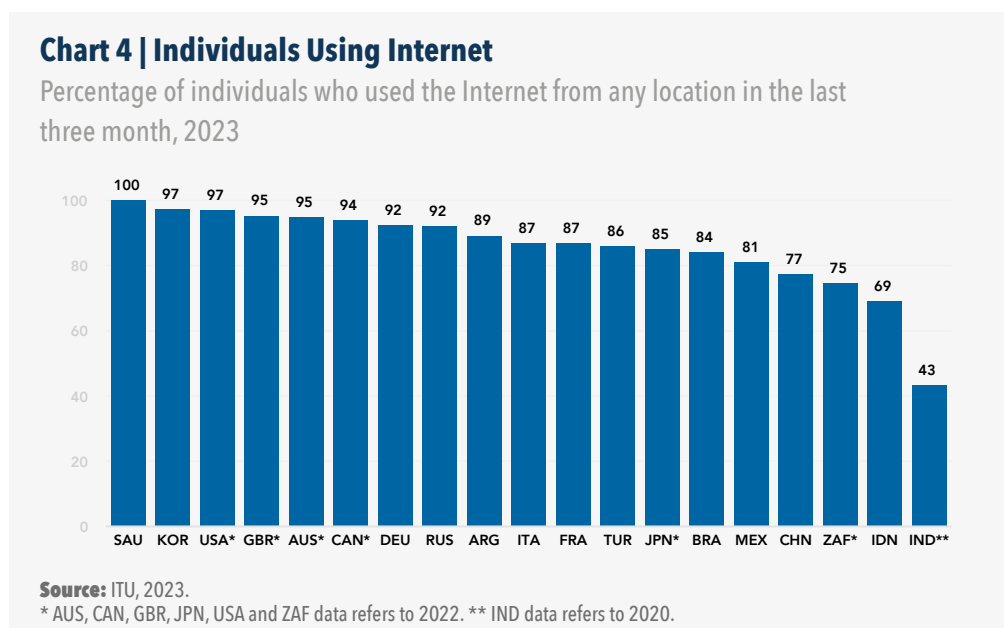
Rural/urban Gap

Indicators for access to the Internet in households are also collected through face-to-face questionnaires in household surveys. The indicator is intended to display gaps between urban and rural areas in terms of connectivity; the closer it is to 1, the narrower the gap, and the better the connectivity.

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Though there are only a few G20 members with data available for this indicator, it reveals how urban and rural dynamics affect connectivity, especially in developing countries with large territories and significant proportions of their populations living in remote areas.

Chart 5 | Rural/Urban Gap in Households with Internet

Ratio is rural households with Internet/urban households with Internet as a percentage, 2022. Values greater than 1 indicate that rural households have more access.

Country	Value
KOR	0.999
FRA	0.953
JPN	0.949
ITA	0.922
RUS	0.920
IDN	0.887
BRA	0.822
ZAF	0.782
MEX	0.559

Source: ITU, 2022.

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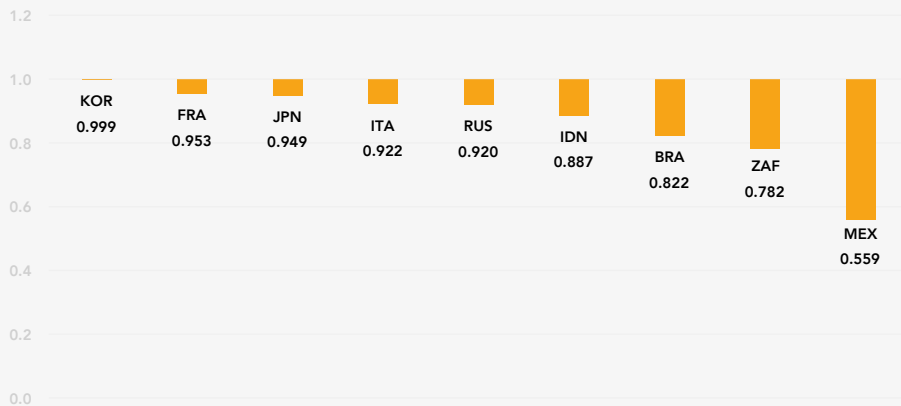
Broadband Quality

Fixed broadband download speed tracks median download speeds in Mbps and is generally associated with quality. Even though there are other factors that may contribute to good experiences when carrying out certain online activities, like latency and rate of package loss, download speed is generally considered to be a key attribute for good experiences with the most common activities performed online.[30]

The data displays high levels of disparity between countries analyzed: While in the **United States** the median download speed reaches 250Mbps, it can be up to eight times slower in other countries.

Chart 6 | Fixed Broadband Download Speed
Median Download Speed (Mbps), 2024

Source: Ookla Speedtest, 2024.

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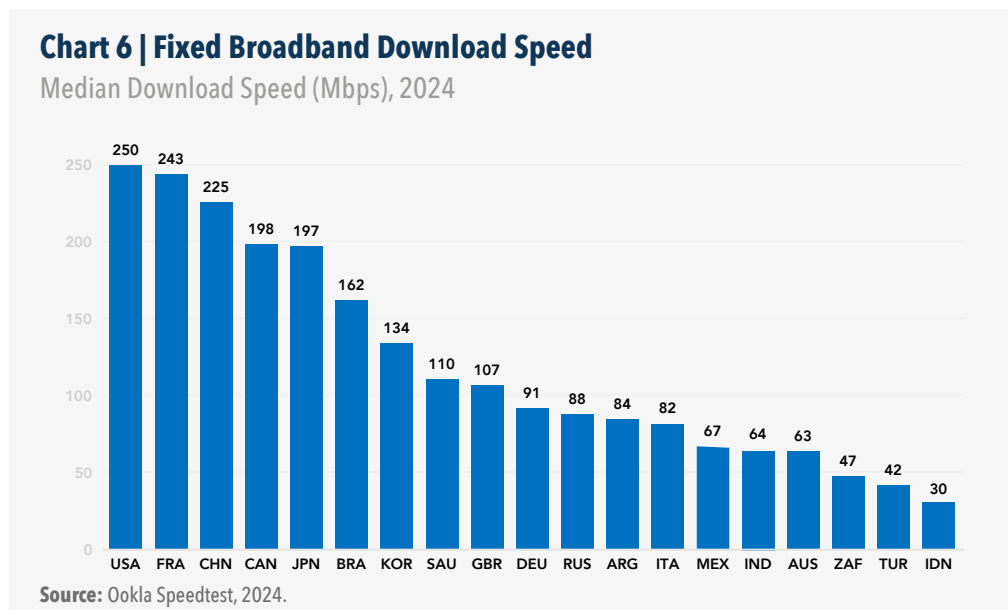
30. Data is collected automatically through an application that performs speed tests around the globe. It is relevant to point out that the use of this application is voluntary, which makes for a non-probabilistic assessment.

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Applied Standards and Computing Capabilities

The development of capabilities regarding Artificial Intelligence depends on physical infrastructures capable of supporting the generation and processing of large volumes of data. Since AI models are trained by using the massive amounts of data generated by the interconnection of devices and the knowledge archived on the Internet, the ability to process this data with speed and stability provides advantages to countries seeking to enhance their AI capabilities.

The data from Datacenter Map present the number of datacenter infrastructures offering colocation, cloud, and connectivity services, activities that are prerequisites for and enablers of the development of AI. According to the data, the **United States** has a large majority of the datacenters mapped (2,626), concentrated in states such as Virginia, California, and Texas. In relation to other countries, most operate more than 100 datacenters.

Chart 7 | Number of Datacenters
Total, 2024

Country	Datacenters
USA	2626
GBR	353
DEU	312
CAN	231
IND	231
AUS	215
FRA	205
CHN	176
BRA	127
JPN	115
ITA	99
TUR	70
RUS	64
KOR	38
ARG	29
SAU	24

Source: Ookla Speedtest, 2024.

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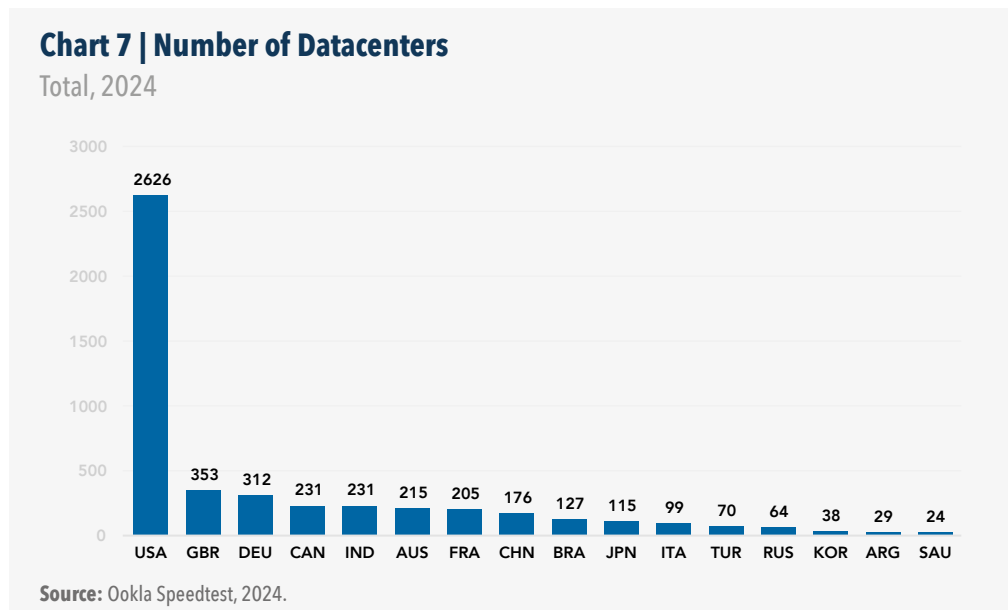
Cloud Services

Specifying further the capabilities necessary for the development of Artificial Intelligence, a crucial aspect is the provision of cloud services. The data from Datacenter Map compiles the number of service providers for infrastructure as a service (IaaS) and platform as a service (PaaS), which covers a significant portion of the requirements needed to establish the technical development of AI, as well as its routine use. The **United States** leads with 124 cloud service providers, followed by the **United Kingdom** (46) and **Germany** (28).

Chart 8 | Cloud Providers

Total, 2024

Country	Value
USA	124
GBR	46
DEU	28
AUS	20
FRA	19
CAN	18
IND	11
ITA	10
TUR	10
BRA	8
RUS	8
ZAF	6
JPN	5
ARG	4
CHN	3
IDN	3
MEX	2
SAU	2
KOR	1

Source: https://www.datacentermap.com/cloud/.
Data collected on May 28, 2024.

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IP Addresses

One of the factors driving the development of AI is the constant generation of data from devices connected to the Internet. With the growth of the Internet of Things (IoT), there is both an increased possibility for generating real-time data and an increasing need for the availability of more IP addresses to correctly identify devices and connections. Therefore, for the rapid and secure development of AI on a large scale, it is desirable for countries to expand the availability of IP addresses as much as possible, which can only be achieved by increasingly adopting IPv6. The **United States** leads in the number of available IP addresses, with 43,856 IPs per 10,000 inhabitants, followed by the **Republic of Korea,** with 22,360.64 IPs per 10,000 inhabitants, and **Australia,** with 20,747.53 IPs per 10,000 inhabitants.

Chart 9 | IP Addresses
Thousands per 10,000 inhabitants, 2024

Country	Value
USA	43.9
KOR	22.4
AUS	20.7
CAN	19.0
GBR	17.2
DEU	16.5
JPN	16.2
FRA	12.6
ITA	9.9
ZAF	5.1
ARG	4.3
BRA	4.2
RUS	3.1
SAU	2.9
CHN	2.5
MEX	2.3
TUR	2.0
IDN	0.7
IND	0.3

Source: https://research.domaintools.com/statistics/ip-addresses/;
https://worldpopulationreview.com/.
Data collected on May 28, 2024.

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Infrastructure Policies

Most G20 members reported that they have policies on the use of cloud computing services to support their government needs. In general, the policies mentioned by countries relate to the conditions for the hosting of data and applications linked to different technologies, including AI, and include guidance for contracting private services as long as specific security requirements are respected.

Even though they have similarities, the reported policies emphasize different elements. In Australia, the use of cloud services by government bodies is based on the Hosting Certification Framework, which seeks to ensure that "Service Providers are offering secure services to their Australian Government customers."[31]

In **Canada,** the "*Guideline on Service and Digital*" includes a provision for "data residency," which refers to the physical or geographic location of an organization's data. According to Section 4.4 of the Guideline, with the exception of classified data, by and large, the country is not legally restricting data storage to Canada.

Similarly, in **France**, "when it comes to the use of computing-based AI by the government, France promotes the use of sovereign digital platforms in order to ensure complete data control and encourages the development of such solutions."[32]

The **United Kingdom** has a "Government Cloud First" policy, which means that when looking for new or existing services, public sector organizations should default to Public Cloud first, using other solutions only where this is not possible."[33] In contrast, **Korea** is promoting the prioritization of private cloud services in the public sector by switching the current public administrative information system to the cloud."[34] In the same vein, **Indonesia**, through its Government Regulation Number 71 Year 2019,[35] encourages and reflects on the use of clouds for government data. **Japan** also encourages this use with its Basic Policy on Appropriate Use of Cloud Computing in Government (September 29, 2023) and its Agreement on Governmental Use of Generative AI, Second Revision (September 15, 2023).[36]

Another characteristic common to most countries is the existence of direct or indirect incentives for government agencies to use cloud services – either to

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31. Information retrieved from: https://www.hostingcertification.gov.au/framework
32. Information provided directly by the French government.
33. Information provided directly by the government of the United Kingdom.
34. Information provided directly by the South Korean government.
35. Information provided directly by the government of Indonesia.
36. Information provided directly by the government of Japan.

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make data hosting more economical and efficient or to deal with the closure of datacenters or "end-of-life technologies." These incentives can be found in **Brazil** and **Saudi Arabia**, to name just two countries. Both adopt the "cloud first" policy; that is, they encourage the prioritization of cloud services rather than local computing services for the hosting of data and applications linked to different technologies, including AI.

Finally, countries are committed to enhancing their cloud environments. In this regard, it is worth mentioning that **China**'s Next Generation Artificial Intelligence Development Plan "proposes to build AI service platforms that coordinate terminal equipment and clouds, as well as to develop an ecosystem that promotes the synergy between Artificial Intelligence software, hardware, and intelligent clouds."[37] **Turkey'**s National Artificial Intelligence Strategy 2021-2025 envisions at least 100 institutions and organizations using the Public AI-as-a-Service Platform by 2025, in order to ensure and sustain interoperability and to develop the AI ecosystem in the country. **India** is heading in the same direction, in that "under the 'IndiaAI Compute' pillar of the recently approved IndiaAI mission, Government of India will build a high-end scalable AI computing ecosystem to cater to the increasing demands from India's rapidly expanding AI start-ups and research ecosystem. The ecosystem will comprise AI compute infrastructure of 10,000 or more Graphics Processing Units (GPUs), built through public-private partnership."[38]

Regarding datacenter-related policies, two objectives stand out among those mentioned by countries: (i) ensuring the security requirements of public data stored in datacenters, including private ones; and (ii) encouraging the development of the datacenter economic segment.

The first objective is adopted by countries like **Australia**, the **Republic of Korea**, and **Canada**. In **Australia**, the Hosting Certification Framework policy covers cloud and datacenter services. It establishes that service providers that offer solutions to Australian government customers must be issued a certification that can be "Strategic," "Assured," or "Uncertified." While the first provides government bodies with the highest assurance level, the third provides them with minimal protection. In addition, "the Australian Government has a data centres panel with a range of suppliers that is mandatory for Non-corporate Commonwealth Entities to use."[39] In the **Republic of Korea**, the Comprehensive Standards on Information Resources of

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37. Information provided directly by the Chinese government.

38. Information provided directly by the government of India.

39. Information provided directly by the Australian government.

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Public Administrative Agencies policy seeks "to facilitate comprehensive management of the information systems of public administrative agencies, and to stably operate data centers and information system facilities."[40] In **Canada**, 43 departments are mandated to consume Shared Services Canada's datacenter services.

Other countries, such as **China** and **Brazil**, are actively working on strengthening their datacenter segments. China's Three-year Action Plan for New Datacenters (2021-2023) sets out principles, objectives, actions, and security measures to guide the country's datacenter development. **Brazil** prepared the document Strategy for the Implementation of a Datacenter Attraction Public Policy, which contains assessments of the Brazilian position in the datacenter market and possible strategies for attracting investments in this area.

Finally, in many countries, datacenter policies are directly or indirectly linked to the policies for contracting and using cloud services. This can be seen not only in Australia's Hosting Certification Framework, but also in **Saudi Arabia**, which determines that "all data in both the Government Cloud and the Commercial Governmental Cloud should be located geographically within the borders of Saudi Arabia."[41] **Canada**'s Guideline on Service and Digital policy also connects the two policies as it considers different types of datacenters, such as "Enterprise datacenters" and "Legacy datacenters," in the cloud deployment models available to governmental departments.

Chart 10 | AI Enabler Infrastructure Policies

G20 Countries that reported to the presidency

2.1) Is your country (national standards body) promoting or requiring the adoption of international standards for AI and digital technologies?

15		2

■ Yes ■ No, but considering ■ No, and not considering ▨ NA

2.2) Does your country have a policy for cloud computing-based AI in the government?

12	1	2	2

■ Yes ■ No, but in the process ■ No, and not in the process ▨ NA

2.3) Does your country have a policy for government data centers?

10	2	1	4

■ Yes ■ No, but in the process ■ No, and not in the process ▨ NA

Source: AI Capacities in G20 countries Survey.

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40. Information provided directly by the South Korean government.

41. Information provided directly by the government of Saudi Arabia.

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High-Performance Computers

As datacenters and cloud services become more ubiquitous, there is expected to be a growing demand for processing capacity, which will impact the number of supercomputers capable of handling the enormous amounts of data generated in each process. The list of supercomputers in operation considers the machines in terms of FLOPS (floating point operations per second), a unit of measure used to quantify the computing power of a computer or processor. In the case of supercomputers, **China** leads, followed by the **United States**, with a significant gap for other countries.

Chart 11 | Supercomputers
Total, 2024

Country	Value
CHN	383
USA	171
DEU	40
JPN	29
FRA	24
GBR	16
KOR	13
ITA	11
CAN	10
BRA	8
SAU	8
RUS	7
AUS	5
IND	4
ARG	1
TUR	1

Source: https://top500.org/lists/top500/2024/06/
Data collected on May 28, 2024

Regarding high-performance computers (HPC) that can be used for AI purposes, most G20 members have already mobilized these structures for academic and industrial research. In **France**, there are supercomputers/clusters at the regional level, and two supercomputers (Jean Zay and Adastra) are available at the national level, mainly for open research usage. In addition, supercomputers/clusters from the private sector are available based on a cloud access mode. In **Germany,** many HPC centers can be used for AI simulations. "A prime example would be the training of the language model OpenGPT-X on the HPC system JUWELS at the research facility in Jülich, one of the three supercomputing centres of the Gauss Centre for supercomputing."[42] The **Republic of Korea** has been "supporting

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42. Information provided directly by the German government.

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researchers with a supercomputer cluster (located in Gwangju) that has 20PF HPCs for AI development and technology advancement."[43] In **India**, HPCs are being used for a variety of applications, such as flood warning systems, seismic imaging for oil and gas exploration, and urban modeling.[44] In **Saudi Arabia**, the Saudi Data and Artificial Intelligence Authority (SDAIA) "has dedicated HPC infrastructure leveraging Huawei and NVIDIA solutions."[45] In **Japan**, "The National Institute of Advanced Industrial Science and Technology's (AIST) supercomputer for AI, ABCI, is used for research, development, and demonstration of human intelligence technologies that utilize high computational power, promote social implementation, and take on the most important challenges in the field of AI".[46]

Countries also made clear that the use of HPCs to contribute to the development and use of AI applications depends on balancing interests and expectations among different stakeholders and on considerable investments. The **United Kingdom**'s experience reveals the need for coordination between different levels of government and between public and private actors. "In addition to private datacenters and GPU clusters, the UK public and academic sectors operate a number of GPU clusters, at Tier 1 (national), Tier 2 (regional) and Tier 3 (local). The national AI Research Resource (AIRR) was announced in March 2023, and will be a network of GPU clusters, federated by a cloud-based service layer and designed to accommodate the infrastructure demands of public, academic and industrial researchers who examine AI workloads. The AIRR is currently comprised of the Isambard-AI and Dawn clusters at Bristol and Cambridge respectively."[47]

The National Artificial Intelligence Research Resource (NAIRR) Pilot from the **United States** "aims to connect U.S. researchers and educators to computational, data, and training resources needed to advance AI research [...] – including access to high performance computing." Furthermore, many other HPCs are available for AI science, and the most recent (Nov 2023) 'top 500 list' includes 161 U.S. HPC systems. This includes 30 in DOE National Laboratories, 76 in industry, 24 in universities, 15 in other government agencies, and 13 [on] other government labs."[48]

The **Canadian** experience demonstrates that articulating different public policies is also essential to enabling the use of HPCs in favor of AI. "As part of the Pan-

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43. Information provided directly by the government of the Republic of Indonesia.
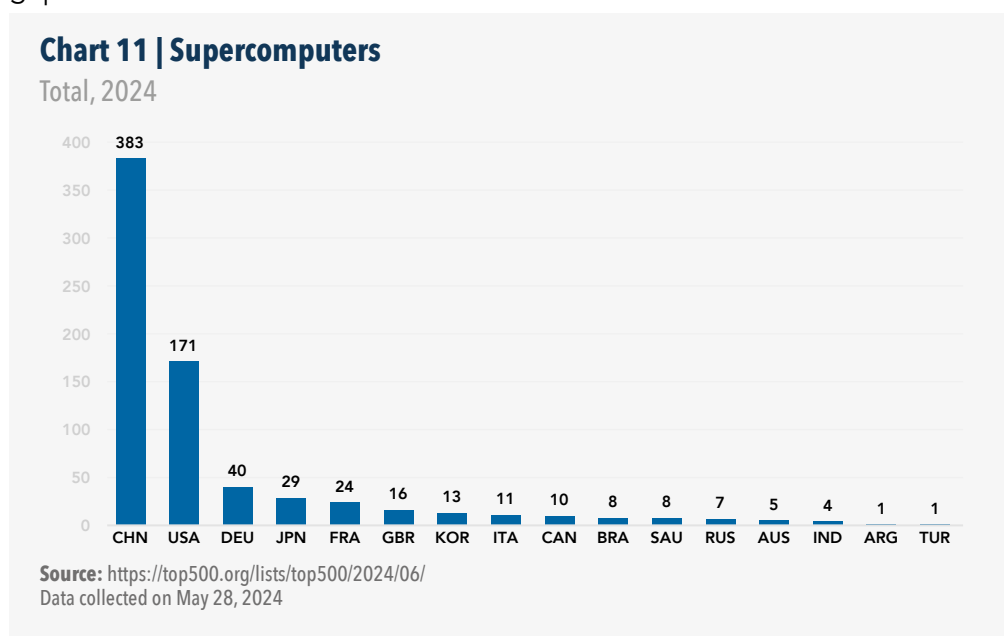44. Information provided directly by the government of India.
45. Information provided directly by government of Saudi Arabia.
46. Information provided directly by the Japanese government.
47. Information provided directly by government of the United Kingdom.
48. Information provided directly by the US government.

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Canadian Artificial Intelligence Strategy (PCAIS), the Government of Canada has provided CAD 40 million in funding to the Digital Research Alliance of Canada for dedicated computing capacity for AI researchers across Canada to support the objectives of the strategy, known as the Pan-Canadian AI Compute Environment (PAICE)."[49] Additionally, "as part of Canada's federal Budget 2024, the Government of Canada announced a CAD 2.4 billion package to secure Canada's AI advantage with funding for infrastructure, start-ups, researchers, safety research, and regulation, including $2 billion invested in Canadian-owned and located AI technical infrastructure for Canada's AI researchers, start-ups, and scale-ups as well as near-term compute access funding through an AI Compute Access Fund and a Canadian AI Sovereign Compute Strategy."[50]

Finally, **Turkey**'s experience signals that building international collaboration is fundamental to strengthening the relationship between HPCs and the development of AI. The country "participates in international collaborations and initiatives related to HPC and AI research, such as the European High Performance Computing Joint Undertaking (EuroHPC JU)."[51]

Chart 12 | AI Enabler Infrastructure: High-Performance Computers (HPCs)

G20 member countries that reported to the presidency

2.4) Does your country have HPCs that can be leveraged for AI purposes?

- Yes: 14
- No: 2
- NA: 1

2.4.2) Where are the HPCs located?

- Academia: 10
- Government: 9
- Private Sector: 7

2.4.3) What is the estimated number of HPCs in your country (e.g., clusters or supercomputers)?

- NA: 6
- Less than 10 HPCs: 2
- 10 to 50 HPCs: 8
- 50 to 100 HPCs: 0
- More than 100 HPCs: 1

Source: AI Capacities in G20 Countries Survey.

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49. Information provided directly by the Canadian government.
50. Information provided directly by the Canadian government.
51. Information provided directly by the Turkish government.

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Datasets for AI Applications

Most respondent countries mentioned initiatives to create datasets that can be used to develop AI applications. Of particular note are health databases and those designed to support the development of natural language processing technologies.

Turkey pointed out that the "Turkish Statistical Institute collects and publishes a wide range of public datasets covering demographics, economic indicators, social surveys, and more. These datasets serve as valuable resources for AI research and applications in areas such as economics, sociology, and public policy analysis."[52] Notable in this sense, among other cases, are the initiatives in relation to the development of healthcare applications – based on data from "electronic health records (with the open consent of the patients), medical imaging data, and patient outcomes data,"[53] produced in partnership with the Ministry of Health" – and public transport – with data from traffic patterns, public transit routes, and commuter behavior. In **Canada**, we see a similar trend with the Ontario Health Data Platform, "which is a federated platform/dataset created for AI/ML applications in health."[54] There is also, in Canada, an Open Data policy aimed primarily at assisting with research and discovery.

In addition to the specific initiatives to build databases for the development of AI applications, we see a convergence among the respondent countries in the importance given to the quality and openness of data. In **Saudi Arabia**, the National Data Bank and the National AI Data Platform are two clear efforts in this direction.[55] In **China**, we note the recent implementation of an update to the National AI Strategy of 2024 with the aim of giving "full play to the multiplier effect of data elements to empower economic and social development;"[56] in this document, there is a concern similar to that presented in the Spanish case with regard to the quality of databases, with the goal of combating issues such as "low quality of data supply, poor circulation mechanism, and insufficient release of application potential."[57] Lastly, in **Australia**, the Intergovernmental Agreement on data sharing between Commonwealth and State and Territory governments and the Data Availability and Transparency Act Scheme are

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52. Information provided directly by the Turkish government.
53. Information provided directly by the Turkish government.
54. Information provided directly by the Canadian government.
55. Information provided directly by the Saudi Arabian government.
56. Information retrieved from: https://www.cac.gov.cn/2024-01/05/c_1706119078060945.htm
57. Information retrieved from: https://www.cac.gov.cn/2024-01/05/c_1706119078060945.htm

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policies that are also geared towards transparency and access to data for technological development.[58]

Statistical Performance

The Statistical Performance Indicator (SPI) is calculated by the World Bank to monitor the statistical maturity and performance of countries. The SPI focuses on five key dimensions of a country's statistical performance: (i) data use; (ii) data services; (iii) data products; (iv) data sources; and (v) data infrastructure. The data displayed refers to the overall score.

The index has a strong correlation with other common development indicators such as GDP per capita, governance, human capital, poverty, and inequality. Of the countries analyzed, five reached scores above 90, while three were below 75.

Chart 13 | Statistical Performance Indicator

SPI Overall Score (0-100), 2022

Country	Score
CAN	92.9
USA	92.8
ITA	91.9
DEU	91.3
FRA	90.8
AUS	89.9
JPN	89.9
MEX	88.6
KOR	87.8
TUR	87.7
GBR	86.5
RUS	84.1
ZAF	82.4
BRA	80.5
SAU	80.4
IDN	79.3
IND	74.5
ARG	71.8
CHN	59.6

Source: World Bank Statistical Performance Indicators (SPI), 2022.

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58. Information retrieved from: https://www.datacommissioner.gov.au/the-data-scheme and https://federation.gov.au/about/agreements/intergovernmental-agreement-data-sharing

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HPC Presence and Use in G20 Guest Countries

All guest countries either have their own HPCs or use joint infrastructures linked to them. In **Uruguay**, one of the HPCs is the National Supercomputing Center (ClusterUY); its services are accessible nationwide to researchers, scientists, and technicians.

In **Denmark**, "a new national center for AI innovation is to be created later in 2024. It will be hosting a supercomputer, Gefion, dedicated to AI research and innovation."[59] In addition, "Danish e-infrastructure Consortium (DeiC) […] is providing access to supercomputer capacities in cooperation with EuroHPC (European High Performance Computing)."[60] **Norway** "also participates in EuroHPC Joint Undertaking, which gives it access to HPC resources in Europe. The country also has a share in the supercomputer LUMI in Finland."[61] **Portugal** and **Spain** are connected to EuroHPC JU as well. "In 2023, the supercomputer MareNostrum5 was installed at the Barcelona Supercomputing Centre (BSC). Portugal is a partner in this new supercomputer, as well as in the future European quantum computer that will be purchased to be embedded in MareNostrum5. Both computers will be cofounded by EuroHPC JU."[62] Additionally, "Deucalion, the fastest supercomputer in Portugal, […] was installed in September 2022 at University of Minho, increasing the availability of high-performance computing capacity in the country tenfold."[63]

Finally, the **UAE** harbors HPCs for research and development in cutting-edge research institutions and higher education institutions. Furthermore, "in July 2023, UAE-based G42 unveiled the world's largest supercomputer for AI training. In March 2024, it introduced a third supercomputer to its lineup."[64]

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59. Information provided directly by the Danish government.

60. Information provided directly by the Danish government.

61. Information provided directly by the Norwegian government.

62. Information provided directly by the Portuguese government.

63. Information provided directly by the Portuguese government.

64. Information provided directly by the government of the United Arab Emirates.

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AI Capabilities (Scientific/ Educational Dimension)

This dimension aims to assess the level of research and development related to AI in a country, including the number of AI-related publications and patents, and the number of AI researchers and engineers involved in R&D. It also looks into AI ethics research, e.g., reflecting the number of publications focusing on the ethics of AI.

The educational dimension relates to the availability of education opportunities for students, such as AI-related degree programs, life-long education or training programs for AI developers, and education opportunities for the general public (UNESCO, 2023b).

Research and Innovation

R&D Expenditure

Investments in research and development are crucial for the pursuit of sustained economic growth, serving as catalysts for the creation of scientific and technological learning ecosystems. These ecosystems facilitate the interaction between businesses, universities, and the public sector in collaborative innovation efforts.

In an era characterized by a technological race toward the advancement of AI, research and development investments assume critical importance, particularly as this period is marked by significant engagement with basic research and a limited number of market-ready innovations. Empowering universities and companies to develop their solutions is a vital component of R&D investments, which should be directed toward cutting-edge technology.

This approach aims to simultaneously expand the boundaries of scientific knowledge and develop high-value-added solutions. According to OECD data, the **Republic of Korea**, the **United States**, and **Japan** are among the leading countries in terms of the percentage of GDP invested in R&D. Nonetheless, a significant number of other countries are committing over 2% of their GDP to technological development.

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Chart 14 | Statistical Performance Indicator

SPI Overall Score (0-100), 2022

Country	Score
CAN	92.9
USA	92.8
ITA	91.9
DEU	91.3
FRA	90.8
AUS	89.9
JPN	89.9
MEX	88.6
KOR	87.8
TUR	87.7
GBR	86.5
RUS	84.1
ZAF	82.4
BRA	80.5
SAU	80.4
IDN	79.3
IND	74.5
ARG	71.8
CHN	59.6
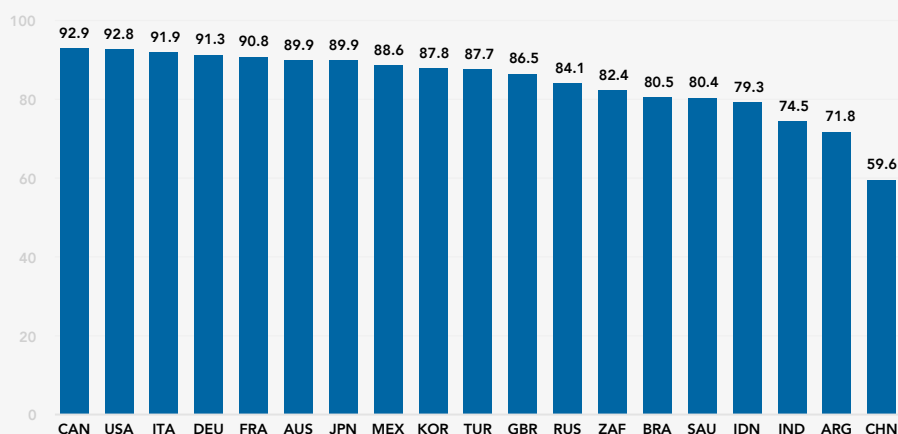
Source: World Bank Statistical Performance Indicators (SPI), 2022.

Country Approaches to Measuring and Reporting AI R&D Spending

Few G20 members have detailed strategies for measuring total AI R&D spending and are able to report accurate estimates. Among those, in the **United States**, measurement focuses on public spending. **Canada** referred to mechanisms to measure both public and private spending.

In the **United States**, the "Networking and Information Technology Research and Development (NITRD) Program has annually reported consolidated Federal nondefense investments in AI R&D as required by Executive Order 13859, 'Maintaining American Leadership in Artificial Intelligence,'"[65] which "required a standardized approach to accurately account for AI R&D investments across the Federal government. At that time, NITRD worked with Federal agencies to create a new Program Component Area (PCA) for AI and also account for investments in AI R&D that are captured under other PCAs."[66] This approach has allowed the US to measure "two types of AI R&D investments: (1) Core AI: those with a primary emphasis on AI R&D, which are reported under the AI PCA, and (2) AI Crosscut: those with primary emphases in areas other than AI, which are reported in other PCAs."[67] In Fiscal Year 2019, the federal budget for AI R&D was USD 2.409 billion.

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65. Information provided directly by the US government.

66. Information retrieved from: https://www.nitrd.gov/apps/itdashboard/ai-rd-investments/

67. Information retrieved from: https://www.nitrd.gov/apps/itdashboard/ai-rd-investments/

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Out of that, USD 831.4 million was in "AI Crosscut" and USD 1.578 billion was in "Core AI." In Fiscal Year 2024, these figures have increased to USD 3.086 billion (Total), USD 1.213 billion (AI Crosscut), and USD 1.872 billion (Core AI).[68]

In **Canada**, the "Innovation, Science and Economic Development Canada (ISED) monitors federal R&D expenditures in AI-related research by Canada's federal research granting agencies – Natural Sciences and Engineering Research Council of Canada, Social Sciences and Humanities Research Council, and Canadian Institutes of Health Research – which totaled approximately CAD 240 million in 2022-2023, with a total of CAD 936.8 million in funding awarded for AI-related research since 2017-2018."[69]

The Government of Canada also provides investments through the Pan-Canadian AI Strategy. In 2021, the government launched "the second phase of the Pan-Canadian Artificial Intelligence Strategy (PCAIS) with an investment of CAD 443.8 million over ten years, from 2021 to 2031. (…) Under the commercialization pillar of the PCAIS, Canada's National Artificial Intelligence Institutes (Amii, Mila, and the Vector Institute) are implementing programs to address business needs and pressing social challenges with AI. These programs are helping to grow the capacity of Canadian businesses to develop or use AI; turn AI research into real-world applications; and encourage the responsible development and use of AI."[70]

Chart 15 | AI Enabler Infrastructure: High-Performance Computers (HPCs)

G20 member countries that reported to the presidency

3.1) Does your country have an approach to measure the public and private allocation of R&D expenditures in AI?

Legend:
- Yes, in both private and public sectors
- Yes, just in the private sector
- Yes, just in the public sector
- No
- NA

Source: AI Capacities in G20 Countries Survey

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68. Information retrieved from: https://www.nitrd.gov/apps/itdashboard/ai-rd-investments/

69. Information provided directly by the Canadian government.

70. Information provided directly by the Canadian government.

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Research Output

A significant indicator for measuring the creation of knowledge in a specific area is the number of publications a country produces. In the case of AI, using the terms "artificial intelligence" or "machine learning" as search parameters in the OpenAlex database reveals that **China** accounts for 21.7% of the published articles, while the **United States** accounts for 11.7%.

India and the **United Kingdom** also play prominent roles; however, there is room for growth to enhance scientific capacity in AI, given the broad implications of this field for knowledge creation and scientific advancement.

Chart 16 | AI Research Publications by Country, from OpenAlex

Percentage of publications, 2022

Country	Percentage
CHN	21.67
USA	11.72
IND	6.04
GBR	4.00
DEU	3.31
IDN	2.77
ITA	2.28
JPN	2.26
CAN	2.25
FRA	2.20
AUS	1.93
KOR	1.90
RUS	1.73
BRA	1.18
TUR	1.15
SAU	1.05
MEX	0.46
ZAF	0.43
ARG	0.13

Source: OECD.AI from OpenAlex, 2022.
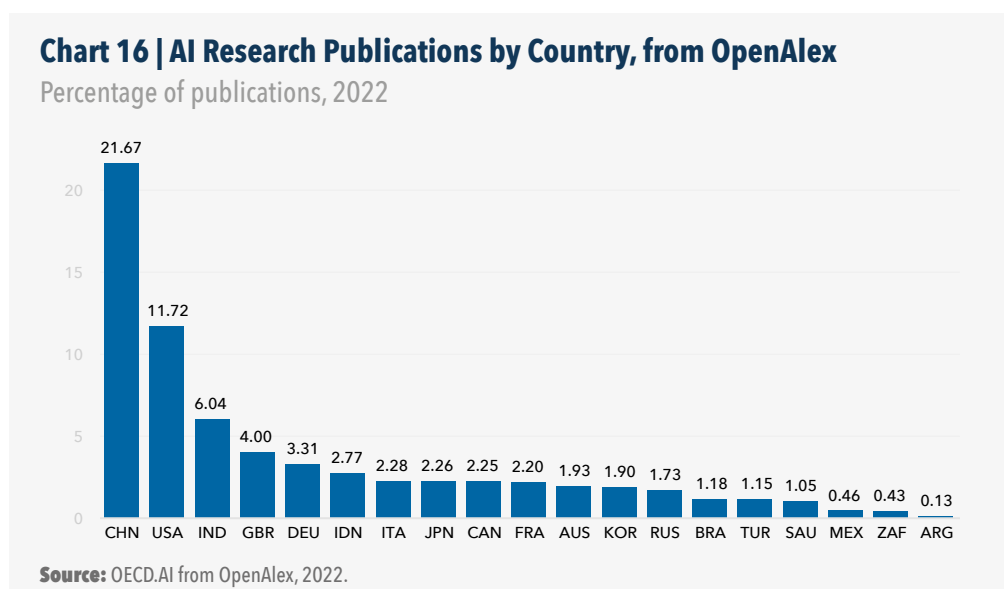
While the number of publications is an important indicator of the scientific maturity of a field within a country, it is crucial to assess the impact of these publications on knowledge creation. Naturally, countries leading in production are also those most cited, with **China** garnering 37.3% of citations in AI and the **United States** representing 19.2%.

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Chart 17 | Citations of AI Research Publication by Country, from OpenAlex

Percentage of citations, 2022

Country	Value
CHN	37.34
USA	19.21
GBR	8.09
IND	7.12
DEU	5.43
AUS	4.84
CAN	4.17
ITA	3.90
KOR	3.57
SAU	2.94
FRA	2.89
JPN	2.24
TUR	1.65
BRA	1.16
RUS	1.06
ZAF	0.65
IDN	0.56
MEX	0.54
ARG	0.13
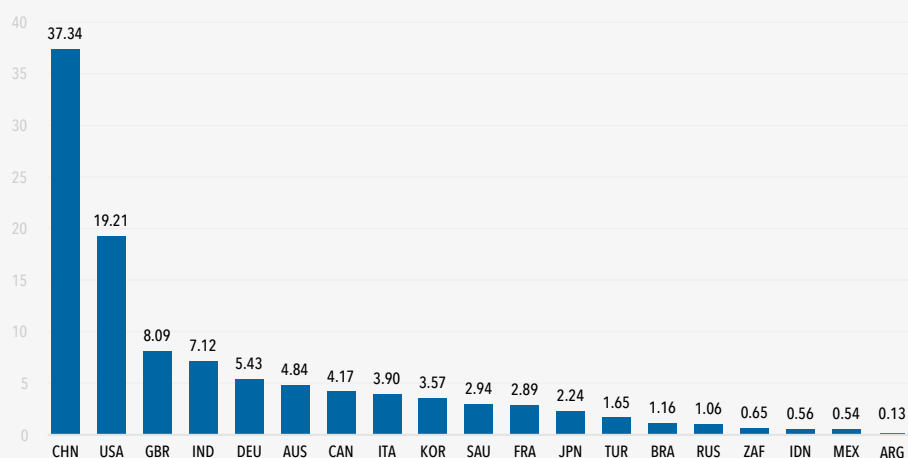
Source: OECD.AI from OpenAlex, 2022.

Contribution to High-impact Projects

One of the most innovative approaches for evaluating the advancement of AI is collaborative development by measuring the use of specialized platforms. Data from GitHub, compiled by OECD.AI, offers a unique perspective on the countries of origin of developers contributing to projects posted on the platform. This indicates which countries have more developers participating in hi-impact projects on GitHub in terms of the number of contributions, providing an intriguing indicator of human capital. This indicator also allows for an assessment of the impact of developers relative to other countries.

In this regard, **India** was the source of 23.3% of contributions to the most impactful projects, followed by the **United States** (14.5%) and **Brazil** (4.3%). This indicator highlights the impact of more practical training, not necessarily related to the academic sphere or accomplishments, given that anyone can contribute to these projects. Another notable point is that this indicator underscores the potential for contributions to AI development projects from developing countries, which may not always have the resources for substantial investments in research and development.

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Chart 18 | Contributions to AI Projects by Country

Percentage of all AI GitHub projects, 2022

Country	Percentage
IND	23.35
USA	14.50
BRA	4.26
GBR	4.03
CAN	3.25
DEU	3.20
CHN	2.46
FRA	2.21
IDN	2.18
KOR	1.82
TUR	1.82
ITA	1.62
JPN	1.21
MEX	0.95
RUS	0.93
AUS	0.86
ZAF	0.53
ARG	0.51
SAU	0.41
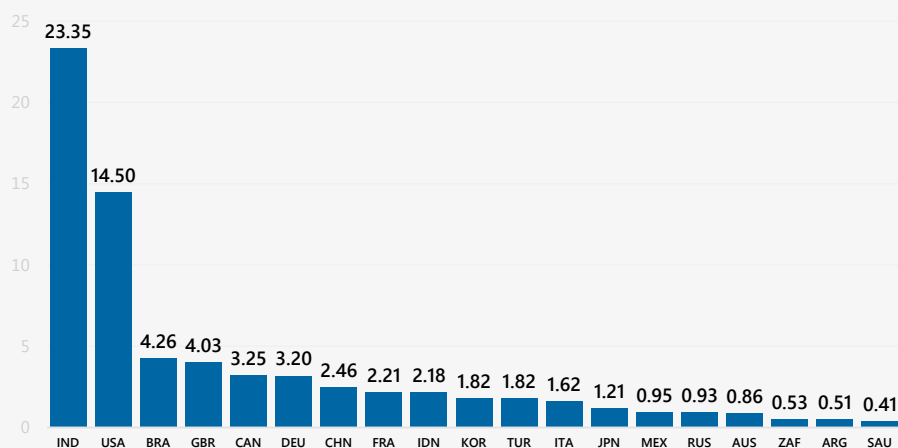
Source: OECD.AI from GitHub, 2022

Ethical AI Research

G20 members reported three key strategies to promote ethics in AI research. The first involves establishing guidelines that steer the ethical development and use of AI systems. The second is certifying ethical practices in research. The third is creating research avenues and incentives that openly promote ethics in AI research.

Argentina and **China** are two countries that have adopted the first strategy. In 2023, in **Argentina**, "the Undersecretary of Information Technologies, dependent on the Secretariat of Public Innovation, published Provision 2/2023, through which the 'Recommendations for Reliable Artificial Intelligence' were approved. This measure aims to establish clear rules to guarantee that the benefits of technological advances are taken advantage of by all sectors of society, strengthening the Argentine scientific and technological ecosystem."[71] **China** "launched the Global AI Governance Initiative, which proposes to put ethics first, including through establishing and improving ethical principles, norms, and accountability mechanisms for AI, formulating AI ethical guidelines, and build sci-tech ethical review and regulatory system."[72]

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71. Information retrieved from: https://www.argentina.gob.ar/noticias/argentina-aprobo-una-guia-para-una-inteligencia-artificial-etica-y-centrada-en-las-personas. The original version is in Spanish.

72. Information provided directly by the Chinese government.

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The second group includes countries like **Saudi Arabia** and the **Republic of Korea**. In **Saudi Arabia**, the Saudi Authority for Data and Artificial Intelligence (SDAIA) "may provide motivational badges that will reflect the level of compliance and progress on AI ethics adoption. And will issue a guide explaining the mechanism and controls for awarding them."[73] The Private Sector AI Trust Verification and Validation System was established in the **Republic of Korea** in 2023. It requires a third-party specialized agency to verify "whether private AI companies complied with the AI trust requirements in their development process."[74]

Examples of the third strategy for promoting ethics in AI can be found in **Australia**, the **United States**, **Canada**, **India**, and the **United Kingdom**. **Australia**'s Centre of AI & Digital Ethics (CAIDE) opened a seed funding round in 2023 for "5 projects exploring the ethical, legal, philosophical, scientific, tech or policy challenges of automated tools, providing expertise in a specific field."[75] In the **United States**, the Office of Science of the Department of Energy and the National Institutes of Health (NIH) have launched funding for projects related to trustworthy AI, whereas NIST promotes research involving different agencies to develop standards and guidelines around Trustworthy and Responsible AI.

In **Canada**, the Canadian Institute for Advanced Research (CIFAR) launched an "AI & Society" program in 2017 funded by the Pan-Canadian Artificial Intelligence Strategy (PCAIS), to "increase understanding of how advances in AI affect people and communities."[76] The program was successful, and its second phase began in 2022.

In the same vein, "Under the 'Safe and Trusted AI' Pillar of the recently approved IndiaAI Mission, the government of **India** will support 26 Ethical AI projects. These projects will focus on advancing indigenous research on Governance of AI in India."[77]

Finally, the **UK** has multiple funding programs for AI ethics research, including Responsible AI UK (RAI UK), Bridging Responsible AI Divides (BRAID), and the Fairness Innovation Challenge. "Responsible AI UK (RAI UK) is a consortium that is conducting and funding research into responsible AI, formed in June 2023.

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73. Information provided directly by the government of Saudi Arabia.

74. Information provided directly by the government of the Republic of Korea.

75. Information retrieved from: https://meri-news.education.unimelb.edu.au/2023/03/21/centre-of-ai-digital-ethics-2023-seed-funding-round/

76. Information provided directly by the Canadian government.

77. Information provided directly by the government of India.

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They have been allocated £31M of funding by UKRI, in part by the Technology Missions Fund. By design, they can allocate resources more rapidly than other UKRI programmes. RAI UK's partners include University of Southampton, University College London, Kings College London and Cambridge University, as well as a range of government agencies, multilateral organisations and technology companies. Bridging Responsible AI Divides (BRAID) is a £15.9M AHRC programme dedicated to integrating arts, humanities and social science research into the UK's responsible AI ecosystem, as well as bridging the divides between academic, industry, policy and regulatory work on responsible AI. Fairness Innovation Challenge is a grant challenge that has offered over £465,000 of government funding, as well as non-financial support from key UK regulators, to support the development of novel solutions to address bias and discrimination in AI systems. The UK's Department for Science, Innovation and Technology (DSIT), in turn, has funded four winning projects across the higher education, healthcare, finance, and recruitment sectors."[78]

Chart 19 | AI Capabilities: R&D and Ethics

G20 member countries that reported to the presidency

3.2) Are there incentives (e.g., loan guarantees or direct grants) to promote ethics in AI research?

| 11 | 4 | 2 |

■ Yes   ■ No   ■ NA

3.3) Are there any incentive programmes or policies related to building a national pool or pipeline of AI talent [...]

Developing talent — 14
Attracting talent — 10
Retaining talent — 7

Source: AI Capacities in G20 Countries Survey.

AI Talent

Most countries have taken diverse actions to develop and retain AI talent, with training of researchers being a common strategy. This approach is evident in countries like **Australia**, the **United Kingdom**, the **Republic of Korea**, the **United States**, **Saudi Arabia**, **India** and **France**, each with their unique initiatives.

In **Australia**, CSIRO (the Australian national science agency) "have estimated that Australian industry will need up to 161,000 new AI and emerging technology

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78. Information provided directly by the government of the United Kingdom.

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savvy workers by 2030."[79] One of the measures adopted by the country to deal with this challenge was the development of the Next Generation Graduates Program, "a cohort-based, industry driven, multi-disciplinary graduate training program that aims to equip students with entrepreneurial thinking and skill sets that are key to boost breakthrough innovation in the exciting fields of AI and other emerging technologies."[80] In **Russia**, "National program Digital Economy of the Russian Federation State support of Talent and Success educational foundation aimed at school students developing projects in the field of artificial intelligence."[81] In **Saudi Arabia**, SDAIA established SDAIA Academy, which aims to support and develop national competencies in the field of data and AI.[82] Additionally, in **India**, "The IndiaAl FutureSkills component of the recently approved IndiaAl Mission aims to mitigate barriers to entry into Al programs and will increase access to Al courses in undergraduate, masters-level, and Ph.D. programs. […] Further, training of trainers' support will be provided to effectively harness the infrastructure provided and deliver the foundational data and Al courses."[83]

The **United Kingdom** is "creating hundreds of new AI PhDs through Centers for Doctoral Training (CDT), with £117m of government investment. This will build on the 16 existing CDTs across the UK to train a new generation of AI researchers who will develop and use AI in areas such as healthcare, climate change and creating new commercial opportunities."[84] In the **Republic of Korea**, there are "AI graduate programs and AI-integrated innovation graduate programs since 2019—currently available at 19 universities as of 2024, along with the plan to support the development of experts in generative AI."[85] In the **United States**, "agencies across the federal government have launched training programs and resources for educators to grow the national AI workforce."[86] **Japan**, for its part, promotes initiatives with companies, universities, and research institutes to encourage the development of AI talents. Meanwhile, in **Turkey**, the Ministry of Industry and Technology is working together with the private sector and universities with the "Sector in Campus Program" to identify the skills needs of the private sector and

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79. Information retrieved from: https://www.csiro.au/en/work-with-us/funding-programs/funding/next-generation-graduates-programs
80. Information retrieved from: https://www.csiro.au/en/work-with-us/funding-programs/funding/next-generation-graduates-programs
81. Information provided directly by the Russian government.
82. Information provided directly by the government of Saudi Arabia.
83. Information provided directly by the government of India.
84. Information provided directly by the government of the United Kingdom.
85. Information provided directly by the government of the Republic of Korea.
86. Information provided directly by the US government.

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integrate these needs into academic curricula, as well as enabling internships to stimulate students to put this theoretical knowledge into practice.[87] Finally, in **France**, "in total, € 2.5 Bln were taken from the national investment plan France 2030 to fund evaluations and training projects, among which €54M were directed to 7 elite schools and training centers for them to significantly increase the number of AI degrees delivered, with the objective to train an additional 6,200 people on AI over the next 3 years."[88]

Like France, other countries have actions aimed at training professionals to be capable of using AI technologies in their professional activities. The **United Kingdom** "established a £30 million AI and Data Science Conversion Course programme to broaden the supply of talent in the UK AI labour market. This is funding universities to develop masters level AI or data science courses suitable for non-STEM students and up to 2,600 scholarships for students from backgrounds underrepresented in the tech industry."[89] The **Republic of Korea** has an "AI capacity building program to reskill workers in diverse fields."[90]

Regarding the training of AI talent, it is also worth mentioning that the **Brazilian** public IT company SERPRO "is building an internal talent pool focused on AI for government applications, specialized in dealing with sensitive and private data."[91] The **Canadian** Government may adopt a similar measure. "While there has not yet been an AI-specific Government of Canada-wide recruitment campaign, the OCIO DTL[92] is assessing the need for one in the near-term understanding that measures to enhance diversity in the AI workforce are crucial for building a more inclusive and innovative talent pool."[93]

The **Canada** CIFAR Artificial Intelligence (CCAI) Chairs is another Canadian action aimed at training AI talent that should be mentioned. It combines efforts to train AI researchers and to attract AI talent from other countries. "Since it was launched [in 2017] the CCAI Chairs program has recruited and retained 120+ of the world's top researchers in AI to Canada with the Chairs training more than 1,600 graduate students."[94] The **United Kingdom**'s Turing AI Fellowship

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87. Information provided directly by the Turkish government.

88. Information provided directly by the Frech government.

89. Information provided directly by the government of the United Kingdom.

90. Information provided directly by the government of the Republic of Korea.

91. Information provided directly by the Brazilian government.

92. Within the Treasury Board of Canada Secretariat (TBS), there is the Office of the Chief Information Officer Digital Talent and Leadership (OCIO DTL).

93. Information provided directly by the Canadian government.

94. Information provided directly by the Canadian government.

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program has a similar format. With a £46m budget, it seeks to attract, retain, and develop world-leading talent in AI. Like Canada and the United Kingdom, other countries also want to attract and retain AI talent from different countries. **Turkey**, the **Republic of Korea**, the **United States**, and **France** – to name a few examples – are countries that have sought to facilitate granting work visas to professionals linked to AI.

In many countries, the development of AI talent is an integral part of a broader digital education strategy.

China rolled out in 2022 the Smart Education of China (SEC), which is "a platform that caters to all levels of education, consolidating a wide array of learning resources and providing 'one-stop' education-related services for teachers, learners, and families. Arguably one of the most extensive repositories of digital learning resources in the world, SEC comprises three sub-platforms, each focused on Basic Education, Vocational Education, and Higher Education."[95]

Turkey has at least four actions that indirectly target the development of AI talent. The first is the 1 Million Employees project, which aimed to train 1 million citizens by 2023. It also provided free online training opportunities and created a pool of resumes for employers.[96] The second action is the Türkiye Open Source Platform devoted to training 500,000 software developers. The third action is the "aerospace and technology festival TEKNOFEST seeks to raise awareness of digital technologies and enhance digital skills through technology competitions."[97] Finally, there is the DENEYAP Türkiye Technology Workshops initiative. According to country representatives, "18 thousand students benefit from this free education opportunity in our 100 Deneyap Technology Workshops in 81 provinces at the middle school and high school level, where we discover the technology stars of the future today and provide them with qualified technology training".[98]

Innovation Output

The number of patents granted also indicates a country's ability to create and protect products with high technological intensity. The importance of patent grants lies in providing an institutional environment that stimulates research

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95. Information provided directly by the Chinese government.

96. Information provided directly by the Turkish government.

97. Information provided directly by the Turkish government.

98. Information provided directly by the Turkish government.

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and development, ensuring legal security and returns on investment in frontier technologies, which are often characterized by uncertain financial returns. At the same time, an efficient patent granting system can provide incentives for companies to invest in cutting-edge technologies, fostering an innovation ecosystem that encourages collaboration among various stakeholders and ensures intellectual property rights.

In the analysis of products with patents containing terms related to AI, the **United States** stands out with a substantial lead, having granted 9,447 patents, followed by **Japan**, with 2,012 patents, and **China**, with 1,407 AI-related patents.

Chart 20 | Number of Granted AI Patents

2021

Source: Center for Security and Emerging Technology, 2021 in AI Index report 2022.
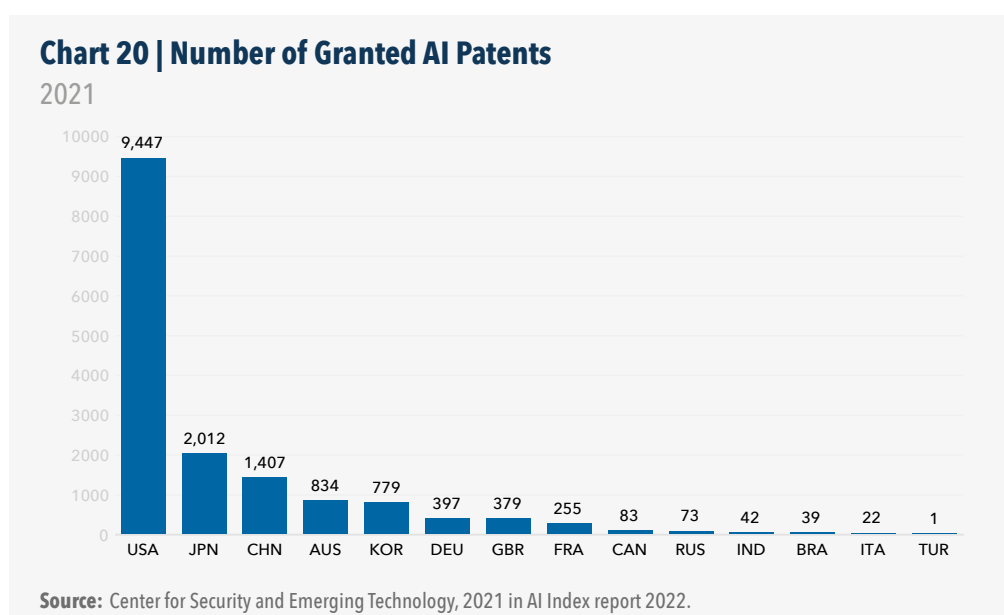
Education

Integrating AI in Education Systems

Countries are taking two non-mutually exclusive actions to introduce AI in education systems: (i) creating AI courses at different educational levels; and (ii) preparing teachers and students to interact with AI systems so that the technology helps provide them with personalized teaching and learning experiences.

First action examples can be found in different countries. **Turkey**, **Saudi Arabia**, and **India** are three of them. In **Turkey**, "at the end of 2023, courses in Artificial

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Intelligence Applications-I and Artificial Intelligence Applications-II were added to the secondary education curriculum. The number of advanced degrees awarded in AI or related fields is also rapidly increasing. In addition to the new advanced degree programs, existing programs are getting more integrated into multidisciplinary studies. 32 new advanced degrees in 2018, 69 new advanced degrees in 2019, 95 new advanced degrees in 2020, 105 new advanced degrees in 2021 and 9 new advanced degrees in 2022 as of May have been established over the 5 last years. Currently, AI-specific, software, computer sciences information systems advanced degrees have over 100.000 students. Finally, the 100/2000 Council of Higher Education PhD Project determined AI in an interdisciplinary manner as a priority. The employment of research assistants and lecturers in AI is set to increase in the coming periods."[99] **Saudi Arabia** launched Way to ATHKA, one of the initiatives of the National Olympiad for Programming and Artificial Intelligence, in which middle school and high school students meet with AI specialists and influencers to learn about the future of AI and participate in machine challenges.[100] Meanwhile, **India** "is preparing to introduce AI upskilling courses at different educational levels. The Skilling in AI aspect of the initiative details the National AI Skilling Framework, aimed at enhancing expertise in AI across primary, secondary, tertiary, and vocational education levels."[101]

As for the second action, the **United States**, the **Republic of Korea**, **Japan**, and the **United Kingdom** provide examples of preparing teachers and students to interact with AI systems. In the **United States**, "the U.S. Department of Education Office of Educational Technology's policy report, Artificial Intelligence and the Future of Teaching and Learning: Insights and Recommendations (May 2023), addresses the clear need for sharing knowledge, engaging educators, and refining technology plans and policies for AI use in education. The report guides educators in understanding what these emerging technologies can do to advance educational goals – while evaluating and limiting key risks."[102]

The **Republic of Korea**'s Government has adopted at least four policies devoted to introducing AI in the education system: "(i) Digital Transformation of Education Initiative (Feb 2023): Roadmap of realizing 'Personalized Learning for Every Student' through AI-embedded Digital Textbooks and teacher training; (ii) AI Digital Textbook Initiative (Jun 2023): Plans for development

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99. Information provided directly by the Turkish government. Minor editorial adjustments were made to the original text.

100. Information provided directly by the government of Saudi Arabia.

101. Information provided directly by government of India.

102. Information provided directly by the US government.

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and implementation of AI-embedded Digital Textbooks; (iii) Teacher Training Initiative (April 2024): Plans for massive teacher training to strengthen teachers' capacity to innovate classes utilizing Artificial Intelligence; (iv) EdTech Softlab – Higher Education Track (Mar 2024): Plans to designate an edtech softlab dedicated to higher education (1 out of 9) for developing AI coursewares that can support personalized learning in basic subjects."[103]

In **Saudi Arabia**, the National Framework for Artificial Intelligence in Digital Learning (AIDL) "aims to establish a set of guidelines, standards, and best practices for implementing AI in all educational sectors."[104] In the **United States**, in October 2023, President Biden issued a landmark Executive Order to ensure America leads the way in seizing the promise and managing the risks of AI. In response to the Executive Order, the U.S. Department of Education will develop new AI resources to advance the safe, trustworthy, and effective use of AI in teaching and learning. These efforts will include a toolkit to support educators as they work to establish guidance and policy around AI use in their local communities (August 2024). In summer 2024, the Department will also release separate guidance for AI educational technology developers and institutions of higher education."[105]

In **Japan**, in July 2023, "Tentative Guidelines for the Use of Generative AI in Elementary and Secondary Education" was published, providing reference materials to determine the propriety of using Generative AI for actors in the field of education.[106] The plan is for this set of guidelines to be revised flexibly after discussions with an expert committee based on technological advances. In addition, the MEXT (Ministry of Education, Culture, Sports, Science and Technology) selected pilot schools from all over the country in 2023-2024 and verified the results and issues in order to use generative AI for learning and reduce the workload of teachers in elementary and secondary education.[107]

Finally, the **United Kingdom**'s Department for Education (DfE) has been mainly focused on "building the evidence base for how generative AI is best used in education, and learning from the experience and expertise of the sector."[108] The department has published a position on Generative AI (GenAI) in education, a

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103. Information provided directly by the government of the Republic of Korea.

104. Information provided directly by the government of Saudi Arabia.

105. Information provided directly by the US government.

106. Information retrieved from: https://www.mext.go.jp/a_menu/other/mext_02412.html

107. Information provided directly by the Japanese government.

108. Information provided directly by the government of the United Kingdom.

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Call for Evidence on GenAI in education, and a report on the views of educators and experts on GenAI. The DfE has also commissioned a GenAI Hackathon project to further understand possible use cases for GenAI in education and generate a report on public attitudes towards the use of GenAI in education.

A few countries presented other actions related to the introduction of AI in education systems.

In **China**, in 2022, "the Ministry of Education issued the Notice of the Guiding Training Program for Graduate Students in the Fields of Artificial Intelligence […], which listed Artificial Intelligence and intelligent social governance as one of the training directions."[109]

As part of the National Framework for Artificial Intelligence in Digital Learning (AIDL) in the Kingdom of **Saudi Arabia**, "the National eLearning Center (NeLC) unveiled a comprehensive framework for integrating Artificial Intelligence (AI) into digital education. This framework aims to establish a set of guidelines, standards, and best practices for implementing AI in all educational sectors."[110]

The **Republic of Korea** has three policies directly or indirectly connected to training educators on AI ethics: (i) AI Ethics and Trust Promotion Plan (October 2023); (ii) Ethical Principles for the Use of AI in Education (August 2022); and (iii) Digital Education Norms (in development).[111]

In **Turkey**, the "Artificial Intelligence Applications Trainer Training Course to be organized by the expert team within Ministry of National Education. 120 participants will be trained on the topics of artificial intelligence tools, block-based artificial intelligence applications, machine learning and deep learning. Fatih Project in Education instructors, who completed the relevant courses in the field of artificial intelligence published on the Teacher Information Network, were selected as pilot trainees for the course. With this training of trainers course, the professional development of teachers regarding current technologies will be supported and local trainings will be organized on the use of artificial intelligence in education in accordance with the measures in the National Artificial Intelligence Strategy 2021-2025."[112]

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109. Information provided directly by the Chinese government.

110. Information provided directly by the government of Saudi Arabia.

111. Information provided directly by the South Korean government.

112. Information provided directly by the Turkish government.

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Chart 21 | AI Capabilities: Education

G20 member countries that reported to the presidency

3.5) Does your country have any strategy, policy, or initiative to promote the training of educators/teachers/professors on AI ethics?

- 2 NA
- 9 No
- 6 Yes

Legend: ■ Yes ■ No ■ NA
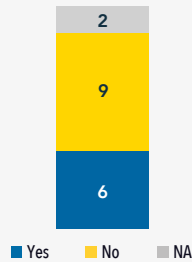
3.4) Are there strategies, incentive programmes, regulations, or policies related to the introduction of AI in the education system focused on [...]

- Primary education: 10
- Secondary education: 12
- Tertiary education and above: 9
- Vocational education and training (VET): 7
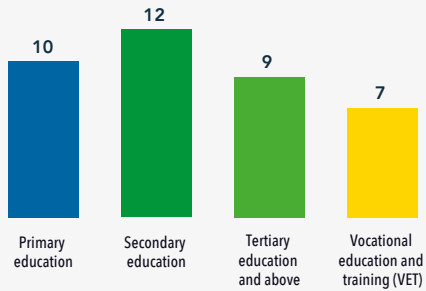
Source: UNESCO, 2021.

Science, Technology, Engineering and Mathematics (STEM) Graduates in Higher Education

The UNESCO Institute for Statistics (UIS) tracks the distribution of graduates and new entrants by field, a key indicator for understanding some of the future trends in the technology labor market. The most relevant data for this area is that related to students in science, technology, engineering and mathematics (STEM) and information and communication technologies (ICT), who are the most involved in technological development.

The data shows significant differences among G20 members. Regarding ICT students' indicators, the proportion varies between 7.4% and 1.5% of all graduates; for STEM students, the variation is between 35.1% and 15.0%. There is a trend toward the same group of countries having higher percentages in both indicators, indicating room for integrated policies aimed at increasing the number of students in these areas.

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Chart 22 | STEM Graduates in Tertiary Education

Percentage of graduates from STEM programmes in tertiary education, 2021
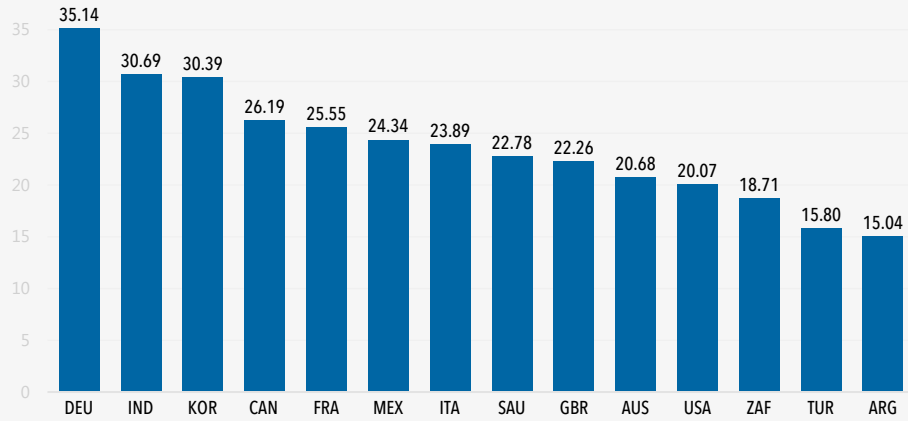
Source: UNESCO, 2021.

Chart 23 | ICT Graduates in Tertiary Education

Percentage of graduates from ICT programmes in tertiary education, 2021

Source: UNESCO, 2021.

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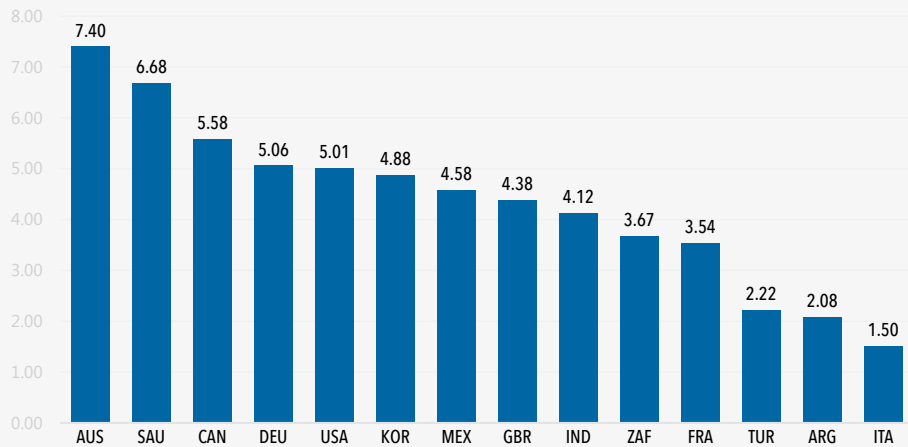
61

Addressing the distribution of STEM and ICT students is not the only concern for G20 economies. It is also important to highlight the gender inequalities in this field. Studies indicate that more women need to participate in technical professions and play a greater role in the creation and development of technologies, demonstrating that the lack of diversity among those producing technologies can negatively impact their use, including biases in AI algorithms that perpetuate social discrimination. This disparity is influenced by a range of complex factors that impact the number of graduates in these areas. Therefore, a thorough examination of this issue and its influencing factors is fundamental for advancing the technology field.

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G20 Guest Countries and AI Capabilities Policies

The set of AI Capabilities encompasses different dimensions. Two are integrating AI into educational systems and training, attracting, and retaining AI talent. G20 guest countries have adopted different strategies for both.

In **Norway**, the "Strategy for digital competence and infrastructure in kindergartens and schools" and "Strategy for digital transformation in the university and college sector" are two of the initiatives devoted to integrating AI into the educational system. In **Uruguay**, Ceibal (the country's digital technology center for education innovation at the service of public education policies) incorporates AI as a thematic area in education, and the National Administration of Public Education (ANEP, for its acronym in Spanish) has organized a series of conferences on the subject for teachers and employees of the organization.

In **Spain**, the National Plan for Digital Skills is "an essential part of the Digital Agenda Spain 2026. It promotes a strategic line to strengthen workers' and citizens' digital skills as a whole."[113] In **Denmark**, "the recently adopted national strategy for digitalization has as one of its objectives to prepare the Danish population for the digitalized future. One initiative is the introduction of 'technology understanding' as an integrated part of the curriculum through all tiers of the educational system."[114]

In **Portugal**, "R&D projects funded by the Foundation for Science and Technology (FCT) resulted in the development of AI talents."[115] Its "R&D expenditure in projects on AI or using AI-related technologies and methods amounts to about €74,3 million in 410 projects, over a period of ten years (2013-2023)."[116] In **Singapore**, the Techskills Accelerator (TeSA), an educational initiative aimed at the development of an information and communication technology workforce,[117] "has partnered with industry to train individuals in AI and data analytics."[118] The **UAE**, in turn, has different programs, such as the Artificial Intelligence Program, the National Program for Coders, and the "UAE AI Summer Camp, which is in its fifth edition and has attracted to date more than 22,000 participants and addressed over 120 topics."[119]

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113. Information provided directly by the Spanish government.

114. Information provided directly by the Danish government.

115. Information provided directly by the Portuguese government.

116. Information provided directly by the Portuguese government.

117. Information retrieved from: https://www.imda.gov.sg/how-we-can-help/techskills-accelerator-tesa

118. Information provided directly by the government of Singapore.

119. Information provided directly by the government of the United Arab Emirates.

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Legal/Regulatory Dimension

This dimension assesses the legal/regulatory frameworks in place to ensure the ethical and safe development and deployment of AI, and the institutional arrangements and mechanisms for monitoring their implementation and enforcement. Regulatory frameworks should include "aspects of effective protection, enforcement, redress, and monitoring of potential harms related to the deployment and use of AI systems" (UNESCO, 2023b, p. 9). Regulations concerning AI, data protection and privacy, data sharing and accessibility, and freedom of information, are some examples of these legal frameworks.

AI Legislative or Regulatory Measures

Safeguards and Guardrails

Many laws and regulations at the national and supranational levels already cover AI and its applications in different domains while addressing other technologies, either directly or indirectly. Existing privacy and data protection legislation, for example, provides a lot of support for understanding how to cope with privacy issues.

Several countries stressed that AI development, employment, and adoption must comply with existing laws and regulations. The **United States** pointed out that "AI is not presumed to be exempt from any civil rights and consumer protection laws or principles, and the federal government can and will enforce these safeguards against fraud, unintended bias, discrimination, infringements on privacy, and other harms from AI."[120] Similarly, the **United Kingdom** stated that "AI is already regulated under a range of applicable laws. These include, but are not limited to, relevant legislative provisions for data protection, equality, online safety, product safety, health and safety, competition and consumer protections, financial services, legal services, and intellectual property."[121]

Canada observed that the country's "existing consumer protection regulators are already moving to address some of the impacts of AI within their legislative authorities. Health Canada has issued guiding principles for the development of medical devices that use machine learning, and the Office of the Superintendent of Financial Institutions is working on updating its model risk guidelines to

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120. Information provided directly by the US government.
121. Information provided directly by the government of the United Kingdom.

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account for the use of new technologies, including AI. Human rights commissions are also moving to understand the implications of AI for discrimination and other human rights issues."[122]

Other countries also mentioned the importance of legal provisions regarding data and consumer protection. "**Saudi Arabia** enacted a personal data protection law that profoundly affects AI by imposing strict regulations on the collection, processing, and storage of personal data, necessitating lawful bases for data processing and adherence to principles like data minimization and purpose limitation. AI systems must ensure transparency and explainability in automated decisions, accommodate data subject rights, implement privacy measures from design inception, conduct Data Protection Impact Assessments (DPIAs) for high-risk processing activities, and comply with restrictions on cross-border data transfers. These requirements reshape the development and deployment of AI, demanding privacy-centric practices and accountability in AI-related endeavors. The competent regulatory authority is the Saudi data and AI authority."[123] **Germany** and **France** highlighted that they apply the General Data Protection Regulation (GDPR). The way it will be implemented by national data protection Authorities will have an "important, direct impact on the development, deployment, and adoption of AI for companies as well as for administrations."[124]

Countries also mentioned the need for complementary legal measures or efforts to adapt existing legislative or regulatory provisions. The **Republic of Korea** and **Turkey** do not have specific legislative or regulatory measures for AI governance and oversight but are in the process of developing them. "**Korea** reports that 9 bills to create a legal foundation for promoting AI and AI trust suitable for the domestic environment are currently under review at the National Assembly."[125] **Turkey** "has created a road map including consultation with relevant stakeholders on the harmonization of domestic regulations aligned with the EU AI Act."[126]

Among the countries that already have AI-specific measures, the **United Kingdom**, **India**, **Canada**, **Saudi Arabia**, and **the United States** mentioned

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122. Information provided directly by the Canadian government.

123. Information provided directly by the government of Saudi Arabia.

124. Information provided directly by the French government.

125. Information provided directly by the South Korean government.

126. Information provided directly by the Turkish government. Minor editorial adjustments were made in the original text.

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either the development of complementary provisions or adaptation of existing legislation. In the **United Kingdom**, the "AI Regulation White Paper" (2023) and the "Government Response" (2024) set out the regulatory approach. **India** "has notified the Information Technology (Intermediary Guidelines and Digital Media Ethics Code) Rules, 2021 ('IT Rules, 2021')," which provide guardrails for AI application in the field of communication.[127] In **Canada**, AI regulation is based on the "Policy on Service and Digital," the "Directive on Automated Decision-Making," the "Guide on the use of generative AI," the "Framework for the Management of Compliance," and the proposed "Artificial Intelligence and Data Act."

Saudi Arabia reported several laws and guidelines on AI, including: "AI Ethics Principles," "Generative AI Guideline for Public," "Generative AI Guideline for Government," "Guidance on Review and Approval of AI & Big Data Based Medical Devices," "Fintech Regulatory Sandbox," "National Framework for Artificial Intelligence in Digital Learning (AIDL) in the Kingdom of Saudi Arabia," "Autonomous Driving Vehicles Regulation" (under development), and "IP Law" (under development)[128].

Finally, in the **United States**, "the White House Office of Management and Budget (OMB) issued, in March 2024, a first government-wide policy to mitigate risks of artificial intelligence (AI) and harness its benefits in the government use of AI. Further, many federal regulators have adapted regulations and guidance to govern AI."[129]

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127. Information provided directly by the government of India.

128. Information provided directly by the government of Saudi Arabia.

129. Information provided directly by the US government.

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Chart 24 | AI Laws/Regulations: Policies in AI Development

G20 member countries that reported to the presidency

4.1) Has your country enacted specific legislative or regulatory measures for the governance and oversight of the development, deployment, and adoption of AI?

11	4	2

■ Yes   ■ No, but under development   ■ No, and not developing   ■ NA

4.2) Is there any other legislation or regulation that directly or indirectly impacts AI development, deployment, and adoption (for example, data privacy or anti-discrimination laws)?

14	3

■ Yes   ■ No

Source: AI Capacities in G20 Countries Survey.

Data Protection and Privacy Laws

All of the responding countries reported that they have established data protection and privacy laws. Figure 4 provides detailed information on the laws reported by the countries.

Chart 25 | AI Laws/Regulations: AI Related Policies

G20 member countries that reported to the presidency

4.3) Does your country have a data protection and privacy law?

17

■ Yes   ■ No, but in the process   ■ No, and not in the process   ■ NA

4.4) Does your government have policies, laws or mechanisms requiring individuals to be notified of automated decision-making […] ?

9	6	2

■ Yes   ■ No   ■ NA

4.5) Does your country have open government data policies?

16	1

■ Yes   ■ No, but in the process   ■ No, and not in the process   ■ NA

Source: AI Capacities in G20 Countries Survey.

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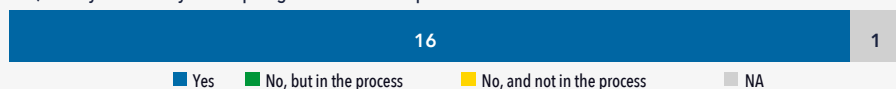
Figure 4a – Data Protection and Privacy Laws among G20 Members

Argentina	The Personal Data Protection Law (Law 25326), or habeas data, protects Argentines if their identity, health, or credit data is used without their consent. *Source:* https://www.argentina.gob.ar/justicia/derechofacil/leysimple/datos-personales
Australia	The Privacy Act 1988 (Privacy Act) is the principal piece of Australian legislation protecting the handling of personal information about individuals. This includes the collection, use, storage, and disclosure of personal information in the federal public sector and the private sector. *Source:* https://www.ag.gov.au/rights-and-protections/privacy#:~:text=The%20Privacy%20Act%201988%20(Privacy,and%20in%20the%20private%20sector
Brazil	The General Personal Data Protection Law (Law 13709) aims to protect the fundamental rights of freedom and privacy and the free development of the personality of the natural person. *Source:* https://www.planalto.gov.br/ccivil_03/_ato2015-2018/2018/lei/l13709.htm
Canada	The Personal Information Protection and Electronic Documents Act (PIPEDA) applies to private-sector organizations across Canada that collect, use, or disclose personal information in the course of a commercial activity. The Privacy Act aims to protect the privacy of individuals with respect to their personal information. *Source:* Information provided directly by the Canadian government.
Germany	The German Federal Data Protection Act (BDSG) translated and contextualizes the General Data Protection Regulation (GDPR) in those areas that are left to national regulation in EU member states. These include, among other things, the processing of employee data, video surveillance, the appointment of data protection officers or of supervisory authorities. The Federal Ministry of Labour and Social Affairs and the Federal Ministry of the Interior and Community have, for example, jointly developed a draft bill for an Employee Data Act to be presented once the internal government consultations have been completed. *Source:* Information provided directly by the German government.
India	Recognizing the data protection and security risks that arise from AI solutions, the Digital Personal Data Protection Act, 2023 ("DPDP Act") was enacted on 11 August 2023. This Act provides for the processing of digital personal data in a manner that recognizes both the rights of the individuals to protect their personal data and for the data fiduciaries the need to process such personal data for lawful purposes. *Source:* Information provided directly by the government of India.
Indonesia	The Indonesian Law on the Protection of Personal Data (Law Number 27, Year 2022) is established as an effort to increase the effectiveness of the processes for implementing personal data protection policies, in order to guarantee citizens' right to data protection and develop collective recognition and respect on the subject. *Source:* https://peraturan.bpk.go.id/Details/229798/uu-no-27-tahun-2022

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Italy	The Italian Data Protection Law 2016/679 was harmonized with the GDPR by means of Legislative Decree 101/2018, that entered into force on 19 September 2018, and amended a number of provisions of Legislative Decree 196/2003 (the "Privacy Code"). *Source:* **Information provided directly by the Italian government.**
Russia	The Russian Federal Law of July 27, 2006 No. 152-FZ "On Personal Data" regulates activities related to the processing of personal data by a variety of actors, aiming for a consistent, legal and equitable use of this data. The legislation also takes security in the storage of personal data as a fundamental principle. *Source:* **https://pd.rkn.gov.ru/docs/Federal_Law_On_personal_data.doc**
Japan	In Japan, the Act of the Protection of Personal Information (Act No. 57 of May 30, 2003) seeks to protect the rights and interests of individuals while ensuring the smooth and proper management of the processes or services of administrative entities, as well as ensuring due consideration of the value of personal information and the fact that the proper and effective application of personal information contributes to the creation of new industries and to an enriched quality life of the Japanese public. *Source:* **https://www.japaneselawtranslation.go.jp/en/laws/view/4241**
Turkey	The Law on the Protection of Personal Data entered into force in 2016. Under the same Law, the Turkish Data Protection Authority was established as an independent regulatory authority with organizational and financial autonomy and a public legal entity. In addition to the current rights and obligations by the Law, Turkey's alignment process with the General Data Protection Regulation of the European Union is ongoing. *Source:* **Information provided directly by the Turkish government, https://www.kvkk.gov.tr/en/**
Saudi Arabia	In Saudi Arabia, the Personal Data Protection Law (PDLP) provides comprehensive requirements related to privacy principles, data subjects' rights, organizations' obligations while processing individuals' personal data, and cross-border data transfer mechanisms and lays out penalties for organizations in case of non-compliance with the PDPL. The Anti-Cyber Crime Law plays a pivotal role in safeguarding digital environments and combatting cyber threats within the Kingdom. This legislation encompasses a wide range of provisions aimed at addressing various forms of cybercrimes, including unauthorized access to computer systems and data interception. *Source:* **Information provided directly by the government of Saudi Arabia.**
United Kingdom	The Data Protection Act 2018 updates data protection laws in the UK, supplementing the General Data Protection Regulation (EU) 2016/679 (GDPR), implementing the EU Law Enforcement Directive (LED), and extending data protection laws to areas which are not covered by the GDPR or the LED. It provides a comprehensive package to protect personal data in the UK. *Source:* **Information provided directly by the government of the United Kingdom.**

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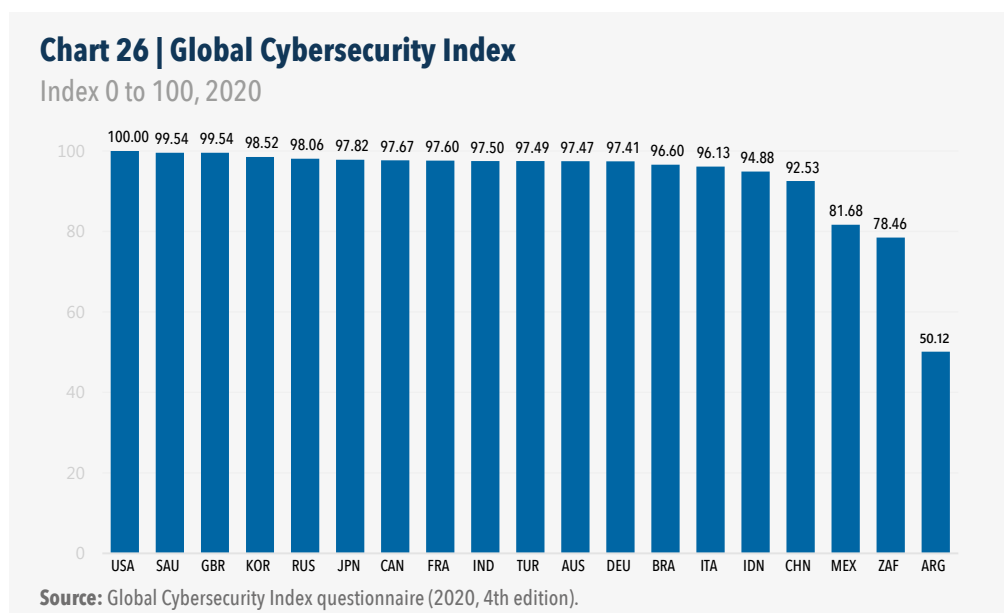|	
China	The Data Security Law of China aims to regulate data processing activities, ensure data security, promote data development and utilization, protect the lawful rights and interests of individuals and organizations, and safeguard national sovereignty, security, and development interests. The Personal Information Protection Law of China aims to protect the rights and interests on personal information, regulating personal information processing activities, and promoting reasonable use of personal information. Sources: www.gov.cn/xinwen/2021-06/11/content_5616919.htm; http://en.npc.gov.cn.cdurl.cn/2021-12/29/c_694559.htm
Republic of Korea	The Republic of Korea's data protection law – the Personal Information Protection Act ("PIPA") – underwent a major overhaul in March 2023. The revised PIPA includes changes in comprehensive areas, reflecting the results of years of in-depth discussions that took place among various stakeholders across domains and sectors. *Source:* **Information provided directly by the government of the Republic of Korea.**
United States	The US follows a sectoral approach to privacy protection. There is no all-encompassing federal legislation that ensures the privacy and protection of personal data. Instead, legislation at the federal level primarily protects data within sector-specific contexts. The Privacy Act of 1974 provides privacy protections for data held by government agencies. The HIPAA Privacy Rule provides privacy protections for health data and prohibits covered entities from disclosing patients' health information without consent. The Children's Online Privacy Protection Rule ("COPPA") provides privacy protections for data collected about children under 13 years of age, generally requiring parental consent for collection or use of any information for such users. The Family Educational Rights and Privacy Act (FERPA) provides privacy protections for students' educational records, generally requiring students' consent for disclosure of information in the records. The Gramm-Leach-Bliley Act (GLBA) protects personal information collected by financial institutions, generally allowing consumers to opt-out of sharing with third parties. The Fair Credit Reporting Act (FCRA) regulates the collection and use of credit information and consumer reports. *Source:* **Information provided directly by the US government.**
France	With Law No. 78-17 of January 6, 1978, France was the first European country to introduce broad privacy laws for the collection, processing, and use of personal data. The law was amended in 2004 to comply with the European Union (EU) data protection directive and strengthen the rights of individuals. In 2016, the Act was further amended to implement the GDPR. *Source:* **Information provided directly by the French government.**

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Figure 4b – Data Protection and Privacy Laws among G20 Guest Countries

Denmark	Denmark is a member of the European Union. As such, EU legislation is part of the Danish legislative acquis – Regulation (EU) 2016/679 of 27 April 2016 (General Data Protection Regulation). *Source:* **Information provided directly by the government of Denmark.**
Norway	Norway operates with an adaptation of Regulation (EU) 2016/679 of April 27, 2016 (General Data Protection Regulation), consolidated in its Personal Data Processing Act of 2022. *Source:* **https://lovdata.no/dokument/NLE/lov/2018-06-15-38**
Portugal	Data protection in Portugal is founded on Law No. 41/2004 of 18 August 2004, transposed into national law Directive (EU) 2002/58/EC concerning the processing of personal data and the protection of privacy in the electronic communications sector. On 8 August 2019, Law No. 58/2019 was published, establishing the application of Regulation (EU) 2016/679 of the European Parliament and the Council of 27 April 2016, on the protection of individuals with regard to the processing of personal data and to the free movement of such data (GDPR). Additionally, the legal framework also includes Law No. 59/2019, of 8 August, which approves the rules regarding the processing of personal data for preventing, detecting, investigating or prosecuting criminal offenses or carrying out criminal assessments purposes, transposing Directive (EU) 2016/680 of the European Parliament and of the Council of 27 April 2016. *Source:* **Information provided directly by the Portuguese government.**
Singapore	The Personal Data Protection Act (PDPA) provides a baseline standard of protection for personal data in Singapore. It complements sector-specific legislative and regulatory frameworks such as the Banking Act and Insurance Act. It comprises various requirements governing the collection, use, disclosure and care of personal data in Singapore. *Source:* **https://www.pdpc.gov.sg/overview-of-pdpa/the-legislation/personal-data-protection-act**
Spain	In Spain, data protection and privacy is legislated by Organic Law 3/2018: on Personal Data Protection and guarantee of digital rights, as well as by the Regulation (EU) 2016/679 of the European Parliament and of the Council on the protection of individuals and the processing of personal data and on the free movement of personal data repealing Directive 95/46/EC (General Data Protection Regulation). *Source:* **Information provided directly by the Spanish government.**
United Arab Emirates	The UAE introduced a Personal Data Protection Law in 2021 to provide proper governance for data management and protection and define the rights and duties of all parties concerned. *Source:* **Information provided directly by the government of the United Arab Emirates.**
Uruguay	In Uruguay, data privacy and protection is regulated by Law 18.331 of 2008, on the Protection of Personal Data, and by arts. 62 and 63 of Law 20.075 of 2022. *Source:* **Information provided directly by the government of Uruguay.**

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Addressing Emerging Cybersecurity Threats

The Global Cybersecurity Index (GCI) is published by the International Telecommunication Union (ITU). It was designed to measure the commitment of countries to cybersecurity. It combines five pillars: (i) legal measures; (ii) technical measures; (iii) organizational measures; (iv) capacity development; and (v) cooperation. The data presented in Chart 26 is the aggregated overall scores for the fourth version of the Index, published in 2020. The improved fifth version is undergoing data collection and is expected to be published by the end of 2024.

The majority of G20 members achieved very high scores, above 90 points. Countries like **Mexico** and **South Africa** are at an intermediate level, scoring close to 80 points. **Argentina** is at a lower level, with a score of around 50 points. This suggests that there are opportunities to solidify governmental actions in this field.

Chart 26 | Global Cybersecurity Index
Index 0 to 100, 2020

USA	SAU	GBR	KOR	RUS	JPN	CAN	FRA	IND	TUR	AUS	DEU	BRA	ITA	IDN	CHN	MEX	ZAF	ARG
100.00	99.54	99.54	98.52	98.06	97.82	97.67	97.60	97.50	97.49	97.47	97.41	96.60	96.13	94.88	92.53	81.68	78.46	50.12

Source: Global Cybersecurity Index questionnaire (2020, 4th edition).

Data Sharing and Accessibility

The Open Data Inventory (ODIN) measures the completeness and openness of the official data provided by national statistical offices (NSOs) on their websites. The index evaluates two main aspects: data availability (coverage) and data accessibility (openness), ranging from 0 to 100. In addition to assessing the presence of important statistical indicators in the social, economic,

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and environmental sectors, ODIN also considers the NSOs' adherence to open data standards.

The 2023 results indicate that G20 economies vary in terms of data availability and accessibility. Seven countries scored 70 or above, while six countries achieved rates between 53 and 68. Additionally, two countries scored below 50 in the index, highlighting the need to improve data sharing and accessibility among G20 members. It is important to emphasize that enhancing data sharing and accessibility is crucial for the development of AI technologies, as they rely heavily on available data and adequate standards for access and use.

Chart 27 | General Openess Indicator

Index 0 to 100, 2023.

Country	Score
DEU	79
CAN	77
AUS	72
USA	72
IDN	71
KOR	71
MEX	70
FRA	68
ITA	68
JPN	68
BRA	64
GBR	63
RUS	62
TUR	59
SAU	58
IND	54
ZAF	53
ARG	45
CHN	37

Source: Open Data Inventory (ODIN), 2023.
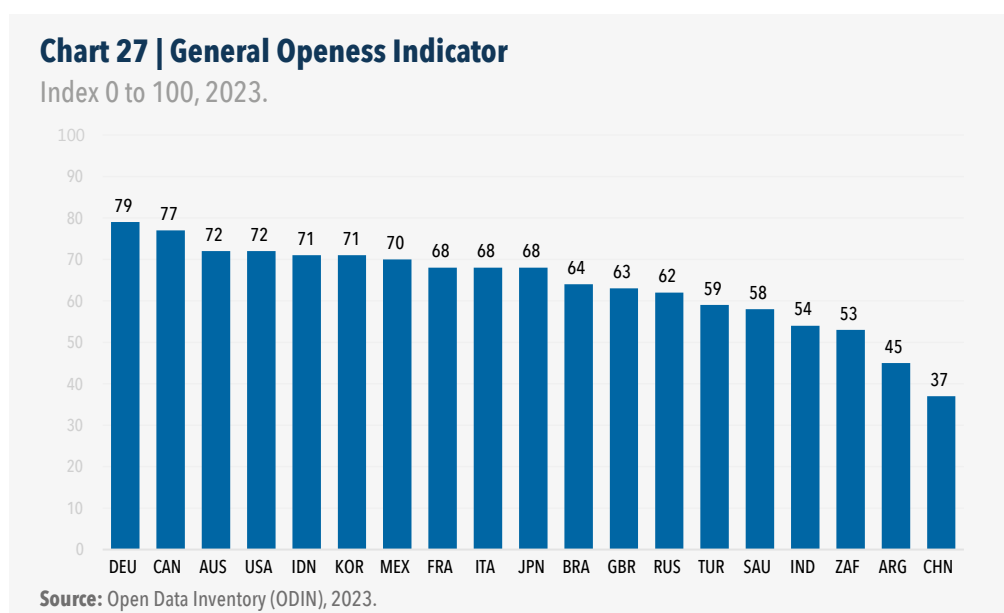
Data Governance in the Public Sector

AI governance and coordination must consider data governance, as data are the foundational building blocks for modern AI systems. Fragmented data policies, inconsistent data quality, and inadequate interoperability and data sharing frameworks hinder the seamless integration and scalability of AI technologies and represent a major challenge for public sector innovation and transformation (OECD, 2022). Effective data governance involves establishing policies, standards, and practices to ensure data sharing, quality, security, and privacy, which are important for the reliable and systematic use of AI systems.

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It is worth mentioning that the United Nations Development Programme (UNDP) developed, in collaboration with UNESCO, a flagship AI product, the Artificial Intelligence Landscape Assessment (AILA), which provides a holistic analysis of a country's AI readiness, assessing governments as users and enablers of AI and on dimensions of AI ethics. The AILA has been introduced in Rwanda, Colombia, Sri Lanka, and Bhutan, in cooperation with relevant ministries and stakeholders.

National Data Governance Frameworks

Twelve out of seventeen countries reported that they have established data governance frameworks, and initiatives are in progress in three countries. In **France**, an inter-ministerial framework governs data sharing and use in the public sector. **Italy** "complies with EU regulation 2022/868EG EU Data Governance Act (DGA)"[130]. In **China**, "in 2022, the State Council issued the Opinions on Establishing a Basic Data Governance System to Maximize the Role of Data,"[131] including a data property rights system that protects rights and interests of individuals and organizations and ensures compliance with regulations; a privacy compliant and efficient data sharing and trading system that combines on- and off-site data; and a secure, controllable, flexible, and inclusive data governance system.[132] **Turkey** has launched the Government Data Space project to transform data management and use in the public sector, establish defined roles for data governance, and foster an environment suitable for advanced analytics and AI applications. The project aims to create a favorable AI ecosystem in the public sector, improve the use and benefits of data for public institutions, and enhance the data management skills of public employees through specialized training and support.[133]

The frameworks of some countries reveal that the time horizon is an important variable in data governance frameworks. Examples of this can be seen in **Canada** and the **United States**. **Canada**'s 2023–2026 Data Strategy for the Federal Public Service has a four-year duration. In the **United States**, "the Federal Data Strategy (FDS) describes a 10-year vision for how the Federal Government will accelerate the use of data to deliver on its mission, serve the public, and steward resources while protecting security, privacy, and confidentiality. The strategy guides federal data management and use."[134]

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130. Information provided directly by the government of Italia.

131. Information provided directly by the Chinese government.

132. Information retrieved from: https://www.gov.cn/zhengce/2022-12/19/content_5732695.htm

133. Information provided directly by the Turkish government.

134. Information directly provided directly by the US government.

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Institutional Arrangements for Data Governance

The institutional arrangements for data governance structures is another issue that calls for attention, as it is not entirely the same across countries. In **Saudi Arabia**, the "National Data Management Office (NDMO), as the national regulator of data in the Kingdom, has developed the framework for national data governance to set the policies and regulations required for data classification, data sharing, data privacy, Freedom of Information, open data and others, in anticipation of necessary legislation."[135]

In **Brazil**, the Central Data Governance Committee (CCGD) is responsible for deliberating on "the protection of personal data; and delivering guidelines for the integration of bodies and entities with the Citizen Base Registry."[136] The CCGD can benefit from contributions from the Data Governance Forum. The Forum, it should be noted, is "an event launched by the Digital Government Secretariat in December 2022 with the aim of creating a network in Public Administration to exchange experiences and boost acculturation in data governance in the public sector, especially among the federal Executive Branch bodies. The event takes place monthly, always with agendas suggested by participants."[137]

In the **Republic of Korea,** the National Data Policy Committee oversees "the policies and strategies for the generation, exchange, use of data, as well as the improvement of related systems. The Committee consists of 30 members: Prime Minister as the Chairperson, 15 government members (Ministers of Economy and Finance; of Education; of Science and ICT; of Interior and Safety; of Culture, Sports and Tourism; and of Trade, Industry and Energy), and private sector members with expertise and experience in the data industry, recommended by the Chairperson."[138] Furthermore, the Korean Open Data Law (Act on Promotion of the Provision and Use of Public Data), established in 2013, lays "the foundation for the country's open data initiatives. Central to this framework is the Open Data Strategy Council, a distinguished body co-chaired by the Prime Minister and a representative from the private sector. This council is notable for its inclusive composition, with half of its members hailing from civil society, ensuring that the government is well-informed by a range of external

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135. Information directly provided by the government of Saudi Arabia.

136. Information retrieved from: https://www.gov.br/governodigital/pt-br/governanca-de-dados/governanca-de-dados. The original text is in Portuguese.

137. Information retrieved from: https://www.gov.br/governodigital/pt-br/governanca-de-dados/governanca-de-dados. The original text is in Portuguese.

138. Information provided directly by the South Korean government.

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insights. The council's primary responsibilities include deliberating, monitoring, and evaluating the government's Open Government Data (OGD) policies and their implementation, thereby adopting a comprehensive approach to data governance. The Ministry of Interior and Safety (MOIS) takes a leading role in these initiatives, while the National Information Society Agency (NIA) supports the implementation of these policies. In addition, the Open Data Mediation Committee (ODMC) is tasked with resolving disputes related to public access to government data, further strengthening the framework for transparent and accessible government data."[139]

In the **United Kingdom**, "data governance for government comprises a small suite of frameworks and guidance, which together form a comprehensive overarching framework (…) Government departments and public sector organisations have their own enterprise data strategies, policies and guidance in place to ensure that data is exploited, managed and protected effectively. Such enterprise level practices are required to align with overarching data management guidance and frameworks. Data management is a devolved matter, and thus non-legislative guidance applies only to reserved matters. All data sharing must comply with data protection legislation, UK GDPR and all guidance published by the Information Commissioner's Office (ICO). In addition, there is a range of cross-government guidance and frameworks to support safe and effective data sharing. These include the National Data Strategy, the Government Data Quality Framework, the Data Sharing Governance Framework, the Data Ethics Framework, the Codes of Practice which support data sharing provisions within the DEA, and data security guidance published by NCSC. Further to this, the Data Standards Authority sets common Data Standards so that data can be reused interoperably across government; and the Data and Technology Architecture Design Authority (DTADA) is responsible for the development of common data architecture for government, including patterns, principles, policies, strategies and standards."[140]

Open Data Policies

Currently, sixteen G20 member countries that reported to the presidency have open data policies, and eight of them have signed the International Open Data Charter.

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139. Information provided directly by the South Korean government.
140. Information provided directly by the government of the United Kingdom.

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In general, country responses on open government data (OGD) policies addressed two topics: (i) the importance of these policies; and (ii) the technical and legal requirements necessary to make them possible.

Regarding the first topic, countries often pointed to OGD policies as essential to strengthening the culture of public transparency, easing the work among public departments, engaging citizens with government, improving public services, and promoting technological development and innovation in the public and private sectors.

Convinced of the benefits of open government data policies, the **United Kingdom** articulated, in 2012, an "open by default" policy, which can be found in the white paper "Open Data: Unleashing the Potential." This commitment was renewed in the National Data Strategy 2020. In **Japan**, the Basic Principles on Open Data were formulated in 2017 based on the Basic Act on the Advancement of Public and Private Sector Data Utilization, which was formulated in 2016. This sets out the significance, definitions, and rules for the openness of administrative data, and is also a guideline for relevant ministries and agencies to work on the openness of administrative data. In light of recent technological trends such as AI, the contents were reviewed and revised in line with the times, including the addition of provisions for promoting open government data implementation.[141] In **India** the "The National Data Sharing and Accessibility Policy (NDSAP) aims […] to encourage open and proactive data sharing to increase the accessibility and easier sharing of non-sensitive data amongst users and their availability for scientific, economic and social developmental purposes."[142] "**Saudi Arabia** has launched the Open Data Policy, with a main principle being Open by Default in order to promote transparency and innovation."[143]

The countries' responses also revealed a crucial understanding. They are aware that the benefits of OGD policies, including the economic benefits, can only be fully realized when they are made compatible with existing legal provisions, especially those related to privacy protection. This awareness is evident in the responses of countries like **Australia** and **Canada**. **Australia** stated that "publishing appropriately anonymized government data will

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141. Information retrieved from: https://www.digital.go.jp/assets/contents/node/basic_page/field_ref_resources/f7fde41d-ffca-4b2a-9b25-94b8a701a037/20210615_resources_data_guideline_01.pdf

142. Information provided directly by the government of India.

143. Information provided directly by the government of the Saudi Arabia.

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stimulate innovation and enable economic outcomes."[144] Similarly, **Canada**'s Directive on Open Government aims to "maximize the release of government information and data of business value to support transparency, accountability, citizen engagement, and socioeconomic benefits through reuse, subject to applicable restrictions associated with privacy, confidentiality, and security."[145]

Regarding legal requirements, it is common for OGD policies to define how data should be classified and the public departments that are subject to it. In **Brazil**, the "Open Data Policy defines rules to promote the openness of government data within federal bodies and entities, such as ministries, local authorities, regulatory agencies, and public foundations."[146] In **China**, "in 2016, the State Council issued the Interim Measures for the Management of Government Information and Resources Sharing, specifying the basic requirements for the classification, sharing, provision, utilization, and supervision of government information and resources. In 2017, the State Council issued the Provisions for Online Government Services, proposing the development of a national online government service platform. In 2022, the Guiding Opinions of the State Council on Strengthening the Building of a Digital government encouraged full leverage of the coordination mechanism to improve the management of government data sharing and service provision."[147]

Additionally, "under the Act on Promotion of the Provision and Use of Public Data, the **Republic of Korea** mandates the formulation of an Open Data Master Plan every three years to outline the nation's strategic approach to enhancing the accessibility and usability of public data. […] This involves collecting open data initiatives from 67 public agencies and integrating feedback from various stakeholders through forums, surveys, and discussions. […] Concurrently, the government develops a National Priority Data Release Plan aligned with the same period […], strategically disseminating crucial data that supports national interests and aligns with current societal and technological trends. […] These strategic efforts are supplemented by detailed, annual implementation plans and strategies for priority data release […]."[148]

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144. Information retrieved from: https://www.finance.gov.au/sites/default/files/2022-10/aust_govt_public_data_policy_statement.pdf

145. Information retrieved from: https://www.tbs-sct.canada.ca/pol/doc-eng.aspx?id=28108

146. Information retrieved from: https://dados.gov.br/dados/conteudo/politica-de-dados-abertos#:~:text=A%20Pol%C3%ADtica%20de%20Dados%20Abertos,ag%C3%AAncias%20reguladoras%20e%20funda%C3%A7%C3%B5es%20p%C3%BAblicas. The original text is in Portuguese.

147. Information provided directly by the Chinese government.

148. Information directly provided by the South Korean government.

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Standards and Interoperability

Regarding the technical requirements for making OGD policies possible, interoperability stands out as an important topic. In **Turkey**, "the national open government data portal was designed following international practices using open source software infrastructure. (…) In addition, Turkey has established the National Data Dictionary (NDD) to promote inter-institutional cooperation and enhance decision-making based on data in the public sector. The Dictionary includes standards and definitions for the data used by the public institutions in all applications, platforms and infrastructure layers."[149] **Saudi Arabia** requires that data must be in an open format and be machine-readable.[150] The **United States** "requires federal agencies to publish their information online as open data, using standardized, machine-readable data formats, with their metadata included in the Data.gov catalog."[151]

Chart 28 | AI Laws/Regulations: AI-Related Policies

G20 member countries that reported to the presidency

4.6) Did your country sign the international Open Data Charter?

Yes	No	NA
8	8	1

■ Yes ■ No ■ NA

4.7) Do you have a national data governance framework?

Yes	No, but in the process	No, and not in the process	NA
12	3	1	1

■ Yes ■ No, but in the process ■ No, and not in the process ■ NA

4.8) Is there a government strategy or programme to improve digital skills in the public sector?

Yes	NA
16	1

■ Yes ■ No ■ NA
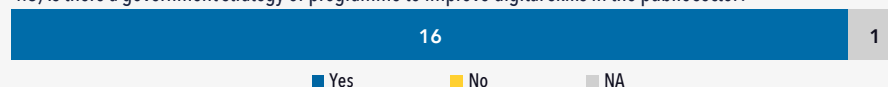
Source: AI Capacities in G20 Countries Survey.

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149. Information provided directly by the Turkish government.

150. Information retrieved from: https://sdaia.gov.sa/ar/SDAIA/about/Documents/Open%20Data%20Policy.pdf

151. Information retrieved from: https://data.gov/open-gov/

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AI Regulation Among G20 Guest Countries

Among the different legal and regulatory aspects of AI, there is much debate on the necessity of establishing legislative or regulatory measures that directly or indirectly drive the governance and oversight of AI development, deployment, and adoption. In **Uruguay**, "the AGESIC (Agency for Electronic Government and Information and Knowledge Society) is given the power to design and develop AI and data strategies,"[152] so that it is currently responsible for the development of the country's national data strategy and for the revision of the national AI strategy – aiming, with this, to provide new subsidies for data-driven management and the responsible, ethical, and safe use of AI, as well as development and innovation in different sectors.

Norway, **Denmark**, **Spain** and **Portugal** have been taking the necessary steps to implement the new European Regulation AI Act. In addition, they have adopted additional measures. The **Danish** Agency for Digital Government "has developed a guide on AI and its use (tools, explanations, advice on using AI),"[153] while the **Norwegian** government "has appointed a work group to investigate whether there is a need for additional legislation. The group concluded that the current regulatory framework is technology neutral and combined with the AI Act will cover the need for regulation of AI."[154]

Additionally, "the **UAE** has published guidelines and principles to steer the development and deployment of AI towards an ethical and responsible future, while avoiding the inhibition of any innovation. Instead, the UAE is aiming to become a testbed for AI technologies on a global scale, such that the uniquely diverse community and cutting-edge digital infrastructure enables testing such technologies in a controlled sandbox environment."[155]

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152. Information provided directly by the Uruguayan government.
153. Information provided directly by the Danish government.
154. Information provided directly by the Norwegian government.
155. Information provided directly by the government of the United Arab Emirates.

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Social/Cultural Dimension

This dimension considers the social and cultural factors that contribute to the ethical development and deployment of AI systems and the mechanisms for the creation of fair and inclusive AI systems. In this regard, this section addresses topics such as the inclusion of social and cultural diversity, considerations of gender representation in the development and deployment of AI systems, and the involvement of different communities and minorities that are impacted by the technology. It will also ask crucial questions about public attitudes about and acceptance of AI, as well as about sustainability and the environment, including provisions to address the environmental impacts of AI systems (UNESCO, 2023b).

Diversity, Inclusion, and Equality

Countries mentioned general policies for promoting diversity in the labor market and specific policies for diversifying the AI workforce. The **German** support measures for young female scientists exemplify the first type of policy. Examples of the second kind can be found in **China**, **Saudi Arabia**, **the United Kingdom**, **Japan**, and **Canada**.

In **China**, "the China Women's Development Foundation, Ant Group, and Ant Charity Foundation started the Aidou project in 2019, aimed at creating digital economy jobs, especially AI labeling, in rural areas. By the end of 2023, the Aidou project has supported the establishment of 17 county-level digital employment centers in Shaanxi Province, with 5,800 local employment positions, of which nearly 70% are women. This has empowered many women to achieve financial independence, and significantly enhanced their sense of personal fulfillment and happiness."[156] **Saudi Arabia** "has launched Elevate, a global program that aims to use AI to reduce the gender gap by empowering more than 25,000 women globally."[157] **Turkey** has launched a new program for the Republic's centenary, "Leading 100s in Technology" by the Women in Technology Association, to provide technical training to 100 women in digital technologies, with training programs having an 80% female quota, including

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[156.] Information provided directly by the Chinese government.

[157.] Information provided directly by the government of Saudi Arabia.

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male students. The program also provides opportunities for networking and women's participation in the labor market.[158]

The **United Kingdom** has "established a £30 million AI and Data Science Conversion Course programme to broaden the supply of talent in the UK AI labour market. It funded universities to develop masters level AI or data science courses suitable for non-STEM students and up to 2,600 scholarships for students from backgrounds underrepresented in the tech industry."[159] **Japan**, for its part, established the "Digital Human Resources Development Plan for Women" in 2022, "setting the goal of accelerating the development of digital human resources for women" and "actively implementing initiatives aimed specifically at women to help them acquire digital skills that directly result in them obtaining an occupation."[160]

Likewise, "under the Commercialization Pillar of the Pan-Canadian AI Strategy, **Canada**'s National Artificial Intelligence Institutes developed an EDI (Equity, Diversity and Inclusion) Strategy, outlining proactive measures to engage with underrepresented groups, including women, Indigenous communities, and minority groups. As part of their program activities under the Strategy, the Institutes are committed to participating in the 50-30 challenge and providing training services to individuals who self-identify as belonging to one or more equity deserving groups."[161] The AI4Good Lab and Indigenous Pathfinders in AI are two examples of programming delivered by the National AI Institutes.

"The AI4Good Lab is a seven-week program by Mila designed to give women, trans women and non-binary individuals the skills they need to build their own machine learning (ML) projects. Through mentorship and curiosity-driven learning, the Lab prepares participants for professional careers in AI. Delivered in partnership with Indspire, Indigenous Pathfinders in AI is a career pathway program designed to offer participants a unique opportunity to explore the world of AI. Through a series of workshops, activities and collaborative projects, participants delve deeper into the subject through an experience that emphasizes Indigenous approaches, perspectives and communities."[162]

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158. Information provided directly by the Turkish government.

159. Information provided directly by the Chinese government.

160. Information provided directly by the Japanese government.

161. Information provided directly by the Canadian government.

162. Information provided directly by the Canadian government.

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Chart 29 | AI Social/Cultural: AI Impacts Regulation

G20 member countries that reported to the presidency

	Yes	No, but in the process	No, and not in the process	NA
5.1) Has your country enacted any law or policy to reduce the digital gender gap?	13	0	1	3
5.2) Has your country enacted any regulatory measure or policy to reduce the digital socioeconomic or rural/urban gap?	7	0	7	3
5.3) Has your country enacted any regulatory measure, incentive programme, or policy to enhance diversity in the AI workforce?	7	2	5	3
5.6) Does your country have in place any regulatory measure or policy for addressing the impact of AI on the environment and sustainability?	7	2	5	3

Source: AI Capacities in G20 Countries Survey.

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The Rural/Urban Gap in Internet Usage

The ratio of Internet users is a common measure to display the gap between urban and rural areas in terms of connectivity; the closer the ratio is to 1, the narrower the gap and the better the connectivity. Though availability of data is low, the results suggest that rural areas have lower levels of connectivity in developing countries, which is consistent with the same analysis of household access indicators.

Chart 30 | Rural/Urban Gap in Internet Use

Ratio of the proportion of individuals in rural areas who use the Internet by the proportion of individuals in urban areas who use the Internet.

KOR 0.98	CAN 0.97
FRA 0.95	ITA 0.94
RUS 0.93	JPN 0.93
BRA 0.89	
IDN 0.76	MEX 0.74

Source: ITU, Individuals Using Internet By Gender and Urban/Rural Location, January 2024.
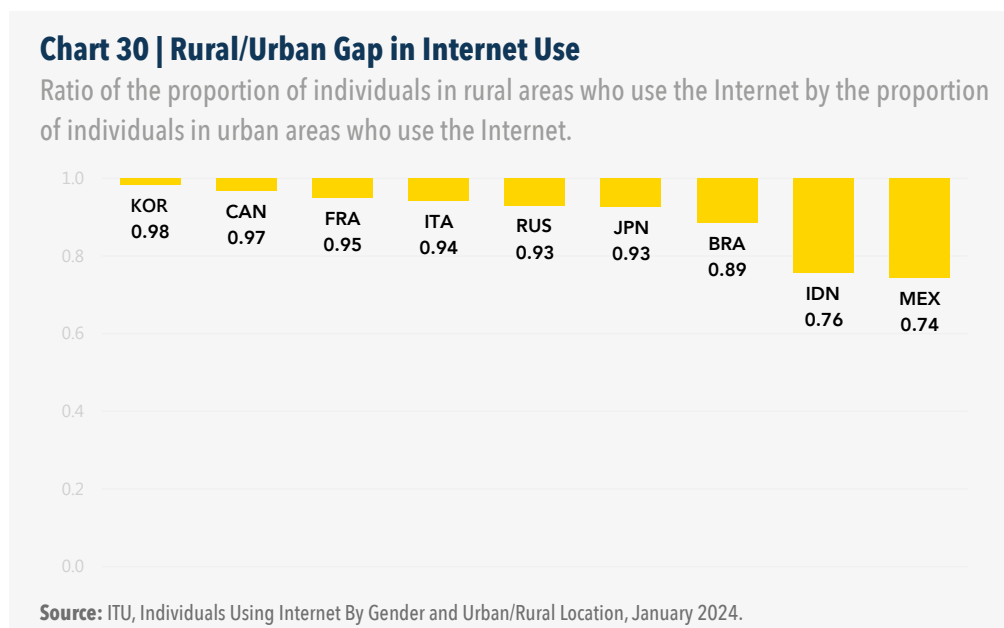
The regulatory measures and policies mentioned by countries seek to overcome different challenges. Two are: (i) ensuring access to digital environments, which involves overcoming different barriers, such as ensuring the existence of financially accessible Internet and cell phone packages and developing digital skills; and (ii) integrating national and local actions concerned with ensuring access to digital environments.

The **Australian** "First Nations Digital Inclusion Plan (FNDIP)" is an example of a policy that tackles the two challenges above. It "builds on the Australian Government's commitment to Target 17 of the National Agreement on Closing the Gap - *by 2026 Aboriginal and Torres Strait Islander people have equal levels of digital inclusion.* It provides a strategic framework and a suite of

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existing and proposed actions, to improve First Nations digital inclusion in three areas: Access, Affordability, and Digital ability."[163] "The FNDIP recognises that governments have a key role to play but that collaboration with communities, non-government organisations, business and industry is required to develop a secure, sustainable and inclusive digital future for First Nations people."[164] **Italy**'s response also highlighted the importance of local actions. More precisely, the country stated that "there are numerous policies at regional and local levels to reduce digital socioeconomic or rural/urban gaps in Italy, and they are supported by the EU cohesion funds 2021-2027."[165]

Other countries also mentioned taking action to overcome digital inequalities, including **China**, **Argentina**, the **United States**, **India**, **Turkey**, **Canada**, and the **Republic of Korea**. They generally seek to align different policies and actions to overcome this challenge. **China** has at least three policies devoted to this end: the Outline of Digital Countryside Development Strategy, issued in 2019; the Guidelines for Building a Digital Countryside 1.0; and the Action Plan for Digital Countryside Development, issued in 2022. **Argentina** has the Digital Points initiative, "a federal network that, through free public spaces, provides connectivity, training, workshops and cultural activities for people of all ages."[166]

In the **United States**, there are efforts to ensure quality Internet at affordable prices for the population. "The Bipartisan Infrastructure Deal will deliver $65 billion to help ensure that every American has access to reliable high-speed internet through a historic investment in broadband infrastructure deployment. The legislation will also help lower prices for internet service and help close the digital divide, so that more Americans can afford internet access."[167] In **India**, some of the many efforts in this direction are the 2014 National Digital Literacy Mission, the 2015 Digital India campaign to connect the entire country, and the 2017 "PM Gramin Digital Saksharta Abhiyan, […] to usher in digital literacy in rural India by covering 60 million households."[168]

In **Turkey** and **Canada** some of the efforts to ensure affordable quality Internet focus on the rural population. **Turkey** "has invested in expanding broadband

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163. Information retrieved from: https://www.niaa.gov.au/our-work/employment-and-economic-development/first-nations-digital-inclusion-plan-fndip

164. Information retrieved from: https://www.niaa.gov.au/resource-centre/first-nations-digital-inclusion-plan-2023-26

165. Information provided directly by the Italian government. Minor adjustments were made in the original text.

166. Information retrieved from: https://www.argentina.gob.ar/jefatura/innovacion-ciencia-y-tecnologia/innovacion/punto-digital. The original text is in Spanish.

167. Information provided directly by the US government.

168. Information provided directly by the government of India.

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infrastructure to rural and remote areas. This includes initiatives to deploy high-speed internet access to remote regions, enabling residents to access digital services and participate in the digital economy. Turkey has established a universal service obligation framework to ensure that basic telecommunications services, including internet access, are available to all citizens at affordable prices. This helps address disparities in access to digital technologies and services across different socioeconomic groups and geographic regions. Turkey has expanded e-government services to facilitate access to public services and information for citizens across the country. By digitizing government services and making them available online, including in rural areas, Turkey aims to improve efficiency, transparency, and accessibility in service delivery."[169]

In **Canada,** "High-Speed Access for All: Canada's Connectivity Strategy features two main objectives that all Canadians have access to broadband at speeds of at least 50 Megabits per second (Mbps) download / 10 Mbps upload, and mobile wireless coverage is available where Canadians live and work, and along major road corridors. This Strategy complements Rural Opportunity, National Prosperity: An Economic Development Strategy for Rural Canada, which is designed to ensure Canadians living in rural and remote communities have equal opportunity to participate fully in our nation's economy and share in its prosperity. Since 2015, the Government of Canada has supported the expansion of high-speed Internet access for Canadians, including rural communities which have slower and less reliable internet access than in urban centres. In 2016, 84 per cent of Canadians had access to high-speed internet. By 2022, this figure increased to almost 94 per cent. This has been possible in part because of a significant increase in access in rural areas, moving from 39 per cent to 67 per cent over this period. The Government of Canada remains committed to its target of ensuring 98 per cent of Canadians have access to high-speed internet by 2026 and 100 per cent of Canadians by 2030."[170] The Telecom Regulatory Policy CRTC 2016-496 (Modern telecommunications services – The path forward for Canada's digital economy) also plays an important role in addressing the urban-rural digital divide in Canada.

The **Republic of Korea**'s Digital Inclusion Promotion Strategy and Digital Bill of Rights provide examples of efforts to promote digital abilities. It is worth mentioning that "with the goal of realizing a shared society of digital prosperity,

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169. Information provided directly by the Turkish government. Minor adjustments were made to the original text.

170. Information provided directly by the Canadian government.

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the Strategy aims to promote digital capacity building for all, create an inclusive digital use environment, facilitate inclusive use of digital technologies, and lay a foundation for digital inclusion."[171]

The Gender Gap in Internet Usage

The concept of gender parity as described by the ITU is defined as the female percentage divided by the male percentage, and it is deemed achieved when the results stand between 0.98 and 1.02.

Data suggests that in most of the analyzed G20 member countries, the ratio is within the boundaries considered adequate for gender parity in Internet usage, indicating close to fully equitable access between genders. In only a few countries progress must be made to increase the proportion of women using technology.

Chart 31 | Gender Parity Score

The gender parity score is calculated as the proportion of women who use the Internet divided by the proportion of men

Source: ITU, Individuals Using Internet By Gender and Urban/Rural Location, January 2024.
* United Kingdom data refers to 2020. ** India data refers to 2018.
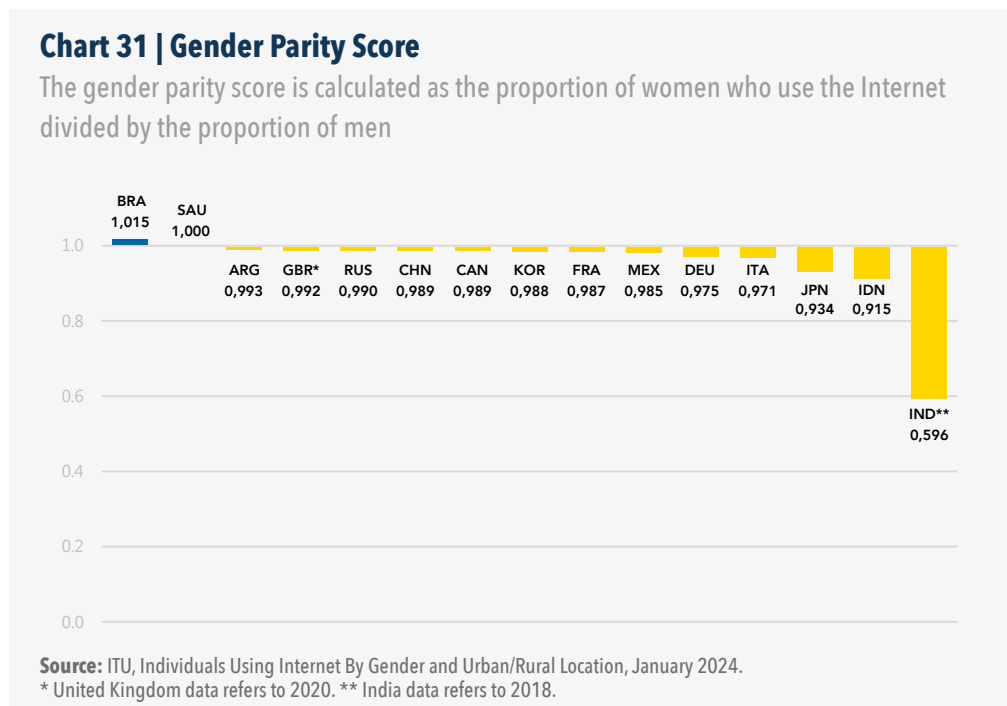
In most countries, the actions to reduce the gender gap are part of a larger set of laws and/or policies to reduce digital inequality. In the **United States**, "The

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171. Information provided directly by the South Korean government.

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Department of Education ran the Online for All campaign to expand access and reduce inequity in Internet access. In 2023, the White House announced the Women in the Digital Economy Fund (WiDEF), a joint effort between USAID and the Bill & Melinda Gates Foundation to accelerate progress on closing the gender digital divide."[172] In **China**, the "Action Outline to Improve Digital Literacy and Skills for All was issued in 2021, identifying training for women as one of the main missions."[173]

Canada has the Playbook for Gender Equality in the Digital Age. "It is intended for governments, legislators, policy makers, advocates, academics, human rights defenders, and anyone else who is thinking about the impact of technological development on gender equality and trying to find ways to address new challenges it poses for the international human rights regime as well as opportunities it promises for empowering women, girls, and gender non-conforming individuals."[174] The Playbook is related to at least another three provisions: the Federal gender equality laws in Canada; the Government of Canada's Gender Results Framework; and Canada's Feminist International Assistance Policy.

Turkey "has implemented digital literacy programs targeting women and girls to enhance their skills and knowledge in using digital technologies. These programs often provide training on basic computer skills, internet usage, and digital tools, thus empowering women to participate more actively in the digital world. Some government-sponsored programs provide ICT (Information and Communication Technology) training and employment opportunities for women. These programs aim to equip women with the necessary technical skills to pursue careers in the technology sector, thus increasing their representation in the industry. **Turkey** supports women entrepreneurs, including those in the technology sector, through various initiatives such as funding schemes, mentorship programs, and networking platforms within the scope of Turkish Tech Entrepreneurship Strategy. By promoting women's entrepreneurship in tech, these initiatives aim to increase the presence of women in the digital economy."[175]

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172. Information provided directly by the US government.

173. Information provided by the Chinese government.

174. Information retrieved from: https://www.international.gc.ca/world-monde/issues_development-enjeux_developpement/human_rights-droits_homme/playbook-manuel_instructions.aspx?lang=eng#a3_4

175. Information provided directly by the Turkish government.

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Digital Accessibility

The vast majority of responding countries mentioned the existence of laws and policies aimed at promoting accessibility to digital environments among vulnerable groups. In some cases, these are manifested in broader digital inclusion plans which, at their core, also target vulnerable groups. In others, the issue has been addressed in national policies aimed at reducing inequalities between specific groups – women, people with disabilities, older people, etc. – which include debates on access to digital environments.

An example of the first scenario is **Canada**, where issues related to digital accessibility are addressed through The Accessible Canada Act (ACA), which "came into force in 2019 and has the overarching goal of realizing a barrier-free Canada by 2040." The ACA created the "Accessibility Standards Canada (ASC) [...] with a mandate to develop national accessibility standards"; in this organization, a specific "technical committee is working to develop a standard on accessible and equitable artificial intelligence systems."[176] With regard to the second scenario, an example is **Turkey**, which mentioned the existence of "laws and regulations aimed at promoting the rights of persons with disabilities, including provisions related to accessibility in public spaces, transportation, and digital public services and technologies."[177] In **China**, the same approach already aims to address the issues of digital accessibility and support for vulnerable groups together, with an emphasis on digital policies aimed at specific vulnerable groups, represented in the Designated Action Plan on Adaptation of Internet Apps for Better Access by the Senior and People with Disabilities and in the Action Plan for Digital Countryside Development, both from 2022.[178]

There are also cases in which both scenarios are considered, i.e., general digital inclusion policies that target specific groups are combined with plans for the inclusion of vulnerable groups that also deal with digital accessibility. **Australia** combines its First Nations Digital Inclusion Plan (2023-26) with measures for specific vulnerable groups that take digital inclusion into account, such as the Disability and Australia's Disability Strategy 2021–2031 and Be Connected – Improving Digital Literacy for Older Australians.[179]

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176. Information provided directly by the Canadian government.

177. Information provided directly by the Turkish government.

178. Information retrieved from: https://www.gov.cn/zhengce/zhengceku/2020-12/26/content_5573472.htm and www.cac.gov.cn/2022-01/25/c_1644713315749608.htm

179. Information provided directly by the Australian government.

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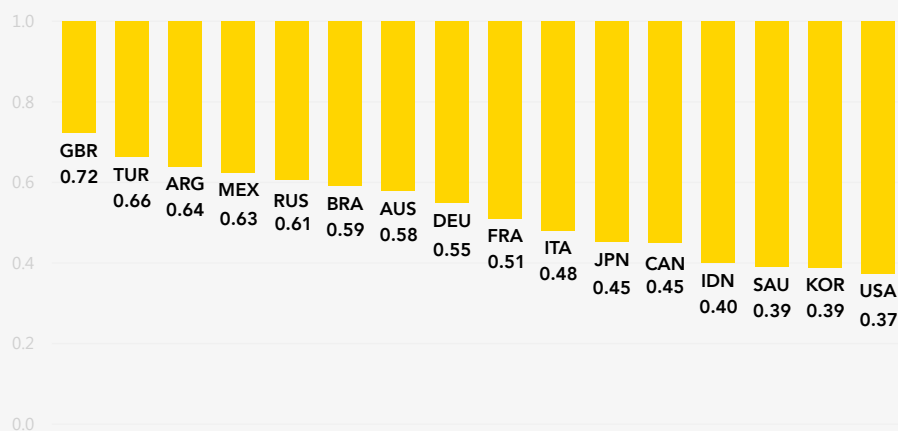
89

Gender Equality in Science, Technology, Knowledge, and Innovation

The ratio of girls divided by boys regarding their expectations to work as engineers or science professionals when they are 30 years old is calculated with data from the OECD Programme for International Student Assessment (PISA), which examines several aspects of the quality and equity of learning outcomes.

The results suggest that in many of the countries analyzed, girls are not being encouraged to pursue this type of career. This indicator complements those that measure traditional gender gaps, like Internet usage, to illustrate further the complex web of issues affecting the gender divide.

Chart 32 | Expectations about the Future, by Gender

Ratio girls/boys of top performers in science or mathematics who expect to work as science or engeneering professionals when they are 30

GBR 0.72	TUR 0.66	ARG 0.64
MEX 0.63	RUS 0.61	BRA 0.59
AUS 0.58	DEU 0.55	FRA 0.51
ITA 0.48	JPN 0.45	CAN 0.45
IDN 0.40	SAU 0.39	KOR 0.39
USA 0.37		

Source: OECD's Programme for International Student Assessment 2018 (PISA 2018).

Public Engagement and Trust

Online Services and Institutional Trust

Digitizing services helps governments meet public expectations, earn trust, and become more efficient and resilient. Since 2002, the United Nations Department of Economic and Social Affairs (UN DESA) has been measuring the adoption of digital governments among UN member States biennially. The Online Service

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Index (OSI) evaluates the presence of features or services on official government websites, with a value ranging from 0 to 1.

Almost all G20 member countries scored in the Very High OSI level in 2022, meaning that most economies were including their governments in the digital economy and providing online information and services for the population. However, the scores ranged from 0.74 to 0.98, indicating that there is still room for improvement in the delivery of online services.

Chart 33 | Score on the Online Services Index
Index 0 to 1, 2022.

Source: UN E-Government Survey 2022.
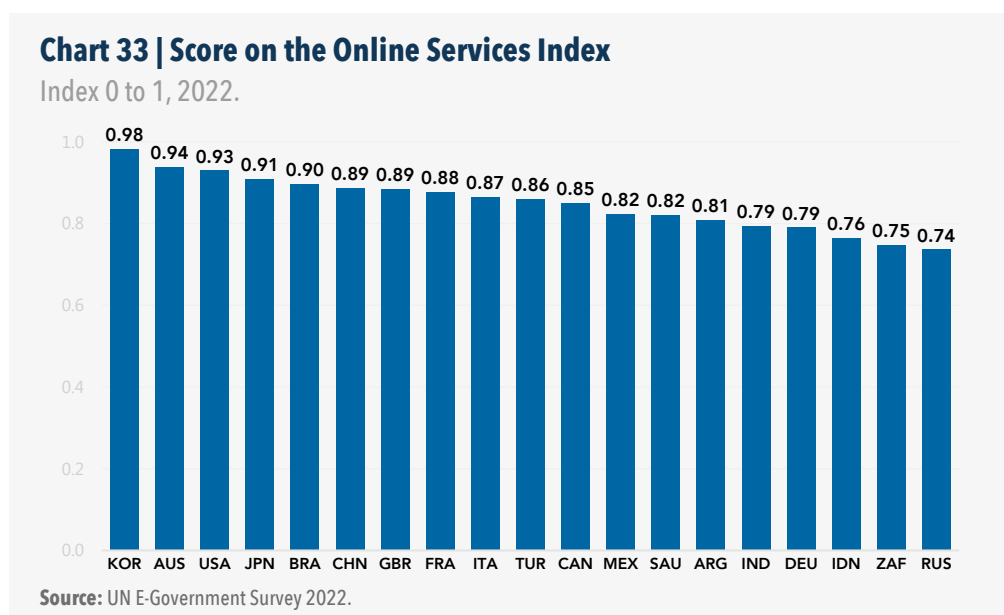
UN DESA also provides an assessment of e-participation. The E-participation Index (EPI) analyses the availability of initiatives related to three dimensions: e-information; e-consultation; and e-decision. In 2022, while nine countries achieved a Very High EPI level, most countries were assessed with a lower level (High EPI). This disparity among the G20 economies, with scores ranging from 0.59 to 1, highlights the need for more inclusive eparticipation initiatives.

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Chart 34 | E-Participation Index

Index 0 to 1, 2022.

Country	Value
JPN	1.00
AUS	0.99
GBR	0.95
KOR	0.94
USA	0.91
BRA	0.90
CHN	0.86
CAN	0.83
TUR	0.78
DEU	0.73
ITA	0.73
MEX	0.73
FRA	0.72
IDN	0.72
SAU	0.69
ARG	0.65
RUS	0.60
IND	0.59
ZAF	0.59
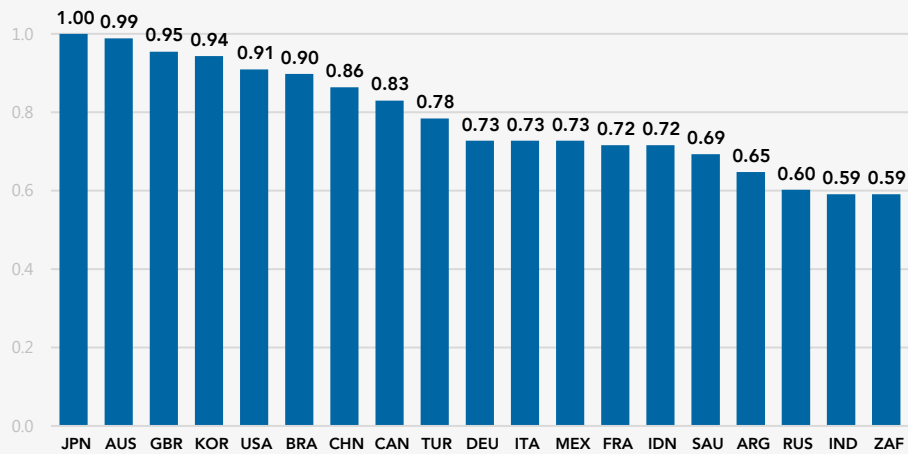
Source: OECD's Programme for International Student Assessment 2018 (PISA 2018).

Culture

Few countries mentioned initiatives using AI to preserve cultural heritage, suggesting there is room to understand how technology can become a useful instrument for this goal.

In the **Republic of Korea**, AI has been used to create virtual versions of independence activists and national heroes with AI ("AI human"). In addition, in museums and art galleries, AI curators (smart cultural curating bots) have been introduced to the public. In **China**, "The Guideline on Promoting Cultural Relics-Related Sci-Tech Innovation mentioned the adoption of AI for the preservation of cultural heritage: (V). Deploy and implement key technical research on cultural relics: Promote the research, application and demonstration of key technologies in the digitization of cultural heritage, the construction of intelligent museums, and the display of mega sites; (XII). Build Cultural Relics-Related Sci-Tech Innovation infrastructure and platform: Build special experimental platforms for scene-based display of cultural heritage and intelligent technology."[180]

France mentioned the Alliance for Language Technologies. It "was proposed in December 2023 as one of the first EDICs.[181] On 7 February 2024, the European

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180. Information provided directly by the Chinese government.

181. European Digital Infrastructure Consortium (EDIC).

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Commission officially set up the ALT-EDIC with the Implementing Decision (EU) 2024/458. Coordinated by France, the ALT-EDIC counts: Twelve Members States: Bulgaria, Croatia, France, Greece, Ireland, Italy, Latvia, Lithuania, Netherlands, Poland, Slovenia and Spain; and Seven observing Member States: Austria, Belgium, Denmark, Estonia, Malta, Romania and Slovakia. The mission of the ALT-EDIC is to develop a common European infrastructure in Language Technologies, focusing particularly on Large Language Models. It seeks to improve European competitiveness, increase the availability of European language data and uphold Europe's linguistic diversity and cultural richness."[182]

Turkey "has various initiatives and programs aimed at preserving its rich cultural heritage, which involve the use of AI technologies. With Digital Archiving Projects, Türkiye has been digitizing cultural artifacts, historical documents, and archaeological sites as part of efforts to preserve cultural heritage. AI technologies, such as image recognition and natural language processing, are utilized to automate tasks such as cataloging, indexing, and analyzing digitized cultural materials. Türkiye has also explored the use of VR and AR technologies to create immersive experiences that allow users to explore historical sites, museums, and cultural landmarks virtually. AI algorithms enhance these experiences by providing real-time interaction, context-aware information, and personalized content recommendations."[183]

Regarding training AI in different languages, the **United Kingdom** mentioned that "the Welsh language technology action plan (2018-23) identifies AI as one of three specific areas to be addressed by the Plan. Its intention was to outline technological developments so Welsh could be used in a wide range of situations, using human voice, keyboard, or other means of interaction. Work package #2 focuses on AI in Welsh and provides details of the work that the Welsh Government funded in this area: the virtual assistant Macsen and work on ChatGPT in Welsh, for example."[184]

China and the **Republic of Korea** showed that the relationship between language and AI is on their radar. **China** pointed out that it "proposed the Global AI Governance Initiative, which proposes to adhere to the principles of fairness and non-discrimination, and avoid biases and discrimination based on ethnicities, beliefs, nationalities, genders, etc., during the process of data collection, algorithm design, technology development, and product development and application."[185] The **Republic of Korea** stated that "the

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182. Information retrieved from: https://language-data-space.ec.europa.eu/related-initiatives/alt-edic_en#the-alliance-for-language-technologies

183. Information provided directly by the Turkish government.

184. Information provided directly by the government of the United Kingdom.

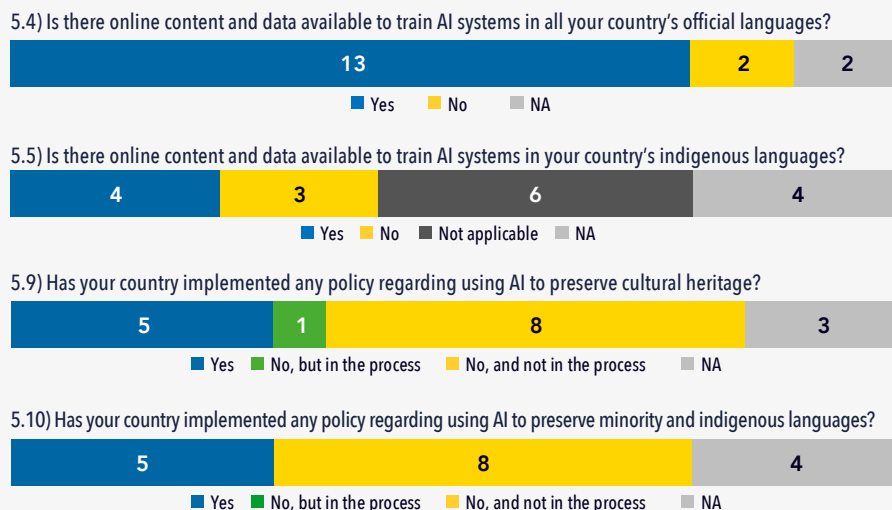185. Information provided directly by the Chinese government.

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Korean government assisted the private sector in developing Korean large-language-model (LLM) and launching the Hyperscale AI Committee."[186]

India is also very active in this area, especially through Digital India Bhashini, which "aims to build a National Public Digital Platform for languages to develop services and products for citizens by leveraging the power of artificial intelligence and other emerging technologies. Bhashini shall make efforts to act as a unifier and align a large diverse network across government, industry, academia, research groups and startups to bring all their contributions into an open repository."[187]

Japan also stands out in the development of intersections between AI and language, pointing out that "The Agency for Cultural Affairs is implementing the 'Ainu Analog Materials Digitization Project' and the 'Ainu Language Archive Creation Support Project' for the preservation, transmission and revitalization of the indigenous Ainu language." In addition, "In the creation of the 'Ainu Language Archive' of the National Ainu Museum, the 'Ainu Speech Recognition System,' developed by Kyoto University, is being used in the process of converting Ainu speech into text and adding timestamps for synchronized reproduction of speech and text."[188]

Chart 35 | AI Social/Cultural: Culture and Language
G20 member countries that reported to the presidency

5.4) Is there online content and data available to train AI systems in all your country's official languages?

13	2	2

■ Yes ■ No ■ NA

5.5) Is there online content and data available to train AI systems in your country's indigenous languages?

4	3	6	4

■ Yes ■ No ■ Not applicable ■ NA

5.9) Has your country implemented any policy regarding using AI to preserve cultural heritage?

5	1	8	3

■ Yes ■ No, but in the process ■ No, and not in the process ■ NA

5.10) Has your country implemented any policy regarding using AI to preserve minority and indigenous languages?

5	8	4

■ Yes ■ No, but in the process ■ No, and not in the process ■ NA

Source: AI Capacities in G20 Countries Survey

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186. Information provided directly by the South Korean government.

187. Information provided directly by the government of India.

188. Information provided directly by the Japanese government.

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Environmental and Sustainability Policies

Countries shed light on three issues related to environmental and sustainability issues: (i) the importance of adopting general frameworks for climate change, which must be valid also for AI technologies; (ii) the use of AI systems for tackling environmental and sustainability challenges; and (iii) the necessity of identifying the environmental impacts of the development and use of AI systems.

Canada's response provides an example of the first issue. The country stated that "environmental regulations are frameworks of general application in Canada, applying across all sectors and technologies: Canada regulates greenhouse gas emissions through CEPA; and draft regulations have been published for Clean Electricity Regulations."[189] With a similar approach, **Australia** mentioned its "Mandatory climate-related financial disclosures." Without explicitly mentioning AI, the document states that the Australian "Government is committed to improving the quality of climate-related financial disclosures, providing Australians and investors with greater transparency and more comparable information about an entity's exposure to climate-related financial risks and opportunities and climate-related plans and strategies. Improving climate disclosures will support regulators to assess and manage systemic risks to the financial system as a result of climate change and efforts taken to mitigate its effects."[190] **Turkey's** National AI Institute has identified climate change and sustainability as a priority area for its ecosystem call to support AI solutions that mitigate the adverse effects of climate change. The "Artificial Intelligence Applications in Monitoring the Effects of Climate Change with New Generation Air Quality Measurement Systems Project" is currently being supported and new calls are planned to expand the government support for AI-based solutions.[191]

France and the **Republic of Korea** gave examples of how AI systems can be used to address climate challenges. **France** mentioned that "several projects using AI for green transition in local municipalities receive dedicated funding."[192] One is "the call for projects 'Frugal AI demonstrators serving the ecological transition of territories.' With a total budget of €40 million from France 2030, this call for projects aims to support local authorities aiming to provide a solution to a public policy management problem or to improve management or operation

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189. Information provided directly by the Canadian government.
190. Information retrieved from: https://treasury.gov.au/sites/default/files/2024-01/c2024-466491-policy-state.pdf
191. Information provided directly by the Turkish government.
192. Information provided directly by the French government.

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of one or more services to users by mobilizing artificial intelligence."[193] **South Korea** mentioned some initiatives, such as the "particulate matter (PM-10, PM2-5) and ozone forecasting using AI-based big data analysis. The forecaster determines the forecast by comprehensively analysing the observation data, numerical model and AI prediction data."[194]

Preventing the Environmental Impacts of the Development and Use of AI Systems

Indonesia, **Saudi Arabia**, **France** and **Canada** provided examples of efforts to identify or prevent the environmental impacts of the development and use of AI systems. **Indonesia**, in a Circular Letter of the Ministry of Communication and Informatics on Ethics in AI, states that "The implementation of Artificial Intelligence shall carefully consider the impacts on humans, the environment, and other living beings, in order to achieve sustainability and social welfare."[195] In **Saudi Arabia**, Principle 4 (Social & Environmental Benefits) of the document "AI Ethics Principles" states that "the social and environmental benefit principle embraces the beneficial and positive impact of social and environmental priorities that should benefit individuals and the wider community that focus on sustainable goals and objectives. AI systems should neither cause nor accelerate harm or otherwise adversely affect human beings but rather contribute to empowering and complementing social and environmental progress while addressing associated social and environmental ills. This entails the protection of social good as well as environmental sustainability."[196]

In **France,** "pre-standardization work was launched to identify the characteristics of low-energy AI."[197] In the **Canadian** public sector, "the Algorithmic Impact Assessment Tool is a mandatory risk assessment tool which supports the Directive on Automated Decision-Making. It is a questionnaire of more than 80 questions designed to help federal departments assess and manage the risks of automated decision systems. As part of the AIA, Section 8 – Impact assessment, includes a question asking departments to assess the impact of the system on the ongoing sustainability of an environmental ecosystem. As well, one of the issue areas highlighted in the Guide on the use of generative

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193. Information retrieved from: https://www.info.gouv.fr/actualite/france-2030-annonce-des-laureats-de-l-appel-a-projets-territoires-intelligents-et-durables-tid-et-de. The original text is in French.

194. Information provided directly by the South Korean government. Minor adjustments were made in the original text.

195. Information retrieved from: https://jdih.kominfo.go.id/produk_hukum/view/id/883/t/surat+edaran+menteri+komunikasi+dan+inf ormatika+nomor+9+tahun+2023

196. Information retrieved from: https://sdaia.gov.sa/en/SDAIA/about/Documents/ai-principles.pdf

197. Information provided directly by the French government.

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AI is environmental impacts. This section provides an overview of the issue, and best practices for users and deployers of generative AI systems."[198]

Health and Social Well-being

Most countries are either developing or already have digital health agendas. Some members of the second group have actions related to developing and using AI systems in health.

In the **United States**, "the U.S. Department of Health and Human Services (HHS), through the Office of the National Coordinator for Health IT (ONC), released the draft 2024-2030 Federal Health IT Strategic Plan for public comment. The draft plan was developed in collaboration with more than 25 federal organizations that regulate, purchase, develop, and use health IT to help deliver care and improve patient health. The draft plan defines a set of goals, objectives, and strategies the federal government will pursue to improve health experiences and outcomes for individuals, populations, and communities while also promoting opportunities for improving health equity, advancing scientific discovery and innovation, and modernizing the nation's public health infrastructure. The draft plan also places an emphasis on addressing the policy and technology components essential for securely catering to the diverse data requirements of all health IT users."[199]

In **Turkey**, the Ministry of Industry and Technology evaluated sectoral, technological and health transformation trends "within the scope of the Smart Life and Health Products and Technologies Roadmap. A series of studies and consultations were further carried out by the Ministry of Health, the Investment Office of the Presidency, relevant Ministries and other stakeholders. As a result, 9 strategic goals, 4 strategic objectives, 28 short-medium and long-term actions and 5 critical project proposals were put forward."[200]

Russia also proposes a framework for the application of AI in the field of health care. Decree of the Government of the Russian Federation No. 2276 of 2022 reports on the "establishment of an experimental legal regime in the field of digital innovations […] regarding of medical activities using technologies for collecting and processing information on health condition and diagnoses

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198. Information provided directly by the Canadian government.

199. Information retrieved from: https://www.healthit.gov/topic/draft-2024-2030-federal-health-it-strategic-plan

200. Information provided directly by the Turkish government.

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of citizens in relation to the implementation of the social and economic development initiative of the Russian Federation Personal Medical Assistants."[201]

Among the countries with digital health strategies, the Brazilian Digital Health Strategy (ESD in the Portuguese abbreviation) proposes critical actions to promote digital health in **Brazil**. Some of these actions are aimed at ensuring that ESD governance involves both the Ministry of Health and social and economic actors; accelerating the adoption of electronic medical records; engaging patients and citizens in the building process for the information systems they will use; training health professionals in health informatics; and creating an environment of interconnectivity and data interoperability that drives an ecosystem of health innovation. The digital health agendas of different countries display similar actions and goals.

In **Canada,** the joint federal, provincial, and territorial (FPT) Action Plan on Health Data and Digital Health has some points that fully or partially coincide with the Brazilian ESD, such as collecting and sharing high-quality and comparable deidentified information to measure the progress being made through common indicators to improve health care, adopt common interoperability standards, and acknowledge the co-existence across regions, provinces, and territories of a diversity of health information systems and capacities.

Thus, privacy, interoperability, and government coordination are important topics to be considered by countries interested in adopting or deepening national digital health agendas.

Like Brazil and Canada, other countries have digital health strategies, policies, or agendas.

In **China**, in 2022, the National Health Commission issued the 14th Five-Year Plan for National Health Informatization, preceded by the 2018 Opinions on Promoting Development of Internet Plus Healthcare[202]. In 2020, **Saudi Arabia** issued the Ministry of Health Digital Strategy Framework and Roadmap, and established a Center of Excellence for Artificial Intelligence for the Health Sector in collaboration with the Ministry of Health.[203] As part of France 2030, **France** launched, in 2021, the 'Digital Health' acceleration strategy (SASN). This interministerial program is "led by the digital health delegation and involves the ministries in charge of the

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201. Information provided directly by the Russian government.
202. Information provided directly by the Chinese government.
203. Information provided directly by the government of Saudi Arabia

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Economy, Finance, and industrial and digital sovereignty, Higher Education and Research, Labor, Health and Solidarités, as well as the General Secretariat for Investment, in charge of France 2030 and the Health Innovation Agency (AIS)."[204] In **Italy**, "the adoption of electronic health records is compulsory. The Decree Law of 18 October 2012, No. 179 requires Italian regions and autonomous provinces to adopt the electronic health records."[205] In **India**, "The Ayushman Bharat Digital Mission (ABDM) aims to develop the backbone necessary to support the integrated digital health infrastructure of the country. It will bridge the existing gap amongst different stakeholders of Healthcare ecosystem through digital highways."[206]

The **Republic of Korea**, **Indonesia**, and the **United Kingdom** provide examples of actions that combine developing and implementing digital health agendas and developing and using AI systems. The **Republic of Korea** Ministry of Health and Welfare established the Health Care Data and Artificial Intelligence Innovation Strategy in 2021. In the following years, the country issued the Implementation Plan for Nationwide Diffusion of AI into Everyday Life and the 2024 People-Industry-Public Project Promotion Plan to Spread AI in Daily Life.[207] **Indonesia**, in its "Health Digital Transformation Policy through SATUSEHAT Platform," points out, among other activities, the development of "a 'Health Big Data Analysis System,' an ecosystem based on artificial intelligence analysis at both the central and local government levels," with "the main output of improving the quality of health policies based on accurate, up-to-date, and complete data."[208]

In the **United Kingdom**, "the key document outlining the country's commitment to digital health is the NHS Long Term Plan, published in January 2019. This plan emphasises the integration of technology to improve patient care and health outcomes. It discusses digital innovations across several areas, including the development of digital services and data systems to support clinical care, including the use of artificial intelligence to analyse data for better clinical insights and decision-making. Additionally, the UK government published a strategy 'Data saves lives: reshaping health and social care with data' in 2022. This strategy sets out how the UK plans to leverage data and data-driven technologies, including AI, to improve the health and care system. It outlines the use of AI in predictive

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204. Information retrieved from: https://sante.gouv.fr/actualites/presse/communiques-de-presse/article/2-ans-de-france-2030-des-resultats-concrets-et-des-perspectives-pour-la-sante. The original text is in French.

205. Information provided directly by the Italian government.

206. Information provided directly by the government of India.

207. Information provided directly by the South Korean government.

208. Information retrieved from: https://storage.googleapis.com/satusehat-platform/supporting-docs/10.%20KMK%2001_07_1559_2022%20tentang%20SPBE%20dan%20Transformasi%20Digital%20Kesehatan.pdf

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analytics, which can foresee patient needs and optimise resource allocation in healthcare services. Another relevant government strategy is the Digital Health and Care Plan (2022), which focuses on the role of digital technologies in transforming healthcare services. It outlines objectives to implement digital solutions effectively within the health sector, including enhancing AI applications in medical imaging and diagnostics to increase the accuracy and efficiency of treatments."[209]

Chart 36 | AI Social/Cultural: Health Policies and AI Education

G20 member countries that reported to the presidency

5.8) Has your country adopted a digital health strategy, policy, or agenda?

15   1 1

■ Yes
■ No, but in the process
■ No, and not in the process
■ NA
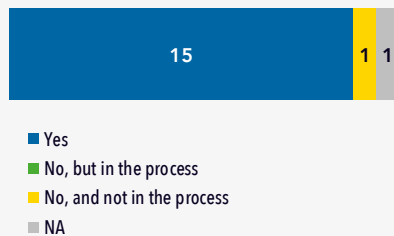
5.11) Are there any educational programs in your country that include both technical and ethical aspects of AI […]

| 16 | 12 | 16 |
| Technical aspects | Ethical aspects | Both technical and ethical aspects |

Source: UN E-Government Survey 2022.

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Dealing with the Urban/Rural Gap: Actions by G20 Guest Countries

Multiple actions among guest countries align with the objective of reducing socioeconomic and rural/urban digital gaps, some of which focus on the expansion of the necessary infrastructure for broadband coverage of rural areas. In **Uruguay**, the "state-owned telecommunications company, ANTEL (for its acronym in Spanish), has deployed fiber optics (LTE) in towns of up to 5,000 inhabitants and is seeking to achieve greater national coverage with 5G technology."[210] In **Denmark**, "broadband coverage is amongst the highest in the European Union. In 2023, 98 pct. of all households and companies had access to 100/30 Mbit/sec. The national goal is that all households and companies have access to 100/30 Mbit/sec. In addition, 98 pct. of all households and companies are to be covered by an infrastructure delivering 1Gbit/sec. download."[211] In **Spain**, the "Universalization of Digital Infrastructures for the Cohesion Program (UNICO) […] serves as a framework for different calls for proposals that will facilitate the universalization of access to ultrafast broadband and the extension of 5G."[212] **Singapore** promotes the DigitalAcess@Home program, "an assistance scheme that supports low-income households with affordable home internet connectivity and devices (laptops and tablets)"[213], as well as the Mobile Acess for Seniors initiative, which "provides subsidised smartphone and mobile plan to lower-income seniors who want to go digital."[214]

Other strategies for dealing with the urban/rural gap mainly address the social aspects of the issue. In **Portugal**, "the Citizen Spot initiative, launched in 2014, consists of a multiservice physical counter where a specialized mediator assists citizens in accessing a portfolio of digital public services, available on various websites, and further teaches them how to operate on their own thereafter."[215] **Norway** has published the Digital Inclusion Strategy and the Digital Inclusion Action Plan, which set out goals and ways to tackle the digital divide and extend access to digital services (especially public ones) to as many people as possible. Additionally, "the **UAE** Government launched various policies and strategies to bridge the digital divide between people living in urban and rural areas,"[216] such as "telemedicine services for people living in the rural areas."[217]

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210. Information provided directly by the Uruguayan government.

211. Information provided directly by the Danish government.

212. Information provided directly by the Spanish government.

213. Information retrieved from: https://file.go.gov.sg/digitalaccess-faq.pdf

214. Information retrieved from: https://file.go.gov.sg/mobileaccess-eng.pdf

215. Information provided directly by the Portuguese government.

216. Information provided directly by the government of the United Arab Emirates.

217. Information retrieved from: https://u.ae/en/about-the-uae/digital-uae/digital-inclusion/bridging-digital-divide

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Workforce AI Capability (Economic Dimension)

This dimension aims to address the size and strength of the supply side of the AI ecosystems in countries, which is important for the ability to develop AI solutions reflecting the particular needs and conditions of a given country and its population. It will look at the size of the technology sector, including the number of companies that develop or deploy AI systems and their employees. It will also address the amount of public and private investment in the field of AI. It will help track the growth of the AI sector. Enhancing capacity in this regard would be related to the ability to support the development of the AI ecosystem in the country, including the attractiveness of investment in AI technology and human talent (UNESCO, 2023b).

Labor Markets

Regarding the labor market's preparedness for AI's impact on jobs, many countries have adopted multisectoral and multistakeholder digital skills strategies. In some countries, these strategies contain actions directly associated with AI.

In **Italy**, "the National Strategy for Digital Skills is the essential basis for the implementation of organic, multisectoral and effective interventions in an area key to the economic and social development of the country. The strategy is the result of a collaborative approach, which put the guiding Technical Committee, partner organizations and the National Coalition of Digital Republic at the same table."[218] In **China**, "the Action Plan to Accelerate the Cultivation of Digital Talents to Support the Development of the Digital Economy (2024-2026) was issued recently. Relevant documents are also issued at provincial level such as Beijing, Zhejiang, and Guangdong."[219] In **South Korea**, the National Digital Strategy was issued in 2022. It seeks "to provide capacity-building/reskilling opportunities for incumbent workers and digital literacy education opportunities for all citizens."[220] In **Canada,** the Skills for Success and the Upskilling for Industry

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218. Information provided directly by the Italian government.

219. Information provided directly by the Chinese government.

220. Information provided directly by the South Korean government. Minor adjustments were made to the original text.

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Initiative (UII) are two policies devoted to helping workers cope with structural changes in the labor market[221].

This issue is also addressed objectively by **India**. "Recognising the potential of AI to disrupt L1 level jobs, under the IndiaAI FutureSkills component of IndiaAI mission, Government of India will set up Data and AI Labs as infrastructure in Tier 2 and Tier 3 cities across India, to impart foundational-level courses in Data and AI. Further, 'training of trainers' support will be provided to effectively harness the infrastructure provided and deliver the foundational data and AI courses. This initiative will transform the country's technical education infrastructure and enhance the AI readiness of India's workforce."[222]

Faced with changes in the labor market resulting from digital transformations (including the advancement of AI), some countries have strengthened existing policies, such as helping workers to find new jobs and strengthening the Vocational Education and Training (VET) sector. In the **United Kingdom**, job centers deliver "centrally designed policies consistently throughout the network but tailored to the local labour market and local needs at Jobcentre level. Jobcentre staff work very closely with local partners, including employers and skills providers to fill local vacancies and progress people in work, including those displaced as a result of automation or artificial intelligence. Jobcentre support is delivered by Work Coaches and includes advice on job vacancies and training opportunities, improving job-search skills and providing personalised support to help Jobcentre customers find and stay in employment. Work Coaches engage with claimants to support access to a comprehensive range of support, which includes; Apprenticeships, Skills Bootcamps, vocational and essential skills training (literacy, numeracy, Essential Digital Skills (EDS) and ESOL), careers advice and Sector-based Work Academy Programmes (SWAPs)."[223] In **Australia**, "the Future Skills Organisation (FSO) is a Jobs and Skills Council established by the Australian Government to address the current labour and skills shortages while future-proofing the country's VET sector."[224] The FSO works in collaboration with industry and other stakeholders. In **Turkey**, the Turkish Employment Agency (İŞKUR) is aiding activities to protect, improve, and generalize employment and prevent unemployment. The Agency is also focused

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221. Information provided directly by the Canadian government.
222. Information provided directly by the government of India.
223. Information provided directly by the government of the United Kingdom.
224. Information retrieved from: https://www.futureskillsorganisation.com.au/our-mission

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on providing vocational education and training in digital skills, especially AI, to foster the resilience of the labor market for the impact of AI on jobs.[225]

Monitoring and Mapping the Impacts of AI on National Labor Markets

Regarding the specific changes in the labor market caused by AI, the first approach adopted by many countries is to map and understand the real impacts of these changes. In **Germany,** "the Observatory for Artificial Intelligence in Work and Society at the Federal Ministry of Labour and Social Affairs (AI Observatory) studies the impacts of AI on work and society, observes trends and develops possible solutions, tools and recommendations for a human-centric AI design and use. This Observatory implements the AI strategy in this specific field."[226] In **France**, "the Ministry of Labor, Full Employment and Integration and Inria[227] together founded LaborIA in 2021, a laboratory aimed at build and consolidate a field vision to better understand artificial intelligence and its effects on work, the active population, employment, skills and social dialogue."[228]

In **Turkey,** "the Turkish Employment Agency is working to determine the need for new skills emerging with the transformation of professions and ways of doing business by artificial intelligence technologies and to create an acceleration programme to close the gap with the existing ones. Furthermore, **Turkey** recognizes the importance of lifelong learning in the context of AI. The public sector and relevant stakeholders promote initiatives that encourage individuals to continuously update and upgrade their skills throughout their careers to remain competitive in the labor market."[229] In **Saudi Arabia**, "a full-fledged study has assessed the impact of AI in the labor market and concluded with recommendations on how to re-skill and upskill individuals. These recommendations are being implemented with relevant entities."[230]

France, the **United Kingdom** and **Canada** provide examples of more specific actions to address AI's impacts on the labor market. In **France**, "€ 2.5 Bln were taken from the national investment plan France 2030 to fund evaluations and

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225. Information provided directly by the Turkish government.

226. Information provided directly by the German government.

227. The French National Institute for Research in Digital Science and Technology.

228. Information retrieved from: https://www.laboria.ai/le-laboria/. The original text is in French.

229. Information provided directly by the Turkish government.

230. Information provided directly by the government of Saudi Arabia.

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training projects, among which € 54 M were directed to 7 elite schools and training centers for them to significantly increase the number of AI degrees delivered, with the objective to train an additional 6,200 people on AI over the next 3 years."[231]

"Starting with commitments made in the AI Sector Deal and continued in the National AI Strategy, the **United Kingdom** government has also funded a broad package of AI skills and talent initiatives throughout the education pipeline, to address the skills gap, support citizens and businesses to take advantage of AI technologies and drive economic growth. The UK recently published a draft AI skills framework which outlines what skills and competencies workers will need to use AI in a business setting. The final version will be published in the spring of 2024, after expert stakeholder feedback. The UK is also piloting a flexible AI upskilling fund to support SMEs in the Professional and Business Services sector to deliver AI training to their employees. £6.4m of grant funding is available, and businesses will be able to bid for funding when applications open in May 2024. Successful applicants will receive 1:1 match-funding to procure a wide variety of AI skills training from the market, as suits their business need."[232]

Canada mentioned that its "Budget 2024 included a commitment of $50 million over four years, starting in 2025-26, to support workers who may be impacted by AI, such as creative industries. This support will be delivered through the Sectoral Workforce Solutions Program, which will provide new skills training for workers in potentially disrupted sectors and communities."[233] Additionally, "the Third Pillar of the Pan-Canadian AI Strategy is Talent and Research, which is in part managed by the Canadian Institute for Advanced Research (CIFAR). CIFAR is enhancing programs to attract, retain and develop academic research talent, and maintain centres of research and academic training at Amii, Mila, and the Vector Institute. In addition, CIFAR is renewing its advanced research, training, and knowledge mobilization programs."[234]

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231. Information provided directly by the French government.

232. Information provided directly by the government of the United Kingdom.

233. Information provided directly by the Canadian government.

234. Information provided directly by the Canadian government.

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Chart 37 | AI Business: Labor Market

G20 member countries that reported to the presidency

6.1) Does your country have a strategy to respond to the impacts of AI on the labor market?
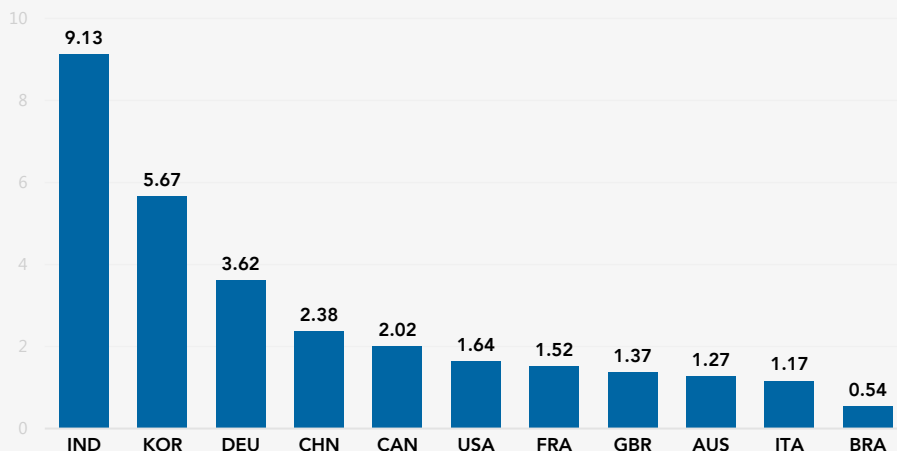
13	2	2

■ Yes ■ No, but in the process ■ No, and not in the process ■ NA

Source: AI Capacities in G20 Countries Survey.

Available Measures of Reported Skills Related to Artificial Intelligence or Occupations

One of the challenges to understanding the dynamics of Artificial Intelligence in the job market is its interdisciplinary nature, preventing a complete link between academic training and professional performance. One of the available ways to try to overcome this problem is the analysis of self-declaration of skills and occupations available via LinkedIn. Stanford University's AI Index compiles the proportion of LinkedIn users who reported skills related to Artificial Intelligence or occupations in the area, taking into account the total number of users in each country. According to this metric, **India** leads, with 9.3% of its LinkedIn users with AI skills or occupations, followed by **South Korea** and **Germany**.

Chart 38 | AI Talent Concentration

Proportion of LinkedIn members with AI talent, 2021

Country	Value
IND	9.13
KOR	5.67
DEU	3.62
CHN	2.38
CAN	2.02
USA	1.64
FRA	1.52
GBR	1.37
AUS	1.27
ITA	1.17
BRA	0.54

Source: LinkedIn, 2021 in AI Index Report 2022.

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Given the interdisciplinary nature of AI development and solutions within organizational contexts, relating AI-related skills becomes a complex task. As a general-purpose technology, AI encompasses a wide range of professions and activities. One way to assess the penetration of individuals working with AI is through the AI Index Report from Stanford University. Using Lin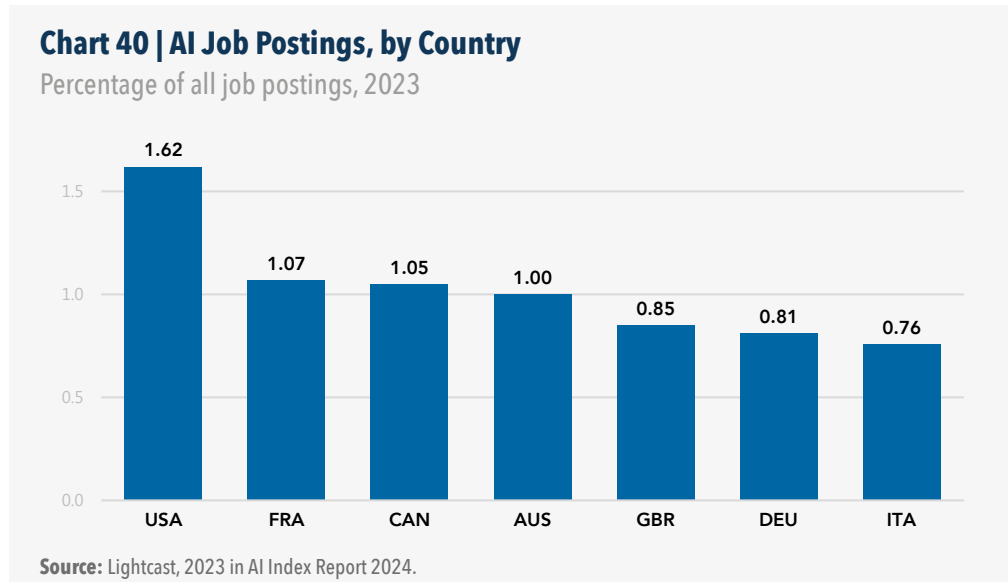kedIn user data, it is possible to establish a metric of AI penetration within occupations and by country: Comparatively, **India** has 2.75 times more people working in AI than the global average, followed by the **United States** (2.2) and **Germany** (1.9).

Chart 39 | Relative AI Skill Penetration

Proportion of LinkedIn members with AI talent, 2021

Country	Value
IND	2.75
USA	2.22
DEU	1.9
CAN	1.67
GBR	1.63
FRA	1.48
KOR	1.35
BRA	1.21
ITA	1.08
CHN**	0.90
AUS*	0.89

Source: LinkedIn, 2021 in AI Index Report 2022.
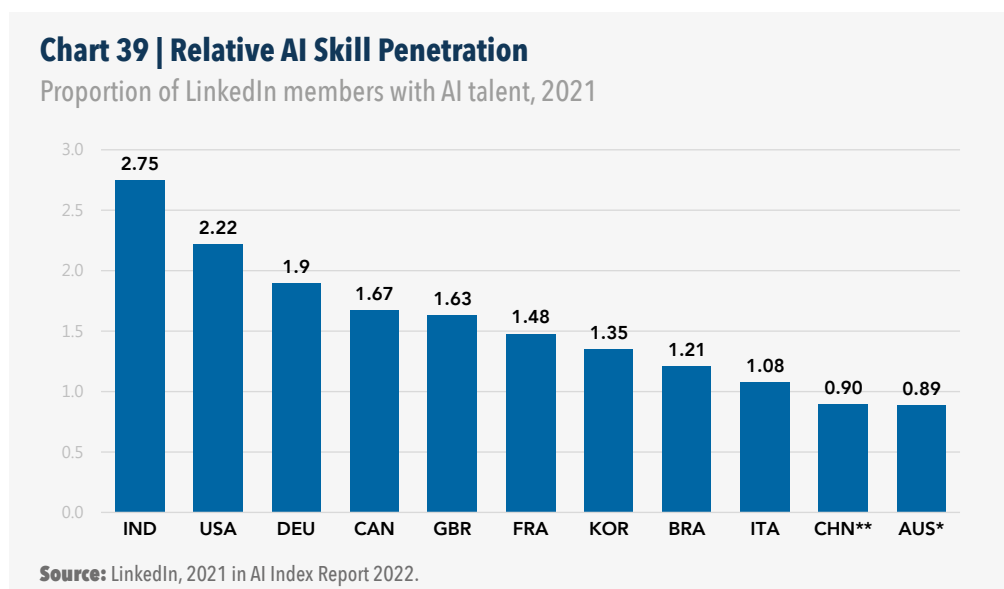
Evaluating the Number of Job Openings

Evaluating the number of job openings within the AI field can be challenging due to the technology's limited presence in the everyday operations of companies and the uncertainties these companies face regarding what to require from professionals. One way to analyze the availability of AI-related occupations is by examining job listings on recruitment websites. The AI Index from Stanford provides data on job openings across various sites, which can indicate the size of the AI job market, or at least the extent of demand by companies for qualified professionals. Among all online job postings in each country, the **United States** leads with 1.62% related to AI, followed by **France** (1.07%) and **Canada** (1.05%). In the case of the **United States**, it is worth noting the presence of major AI-producing companies and a well-established technology market. However, it
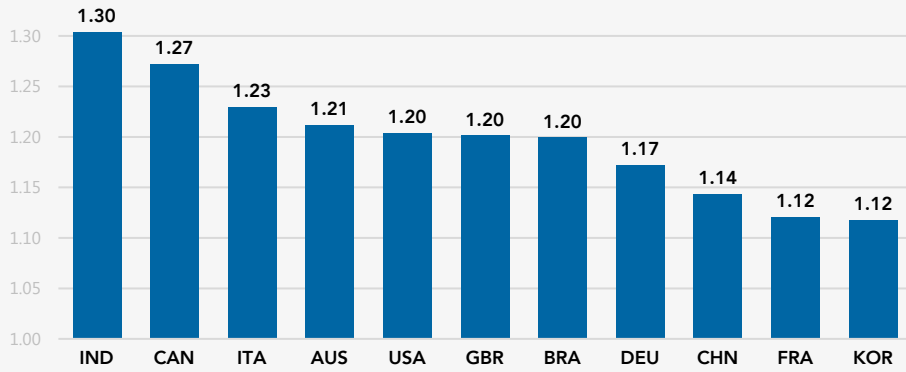
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is important to highlight that AI-specific job openings do not reach 2% of the total job listings in any of the countries mentioned.

Chart 40 | AI Job Postings, by Country

Percentage of all job postings, 2023

Source: Lightcast, 2023 in AI Index Report 2024.

Using data from LinkedIn compiled by Stanford University's report, it is possible to analyze a measure of the job market's activity in Artificial Intelligence. By examining LinkedIn users with AI skills who have added new jobs, relative to the total number of users in the same location, the report offers insight into how much companies are actively seeking new professionals. For example, using 2016 as a reference year, the graph demonstrates that in 2021 there was a 1.30 times greater demand in **China**. From the analysis of the hiring index, it can be inferred that there is indeed a demand for AI-related professionals. However, it cannot be conclusively proven that this job market is heating up, as all countries exhibit the same level of hiring intensity.

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Chart 41 | Relative AI Hiring Index, by Country

Average month in 2016 as 1, numbers above 1 indicate an increase and below 1 indicate a decrease in workers with AI Skills or AI-related occupations

Source: LinkedIn, 2021 in AI Index Report 2022.

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G20 Guest Countries Strategies for AI Impacts on the Labor Market

Guest countries have been elaborating and implementing different strategies to deal with the impacts of AI on the labor market. "The **UAE** has launched an initiative to reskill, retool, and retire UAE employees whose current jobs will be affected by AI."[235]

Denmark, **Portugal**, and **Spain** have fostered broad digital capabilities, including AI. In **Denmark**, as part of the Denmark Digitalisation Strategy – Together for the Digital Development, "one important initiative is to strengthen further education and training in order to maintain and expand highly specialized IT experts, including AI experts."[236] In **Portugal**, "Portugal INCoDe.2030, in its Axis 2 - Training, Qualification and Re-qualification, promotes a series of professional training programs and initiatives focusing on digital skills that are valued for the integration and reintegration in the labor market."[237] In **Spain**, "the National Artificial Intelligence Strategy (ENIA) Strategic Line 2 promotes fostering digital capabilities, the empowerment of national talent and the attraction of global skills in the field of AI."[238] The county also has a "Scholarship Program in AI and Enabling Technologies and programs to attract and retain research talent."[239]

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235. Information provided directly by the government of the United Arab Emirates.
236. Information provided directly by the Danish government.
237. Information provided directly by the Portuguese government.
238. Information provided directly by the Spanish government.
239. Information provided directly by the Spanish government.

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