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AMERICA

G20.AI
NATIONAL STRATEGIES, GLOBAL AMBITIONS

Wild West | Assertive East | Elusive Middle Ground

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I.

EXECUTIVE SUMMARY

"If a machine is expected to be infallible, it cannot also be intelligent."

Alan Turing[1]
English mathematician
(1912–1954)

Many countries have launched their national strategy documents on Artificial Intelligence (AI) in recent years; in the last five years alone, more than 60 did so, following Canada which was the first to release its document in 2017. In Europe, 20 member states of the European Union (EU), and Norway, had published their national AI strategies by 2021.

This report, *G20.AI: National Strategies, Global Ambitions,* gives an overview of the AI strategies of G20 countries. It is the second in a series of ORF reports on AI, the first of which was published in 2018 and laid out the national strategies of 12 countries that had released theirs at the time.[2] It is vital to understand G20 approaches to optimising the benefits of this transformational technology, as India prepares to take the G20 presidency in December 2022.

Fifty years after the internet was born, public outcry against surveillance technologies is forcing governments to rewrite the norms of the public square in the digital, networked era. A rethinking of the economics is underway: How much automation is politically and economically sustainable? Meanwhile, algorithms are toying with social faultlines; those with access to cryptocurrency and a 5G-smartphone are challenging central banks and bankers; and angry short sellers banding together on Reddit are threatening the clout of hedge funds. A great transition is afoot, and at the heart of this churning is AI.

As countries and companies conduct AI research and deploy the technology in the public sphere, who is to police it and how? The past year has laid bare the weaknesses of, and the threats to digital democracy. The demand for tech companies to ensure algorithmic fairness, accountability, transparency, and ethics has become louder. Large, private-owned platforms designed and anchored in Anglocentric worldviews push the kind of free speech absolutism that is in conflict with laws in most democracies. Moreover, these same companies have long had a stranglehold on the AI agenda,[3] and they must be scrutinised.

The influence of these companies covers a massive terrain: Facebook alone has 3 billion users; Twitter has 300 million; and many individual "influencers" have millions of followers. As the populations of social media users across the globe expand exponentially,

regulators are scrambling to catch up. Indeed, a clash of norms is upon the world. This is very different from how it was in the 1990s, when the internet first evolved from being an obscure research network into something that millions of people used in their everyday lives. At that time, the public was told that more participation in the digital world would strengthen democracy. Thirty years since, certain countries have succeeded in using the internet as a means to interfere with the elections of other sovereign countries; there has been a rise in the incidence of State-sponsored malicious cyber activity; tech companies have begun to stockpile and sell data, provoking privacy concerns; and social media platforms have become potent vectors for the spread of misinformation and disinformation, turning people against one other and dividing societies.

A Deloitte global survey of 500 government leaders in 2021 found that 92 percent of respondents at the federal level, 95 percent at the state level, and 84 percent at the local level are of the view that AI is "mission critical" over the next five years.[4] At least half of those surveyed listed gaps in skills as a crucial reason for the inability of governments to utilise AI applications in the most effective manner.

Indeed, many lower- and middle-income economies are taking ambitious steps in AI innovation. Geographies like India, for example—where the scale of societal problems is massive and the solutions are complex—are witnessing the proverbial snowball effect: it is not any one line item that tips the scales but simultaneous, cutting-edge developments. The results are remarkable: A Nasscom report[5] lists India as a promising nation for innovative technology. India has filed over 6,000 applications for AI patents over the last decade, more than 94 percent of which were in the past five years alone.

To be sure, the politics of this process is unavoidable, as it has been in earlier innovation cycles. The shifts in technological expertise from the fabled locale of Silicon Valley to formerly colonised swathes of the Global South are combining to create an undeniable force. What is similar across nation states trying to come up with strategies for artificial intelligence? For one, the careful dance around definitions of 'fairness' and the nebulous construct of AI ethics.

The contours of this story are changing in national and cultural contexts, but the idea that technological systems normally preserve existing hierarchies and power structures continues to hold true in more ways than what are immediately obvious. Where do countries stand on the promise and the peril of AI? How are they articulating it in government agendas? Observer Research Foundation presents Round Two of a global snapshot: *G20.AI: National Strategies, Global Ambitions.*

1   Lecture to the London Mathematical Society, 20 February 1947. Quoted in B. E. Carpenter and R. W. Doran (eds.), A. M. Turing's Ace Report of 1946 and Other Papers (1986); Alan Turing has played a pivotal role in laying the foundations of artificial intelligence and theoretical computer science.

2   Samir Saran, Nikhila Natarajan and Madhulika Srikumar, *In Pursuit of Autonomy: AI and National Strategies,* India, ORF, 2018, https://www.orfonline.org/wp-content/uploads/2018/11/Ai_Book.pdf.

3   David Rotman, "How to solve AI's inequality problem", *MIT Technology Review,* April 19, 2022, https://www.technologyreview.com/2022/04/19/1049378/ai-inequality-problem/.

4   Edward Van Buren, William Eggers, Tasha Austin and Joe Mariani, *Scaling AI in Government,* Deloitte, December 13, 2021, https://www2.deloitte.com/us/en/insights/industry/public-sector/government-ai-survey.html.

5   Tanmay Tiwari, "Over 5,000 IoT patents filed in India over the last 5 years: NASSCOM", *Techcircle*, June 5, 2020, https://www.techcircle.in/2020/06/05/over-5-000-iot-patents-filed-in-india-over-the-last-5-years-nasscom

II.

RATIONALE AND METHODOLOGY

The substantive frame of this report is limited to the national AI strategies of G20 countries. (Table 1 lists the current status of national strategies and approach documents as of March 2022.) This report analyses the domestic agenda and capabilities of each nation in the context of its global priorities, using a combination of textual analysis and cross-referencing a common pool of AI strategy reports. Throughout the analysis, US–China relations serve as a backdrop.

Table 1. National AI Strategies/Approach Documents of G20 economies

Country	Strategy Document	Published
Argentina	Plan Nacional de IA Gobierno de Argentina - IALatam[6]	2019
Australia	Australia'a AI Action Plan[7]	2021
Brazil	Inteligência Artificial – Português[8]	2021
Canada	Pan-Canadian AI Strategy - CIFAR[9]	2017
China	Next Generation AI Development Plan [新一代人工智能发展规划][10]	2017
France	AI For Humanity[11]	2018
Germany	Artificial Intelligence Strategy of the German Federal Government[12]	2020
India	India's National Strategy for Artificial Intelligence[13]	2018
Indonesia	Strategi nasional kecerdasan artifisial indonesia.[14]	2020
Italy	Artificial Intelligence Strategic Programme 2022-2024[15]	2021
Japan	AI Strategy 2019 Governance Guidelines for Implementation of AI Principles[16]	2019
Korea	National Strategy for Artificial Intelligence: Toward AI World Leader beyond IT[17]	2019
Mexico	Towards an AI Strategy in Mexico[18]	2018
Russia	Decree of the President of the Russian Federation on the Development of Artificial Intelligence in the Russian Federation - Centre for Security and Emerging Technology [19]	2019
Saudi Arabia	Realising Our Best Tomorrow[20]	2020
South Africa	Not yet released	

	Turkey	National AI Strategy 2021-2025[21]	2021
	United Kingdom	National AI Strategy[22]	2021
	United States	National AI Initiative Act of 2020[23]	2019
		Artificial Intelligence for the American People[24]	
		Maintaining American Leadership in Artificial Intelligence (Executive Order)[25]	
		2021 Final Report - NSCAI (Recommendations)[26]	
	European Union	Coordinated Plan on Artificial Intelligence 2021 Review[27]	2021

This leaderboard reflects the relative overall strength of each G20 country's AI strategy as reflected by the totality of its national strategy documents. The countries on the outermost edge of the circle emerge the strongest. The US and China lead the pack, followed closely by countries in the inner circles. Each country's spot is based on its performance on four parameters that thread the entire report together: research and development, AI workforce, ICT infrastructure, and the data ecosystem.

In some countries where one incumbent government had published a strategy document and the successive government is shaping its own version, this report refers to the entire combination of those documents, presuming them to speak of the nation's strategic bent. In the United States (US), for example, the Donald Trump administration released the document, *Artificial Intelligence for the American People*[28] in 2019 and the *National AI Initiative Act of 2020*[29] came into force a fortnight before Joe Biden took over the presidency. Within a month, the National Security Commission on Artificial Intelligence issued a 756-page blueprint outlining steps that the US Government should take to "win" in the AI era. In this case, this analysis considers the totality of the recommendations across the different documents.

This study utilises four parameters that thread together all the G20 AI documents and are fundamental to building an AI ecosystem: Research and Development (R&D); Skills; ICT Infrastructure; and Data Ecosystem. The national strategy documents share these common elements, allowing the authors to compare the level of specificity that each country accords to each pillar, their definitional boundaries, and the domestic priorities that may be animating the different approaches.

This analysis also uses the following resources for context and comparison: *Building an AI World: Report on National and Regional AI Strategies*[30] (Canada); Global AI vibrancy tool[31] (Stanford Institute for Human-Centred Artificial Intelligence); the *Global AI Strategy Landscape*[32] (Holon); *The AI Policy Observatory*[33] (OECD) that tracks 700 AI policy initiatives from 60 countries, territories and the EU; the *Global Innovation Index*[34] (World Intellectual Property Organisation); AI Index[35] (Stanford Institute for Human-Centred Artificial Intelligence); AI Readiness Index[36] (Oxford Insights); Investment Tracker[37] (Georgetown Centre for Security and Emerging Technology); Data Protection and Privacy Legislation Worldwide[38] (United Nations Conference on Trade and Development); Network Readiness Index[39] (Portulans Institute); and Global Talent Competitiveness Index (INSEAD).[40]

The strength of each country's AI strategy is illustrated on a radar plot and the surface area of the plot indicates each country's relative strength. The farther out the nodes for each parameter are on the plot, the stronger the strategy, and vice versa.

Like any analysis that involves a close reading of documents issued by governments, this report is limited in qualitative interpretations of technological, geopolitical, and strategic details. Government strategies may not reveal the full gamut of applications that are under consideration or even the shifts in strategy based on new information that is available to the government but not yet in the public domain. Despite these limitations, this report is part of ongoing efforts by the Observer Research Foundation to understand the broad trajectory in which a transformational technology is affecting governmental actions.

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22   Office of Artificial Intelligence, *National AI Strategy 2021*, United Kingdom, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1020402/National_AI_Strategy_-_PDF_version.pdf.

23   House of Representatives, *National Artificial Intelligence Initiative Act, 2020,* United States https://www.congress.gov/116/crpt/hrpt617/CRPT-116hrpt617.pdf#page=1210.

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27   European Commission, *Coordinated Plan on Artificial Intelligence 2021 Review,* 2021 https://digital-strategy.ec.europa.eu/en/library/coordinated-plan-artificial-intelligence-2021-review.

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29   House of Representatives, *National Artificial Intelligence Initiative Act, 2020,* United States https://www.congress.gov/116/crpt/hrpt617/CRPT-116hrpt617.pdf#page=1210.

30   Tim Dutton, Brent Barron, and Gaga Boskovic, *Building an AI World: Report on National and Regional AI Strategies*, CIFAR, 2020, https://cifar.ca/wp-content/uploads/2020/05/buildinganaiworld_eng.pdf.

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III.

G20 NATIONAL
A.I. STRATEGIES

ARGENTINA: A.I. BOOM AMIDST ECONOMIC UPHEAVAL

AI FOR SDGs

SHOCK-PROOFING DOMESTIC TECHNOLOGY ENTERPRISES

REGULATORY LAGS

"Digital innovation is an increasingly important engine of economic growth and human development. Argentina faces the challenge of maximizing the opportunities offered by this [digital] transformation and, at the same time, ensuring that all of society has access to its benefits."

Andrés Ibarra
Former Vice
Chief of Staff and
former Minister of
Modernization of the
Argentine Republic
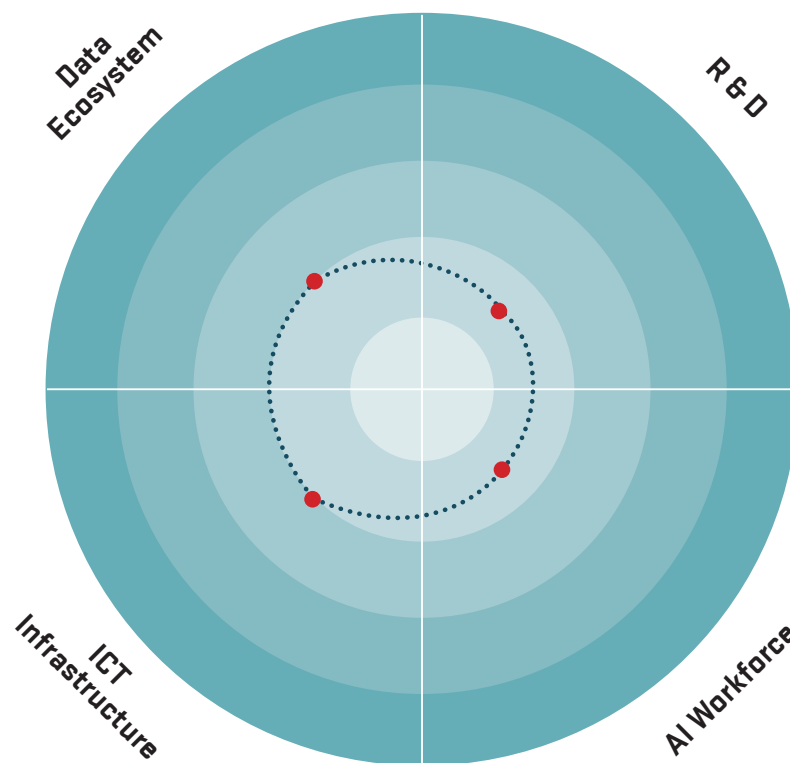
OVERALL STRATEGY

Argentina has been making concrete attempts at deploying AI in the public sector. For instance, AI systems such as Prometea[41] have been deployed to identify urgent court cases and reduce administrative workload in court proceedings and Technology Platform for Social Intervention[42] (TPSI) has been deployed to predict teen pregnancies and prevent school dropouts. Prometea has sparked positive interest to expand the use of the platform for automating tasks from over 60 organisations including the United Nations, University of Oxford, and Organisation of American States.[43] TPSI, however, has received public criticism for policing young women's bodies: it sells itself as being able to identify young women that it calls "predestined" for early pregnancy; this, absent accountability mechanisms in place against the misuse of AI. Ana Pérez Declerq, a vocal opponent of TPSI and Director of the Observatory of Violence Against Women has said, "[The technology program] is a patriarchal contrivance."[44]   *The Plan ArgenIA* or *the National Plan for AI,*[45] released in 2019, seeks to address similar ethical concerns in AI deployment in Argentina through, for instance, setting up a committee for monitoring and evaluating AI use.

The Government of Argentina began working on the National Strategy on AI in 2018 in consultation with over 400 experts and 80 enterprises gathered in creative workshops and various conferences and meetings. The strategy was developed in line with both the *National Strategy for Science, Technology and Innovation*[46] and the *Argentine Digital Agenda.*[47] The ensuing strategy document, *Plan ArgenIA*, was however not ratified by the Mauricio Macri administration after its launch. Therefore, it has yet to be implemented, and serves only as a reference document for the current Alberto Fernández administration.[48]

The Plan has proposed a multi-sectoral approach to fostering an enabling environment that will ensure inclusive and economic development and utilise AI for the achievement of the Sustainable Development Goals (SDGs). This is an important objective as Argentina has been struggling to meet its SDG targets—a situation that is compounded by its foreign debt obligations.[49]   By facilitating collaboration among stakeholders, the Plan seeks to embrace the realities of the global order while accounting for domestic needs and readying domestic AI solutions such as Prometea and TPSI for export. The Plan has identified specific objectives to foster talent development, supercomputer infrastructure, R&D, public and private sector implementation of AI, data governance, and innovation laboratories, as well as to raise public awareness with a focus on ethics and regulation. The government has yet to allocate a budget as part of this plan, but has ordered the concerned ministries to communicate their requirements from the federal budget for AI development and deployment.

RESEARCH & DEVELOPMENT

The country provides a strong entrepreneurial ecosystem for innovation focused on employing AI for SDGs.[50] It is home to around 6,000 technology startups, of which those like Globant, Mercado Libre, and Despegar have reached unicorn status. To ensure that the volatility of the economy does not hamper the growth of entrepreneurship, the Plan has proposed initiatives such as the creation of a National Fund of Entrepreneurial Capital, modifications in legislation to support ease of doing business, tax benefits for individuals investing in SMEs, and establishment of innovation labs.

AI WORKFORCE

Companies like Google, Facebook, Microsoft, and JP Morgan and Chase have opened offices in Argentina to source cheap talent from reputed AI universities in the country.[51] However, this creates a shortage of professionals who are willing to work in domestic SMEs and startups. To address the shortage in the long term, the Plan proposes to include programming and AI in school curricula, and increase investments in digital education. It also proposes increasing the number of AI-related degrees and scholarship programmes. The Plan has also set its focus on skilling trainers, re-skilling existing workforce, and developing a strategy to communicate the risks and benefits of the use of AI.

ICT INFRASTRUCTURE

Bahía Blanca is one of the cities in the province of Buenos Aires to have been awarded the title, *Pais Digital* (digital country). Based on the foundations of Open Knowledge and Open Data, the city has transformed governance through innovation projects and transparency to facilitate the adoption of emerging technologies. The city has the highest percentage of households in the country using the Internet. However, overall, the country average for broadband use is only 16 percent.[52] Investment in ICT is one of the priority areas for 2020-23 as part of *Plan ConectAR*,[53] focusing on improving existing 4G connectivity and deploying 5G through fibre optics and satellites, along with increasing the use of cloud computing. The 5G spectrum allocation auction could happen in 2022-23. However, the deployment can reach only 9 percent of the total population by 2025, according to a recent report published by Global Systems for Mobile Communications,[54] given issues of high prices on telephone and internet services amidst rising inflation.

DATA ECOSYSTEM

Access to structured, labelled and real-time data is a massive challenge in Argentina. While acknowledging the importance of data sharing, the Plan has identified cooperation agreements and strategies to facilitate data exchange between private and public sectors. *Decree No. 1273/2016* sets the foundation for facilitating interoperability and data exchange through the Argentine Data Interoperability Platform, and *Decree No. 117/2016* with Law on Access to Public Information seeks to establish an open data policy for public administration.[55] The open data policy has allowed the general public to access 980 data sets collected by 33 public administrations. To address the issues of labelling and benchmarking, the Executive Branch also released a *Guide for Publishing Data in Open Formats* and the *Identification and Use of Interoperable Entities*[56] to provide best practices and policies in one place. The Data Protection Law focuses on ensuring transparency on the decisions made by AI systems on the logic used, source of information, and relevance.[57]

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AUSTRALIA: AT THE HELM OF A.I. WAVES

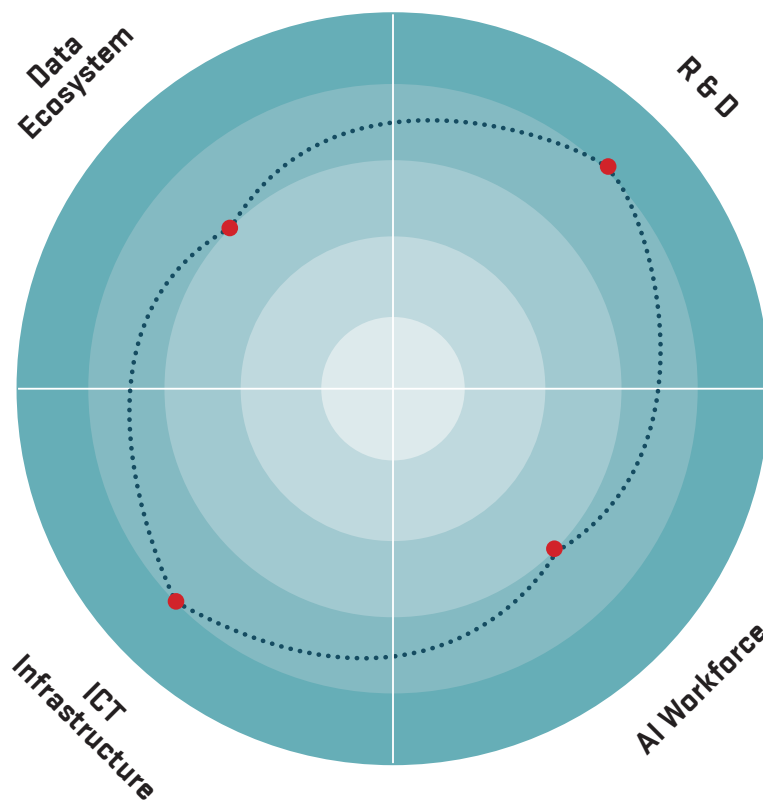**COORDINATED WHOLE-OF-ECONOMY APPROACH**

SEARCH FOR LIKE-MINDED COUNTRIES

ESTABLISHING LEADERSHIP ON AI RESEARCH COMMERCIALISATION

"Partnerships matter."

Scott Morrison
Former Prime Minister
of Australia

OVERALL STRATEGY

A ustralia aspires to be a global leader in developing and adopting trusted, secure and responsible AI[58] by 2030 and maximising the economic opportunity of the nearly US $20 trillion that AI presents to the global economy. The *AI Action Plan,*[59] released by the Scott Morrison government in June 2021, is a core element of Australia's overarching *Digital Economy Strategy 2030.*[60] The action plan has outlined a mix of AI direct measures, programs to enhance digital skills and technology, and foundational changes to the policy ecosystem. The demand for increased domestic investment in AI[61] to ensure commercialisation of research is being gradually heard, and the plan allocates greater resources to the sector.

At the inaugural Sydney Dialogue in November 2021, then Prime Minister Morrison declared, "Partnerships matter."[62] In the same address, the prime minister discussed the international partnerships forged by Australia in recent years to augment standards-setting and AI development. As exemplified in the *International Cyber and Critical Technology Engagement Strategy,*[63] the international rules based order for securing democratic freedoms has been the guiding light of all multilateral and bilateral partnerships initiated and sustained by Australia.

In September 2021, Australia entered AUKUS—the trilateral security partnership with the UK and the US[64] with a broader focus than gaining access to nuclear submarines. The trilateral efforts will focus on "cyber capabilities, artificial intelligence, quantum technologies, and additional undersea capabilities." With India, Japan, and the US part of the Indo-Pacific Quadrilateral Security Dialogue or Quad,[65] the focus is to build resilient supply chains in the region and design common technical standards on AI, telecommunications, 5G, and semiconductors against vulnerabilities and disruptions. Australia is closely collaborating and working in partnership with forums such as the Global Partnership on AI (GPAI), Association of Southeast Asian Nations (ASEAN), Organisation for Economic Co-operation and Development (OECD), and G20 as well.

Australia has also been leveraging domestic networks to enhance AI adoption and to commercialise AI research at a rapid pace. The national plan has drawn insights from multiple stakeholder discussions and *Techtonic,*[66] the government's national AI summit. The country also released a *Blueprint for Critical Technologies*[67] in December 2021 to promote the use of 63 critical technologies while collaborating with like-minded countries to maximise the economic opportunities offered by critical technologies, preserving national interests, and challenging China's dominance in the technology domain.

RESEARCH & DEVELOPMENT

The Australian Department of Industry, Innovation and Science co-developed, *Artificial Intelligence: Solving problems, growing the economy and improving our quality of life*[68] in November 2019 with Commonwealth Scientific and Industrial Research Organisation (CSIRO)'s Data 61,[69] the government's corporate entity to identify areas for AI specialisation. Priority areas include facilitating the development and adoption of AI to improve domestic and international standing on healthcare, city infrastructure, and natural resources management.

Australia has made significant progress in the three sectors and is in the process of implementing various programs and projects as part of the *Modern Manufacturing Strategy*[70] to assist in the commercialisation of academic research and startup ideas with US$1.04 million accelerators for AI scale-ups.[71] The government also established the National Artificial Intelligence Centre[72] in December 2021 to foster collaboration between SMEs, industry, and researchers on responsible AI as part of the targeted earmarked budget under the AI Action Plan. In collaboration with the University of Adelaide and the South Australian Government, a Centre for Augmented Reasoning was also instituted with US$13 million to stimulate innovation and research on AI.

AI WORKFORCE

Australia is leading the world in AI research, with its academic publications being cited[74] more than those of other countries. However, there remain gaps in the skills needed to drive innovation and commercialisation of research. The Government has been making concerted efforts to address skill shortages with the AI graduates program, targeted scholarships, increased international research partnerships, digital and cyber skills programmes, and the University Research Commercialisation Scheme.

CSIRO is also conducting scholarship programs[75] to retain and attract AI job-ready specialists.

The country has adopted several proposals to address the skills gaps for a new generation of workers and build digital literacy training for company directors under the Australian Small Business Advisory Service's Digital Solutions Program.[76] To ensure diversity in the workforce, various initiatives have also been introduced, including Boosting Female Founders[77] and Boosting the Next Generation of Women in STEM.[78] These initiatives aim to support, grow, and scale startups by women in domestic and global markets.
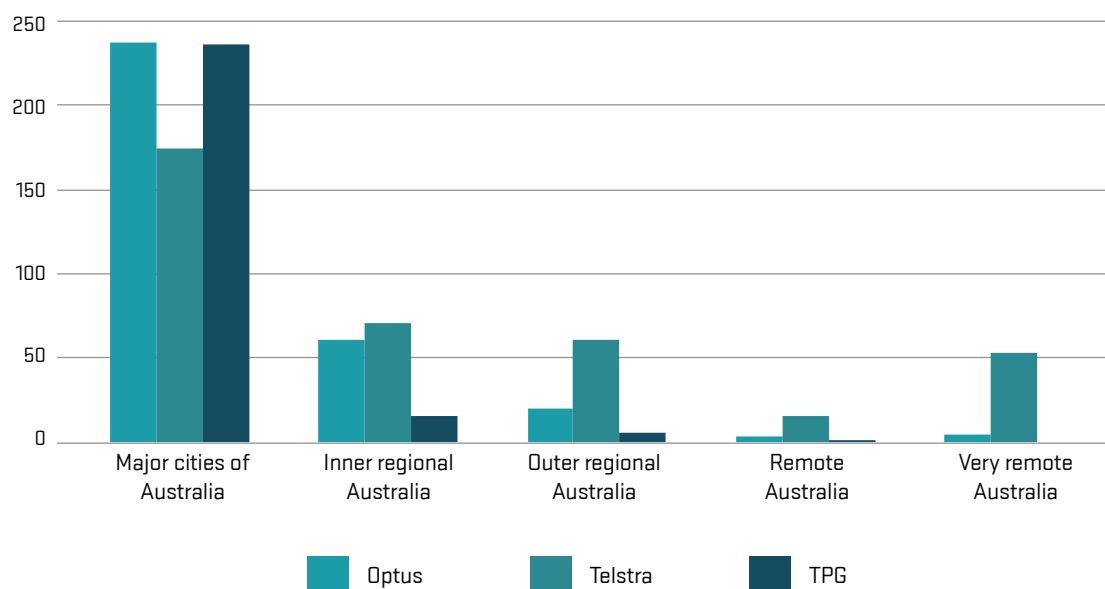
ICT INFRASTRUCTURE

The Australian government had introduced the National Broadband Network project[79] to upgrade the domestic broadband infrastructure by 2020. While the Digital Inclusion Index has been gradually improving, 11 percent of Australians remain without access to digital services.[80] One of the central contributing factors for the exclusion is the high costs of reliable internet services. This divide could further increase[81] as mobile network operators prioritise the deployment of 5G spectrum bands in cities while regional Australia struggles to transition from 3G to 4G. Andrew Williams, the Australian Communications Consumer Action Network's acting chief executive echoed these concerns:[81] "While we understand that there are financial reasons for their [telecom companies] focus on the cities, it is still concerning to see the large disparity

between new sites rolled out into major cities and those being built in regional and remote Australia." Under the 2020–21 Budget's *JobMaker Digital Business Plan,* the country has extended support to businesses in evaluating and developing 5G use cases and products[83] could also be utilised to assist in the equitable adoption of 5G. The Digital Transformation Agency under the Australian government developed a *Secure Cloud Strategy*[84] in 2021 to support industries in transitioning to the cloud network and adopting agile methods of service improvement.

NUMBER OF NEW SITES BY MOBILE NETWORK OPERATORS & ABS REMOTENESS AREA – 2020 TO 2021

Source: Australian Competition and Consumer Commission, Mobile Infrastructure Report 2021, December 2021, https://www.accc.gov.au/system/files/Mobile%20Infrastructure%20Report%202021.pdf.

The New South Wales government is also planning to invest US$2.7 million in increasing the role played by Australia in the global semiconductor value chain[85] by launching a Semiconductor Sector Service Bureau (S3B).[86] It will be funded by the Australian government's Emerging Industry Infrastructure Fund and stakeholders will include universities, startups, design firms, and research organisations working on fabrication and packaging of semiconductors.

DATA ECOSYSTEM

Australia believes that data is a national resource and should be utilised for the growth of the economy, improvement in service delivery, and transformation of policy outcomes. To this effect, *data.gov. au*[87] has anonymised publicly accessible datasets published by local, state, and federal government agencies. *The Data Availability and Transparency (Consequential Amendments) Bill 2020*[88] was introduced in Parliament in December 2020 to facilitate access to public sector data and is currently under review. The Australian government is also updating and reviewing[89] the necessary changes to the Privacy Act 1988.[90] The government is also working on Australia's Data Strategy that attempts to maximise the value of data by instilling trust and ensuring greater use of data while protecting it.

The Australian government released a voluntary AI Ethics Framework in 2019 with a focus on eight principles that affirmed its commitment with OECD principles on AI.[91] The principle of contestability stood out as it allows the impacted person, community, or group—especially the vulnerable—to challenge the outcome. Most AI organisations in Australia are only now beginning to implement their versions of responsible AI.[92] To account for this and provide guidance for operationalising ethics principles, the AI Action has proposed initiatives such as sharing lessons from pilot implementation and using international forums to drive engagement.

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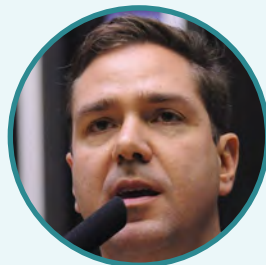# BRAZIL: READJUSTING FOR 4.0

PUBLIC SECTOR-LED
INNOVATION
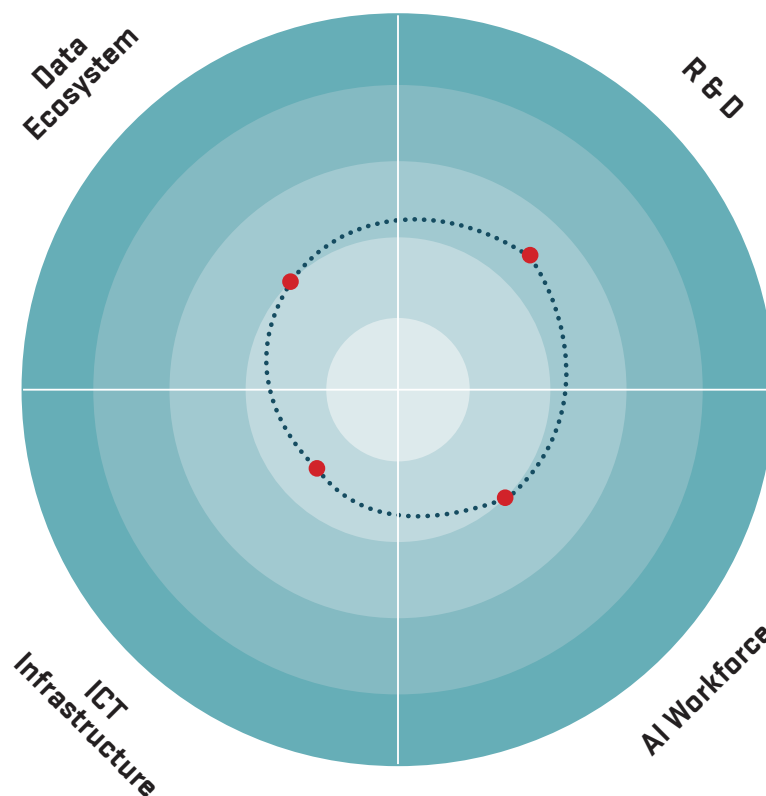
LEGAL ROUTE FOR
AI PRINCIPLES

INDUSTRY 4.0

"Artificial intelligence is already part of our reality. Now is the time to outline principles, rights and duties, and responsibilities."

Eduardo Bismarck
Member of the Chamber
of Deputies of Brazil

OVERALL STRATEGY

B razil is the only developing country within the G20 that has proposed a legal framework for AI to reduce its use across public and private sectors for abusive, illicit or discriminatory practices and protect fundamental rights. The regulatory objectives also include promoting competitiveness in the industry, re-skilling the workforce, and stimulating improvement of public service delivery using AI. The Chamber of Deputies approved the *Bill 21/20*[93] for AI regulation in September 2021 and is currently up for review with the Senate.

The bill was approved to provide legal certainty while acknowledging that this technology is dynamic and strict regulations could adversely affect foreign investment. As such, the bill lays down broad principles that encourage self-regulation and assign responsibility for enforcement to sectoral regulators through subjective liability.[94] Eduardo Bismarck,[95] Member of the Chamber of Deputies of Brazil, during the Chamber hearing noted that this would be the first step in defining Brazil's regulatory approach: "Artificial intelligence is already part of our reality, and Brazil will also enact other legislation in the future. Now is the time to outline principles, rights and duties, and responsibilities." The Bill sought inspiration from the

US's sectoral approach, the EU's risk-based governance, and OECD's AI recommendations.[96] Through Brazil's involvement in GPAI, OECD, and G20, it is actively fostering dialogue on AI standardisation and policy.

The Government of Brazil, with Ordinance No. 4617, published the *Artificial Intelligence Strategy (EBIA)*[97] in August 2021, a month prior to defining its regulatory approach on AI. The strategy is aimed at strengthening AI R&D along with ethical deployment to address the country's social and development challenges. The Ministry of Science, Technology, Innovations and Communications (MCTIC) is tasked with creating a map of best practices and coordinating implementation of the strategy with assistance from stakeholders across academia, the public sector, and private stakeholders. EBIA cuts across nine thematic axes and proposes strategic actions to achieve the vision including utilising AI-based tools by 2022 within approximately 12 federal public services.[98] The EBIA builds on the *Brazilian Strategy for Digital Transformation (E-Digital) Strategy, 2018-21*[99] released in March 2018 that aimed to harmonise digital initiatives by government agencies to achieve the SDGs. The E-Digital strategy also allocated resources towards Research, Development and Innovation (RD&I) on AI after evaluating its potential impacts.

RESEARCH & DEVELOPMENT

Since 2016, MCTIC has been working on providing financial incentives to startups, including tax exemptions and appealing tax rates, so they can kickstart AI projects that improve administrative activities such as social services, job advertisements, and citizen services. Under the *National Strategy for Science, Technology and Innovation (2016-2022),*[100] the country identified innovation as a priority. Marcos Cintra, President of Financiadora de Estudos e Projetos (FINEP) under the MCTIC, while underlining the importance of innovation stressed, "Therefore, within this strategy for 2035 innovation remains highlighted as priority... we are facing what we call the era of knowledge and this is how we can define what transforms information as a production factor."[101] FINEP, in partnership with MCTIC, launched *Public Selection Technologies 4.0* to provide economic subsidies to innovations within Health 4.0, Agro 4.0, Smart Cities 4.0, and Industry 4.0.[102]

While the domestic firms and businesses are gradually increasing their investment in R&D, innovation is significantly being pushed by public sector banks, with the Brazilian National Social and Economic Development Bank (BNDE) as investment partners and credit suppliers for the industry strategy.[103] The AI Advanced Institute was established in 2019 to

promote domestic collaboration between enterprises and academia on Research Development & Innovation (RD&I) projects on agriculture, infrastructure, environment, digital governance, smart cities, natural resources, environment, and security. Brazil is also actively engaging with international partners, such as China through the Sino-Brazilian Commission for High Level of Agreement and Cooperation's Science, Technology and Innovation subcommittee.[104] EBIA is also proposing new opportunities for collaboration and RD&I through public sector investments in research and addressing barriers to innovation, along with the creation of eight centres for applied AI research with funding up to US$1 million.[105] Despite Brazil's ambitious plan, the MCTIC witnessed a heavy impact of spending cuts in the budget in 2021. Marcos Pontes, MCTIC Minister, raised concerns against spending cuts in the Senate hearing.[106]

AI WORKFORCE

Brazil's investment priorities do not put education in the forefront.[107] Therefore, creating a stable AI workforce is a big challenge for the country in its quest to prepare for the Fourth Industrial Revolution (4IR). Nonetheless, between 2015-20, nine out of the 12 universities in Latin America that have excelled in their research and published papers on AI are in Brazil.[108] EBAI has emphasised the need to encourage investments in AI talent. The Secretary of State for Innovation, MCTIC, Paulo Alvim has also said, "It is strategic imperative for Brazil to train human resources, develop companies and produce research in the various fields of AI and digital technologies and thus overcome our fear of facing a new culture."[109]

"It is strategic imperative for Brazil to train human resources, develop companies and produce research in the various fields of AI and digital technologies and thus overcome our fear of facing a new culture."

Paulo Alvim
Secretary of State for Innovation, Ministry of Science, Technology, Innovations and Communications

NUMBER OF FIBRE BACKHAUL PROVIDERS PRESENT IN MUNICIPALITIES IN BRAZIL, 2019

Backhaul providers (fibre)	Number of municipalities	Share of municipalities (%)
0	1 558	28
1	1 350	24.2
2	1 031	18.5
3	593	10.6
4	406	7.3
5 or more	632	11.3

Source: Anatel (2020c), Plano Estrutural de Redes de Telecomunicações (PERT) 2019-2024, Atualizaçao 2020, https://sei.anatel.gov.br/sei/modulos/pesquisa/md_pesq_documento_consulta_externa.php?eEP-wqk1skrd8hSIk5Z3rN4EVg9uLJqrLYJw_9INcO4m2N1jXIPEu1rXnv7UHJFGKd-jO_xz5ZYqyuXgvKFPZe9U7a4FRauel0Ej_GJ3pzD2sKi_sQQhtHNHQk_javEK

ICT INFRASTRUCTURE

Investments in robust ICT infrastructure are a core part of the country's strategy. However, the high cost of digitalisation, compounded by cyber risks and the challenges in IT implementation, limit the growth of technology enterprises in Brazil.[110] The cost of fixed broadband,[111] and the consumer taxes for using mobile services, also lean on the higher side. As the country plans to implement 5G services, affordability and accessibility for citizens will remain a crucial concern. The Inter-American Development Bank approved a loan of US$1 billion to accelerate the connectivity programs and increase access to digital services, technologies, and skills.[112]

DATA ECOSYSTEM

One of the key outputs of the Public Information Access Law, 2011 is the Brazilian Open Data Portal that allows individuals or organisations to access data held by public agencies.

The country is currently working on introducing best practices of data cleaning and quality assurance. Brazil's General Data Protection Law[113] came into effect in September 2020 and mandates compliance mechanisms for companies along with legal parameters while defining the use of personal data, with a focus on transparency and fairness.

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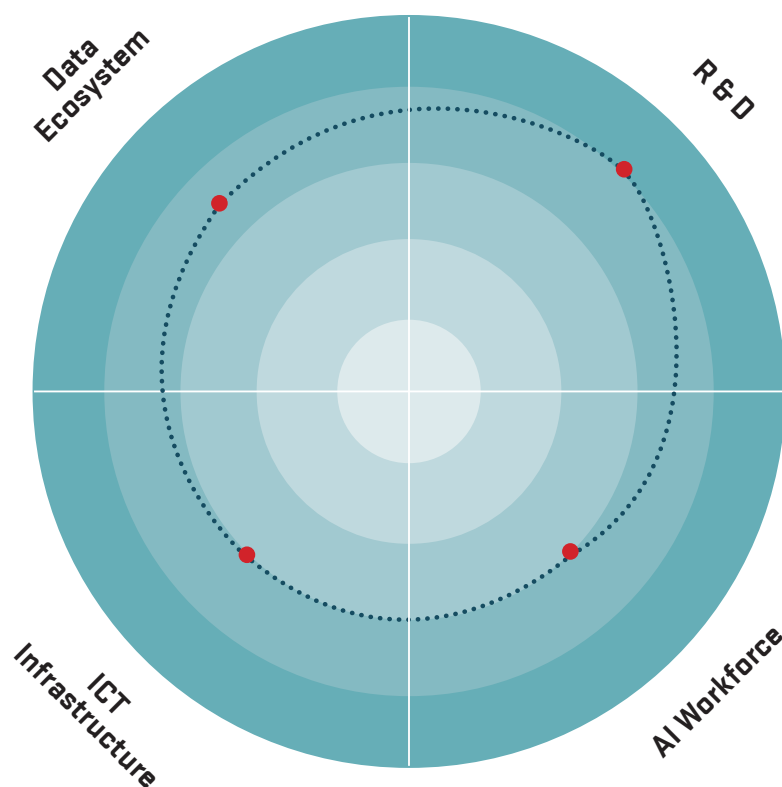
CANADA: FIRST OFF THE BLOCK

STRUGGLE TO RETAIN TALENT

FLEXING THE AI RESEARCH MUSCLE

THOUGHT LEADERSHIP ON RESPONSIBLE AI

Canada traces its long line of AI research programs to the 1980s when it launched 'AI, Robotics & Society' in 1983.

OVERALL STRATEGY

anada was the first country to release a national AI strategy, in 2017.[114] Since then, key indicators on AI investments have been increasing.[115] Google's DeepMind chose Edmonton for its first international location;[116] Microsoft hired over 75 employees for its Montreal research lab;[117] Thomson Reuters invested US$100 million in its Toronto Technology Centre;[118] and overall, there was a 50-percent uptick in foreign direct investment in information and communication technologies from 2017 to 2019. The country takes pride in its research muscle. Enhancing the country's visibility in AI research and training is among the five pillars of Canada's National AI Strategy. The following are the elements of this goal: generating world-class research and innovation; increasing collaboration with receptors of innovation across sectors; attracting and retaining AI talent; and translating AI research discoveries into applications for the public good.

Canadian technology spend on AI is projected to grow at 25 percent annually from 2018 to 2023.[119] One of every ten papers selected for oral presentations at the prestigious Conference and Workshop on Neural Information Processing Systems (NeurIPS) 2019

were authored by researchers based in Canada.[120]   Canada boasts more than 100 top-tier researchers who oversee laboratories at universities across the country, many of whom are Canadian Institute for Advanced Research (CIFAR) AI (CCAI) Chairs.[121] They include 2018 ACM A.M. Turing Award winners Yoshua Bengio and Geoffrey Hinton, as well as influential machine-learning researchers Richard Sutton, Jimmy Ba, Aaron Courville, and Joelle Pineau. Over the past two years, Canada's AI research leaders have collectively published over 4,000 research papers, and trained over 2,400 master's and doctoral students.[122]

The Montréal Declaration on Responsible Development of Artificial Intelligence,[123] launched in December 2018, is recognised internationally as one of the high-profile initiatives for responsible AI. It is a set of ethical guidelines for AI development, led by Université de Montréal in collaboration with the Fonds de Recherche du Québec, citizens, experts, public policymakers, industry stakeholders, and civil society organisations. It is built upon 10 principles and eight recommendations that promote the fundamental interests of people and groups. Internationally as well, Canada has been a champion of responsible AI. During Canada's G7 presidency in June 2018, Canada and France founded the GPAI.[124] In 2020, UNESCO engaged with the Mila and Algora Lab (UdeM) to lead a global online consultation on AI ethics. The goal is to build the first global normative instrument to address the developments and applications of AI.

Canadian technology spending on AI is projected to grow at 25 percent (annually from 2018 to 2023).

Source: Pan-Canadian AI Strategy Impact Assessment Report, October 2020
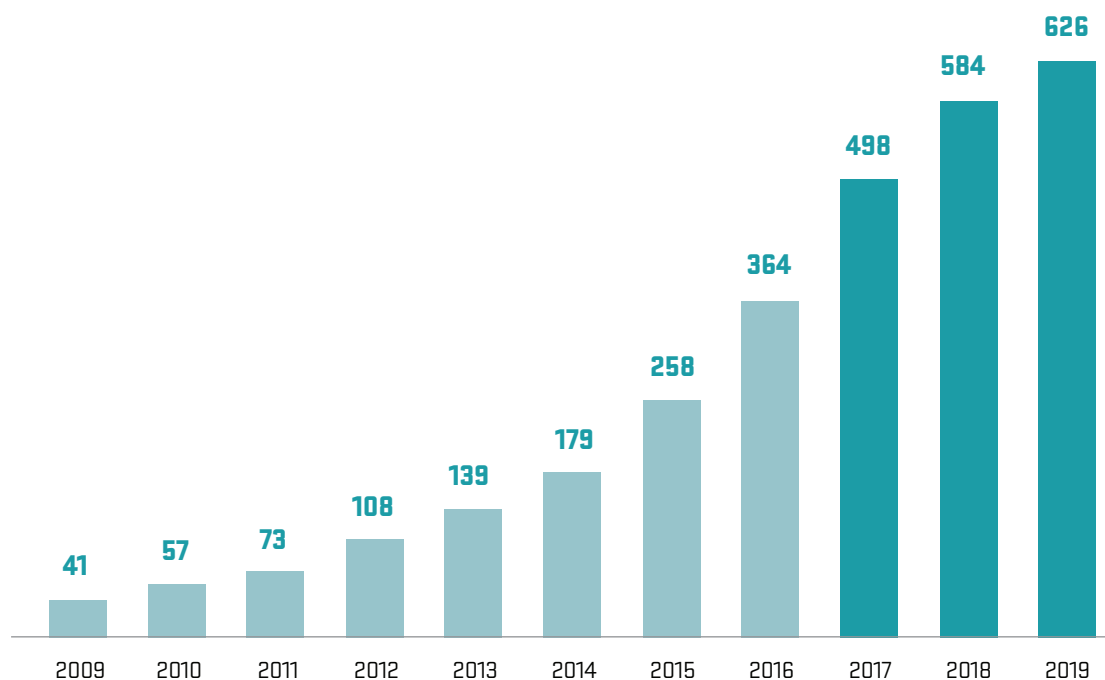
RESEARCH & DEVELOPMENT

The Pan Canadian Impact Assessment Report[126] released in late 2020 offers an efficient summary covering investment since 2016 (over a billion US dollars, if including embedded AI), patents from 1998–2017, and researcher count. True to form and strategy, Canada's R&D focus leans heavily on intellectual firepower. The Canada CIFAR AI Chairs program retained and recruited 80 world-class researchers in the territory. In 2019, according to SCOPUS, Canada published some 2,054 AI papers with a consistent annual growth rate of 4 percent. Canada maintains an H-Index of 216 and is ranked 4th globally for AI out of 239 countries worldwide.[127]

NO. OF AI FIRMS LOCATED IN CANADA

Year	Number
2009	41
2010	57
2011	73
2012	108
2013	139
2014	179
2015	258
2016	364
2017	498
2018	584
2019	626

Source: Accenture & CIFAR, Pan-Canadian AI Strategy Impact Assessment Report, October 2020,
https://cifar.ca/wp-content/uploads/2020/11/Pan-Canadian-AI-Strategy-Impact-Assessment-Report.pdf

AI WORKFORCE

From 2015 to 2019, Canada increased its rank on the *AI Skills Migration Index*[128] by 20 spots to 4th place among 55 countries. Talent follows opportunities, and the Canadian AI ecosystem creates jobs and has a reputation that attracts and retains a highly-skilled talent pool. Canada takes pride in its share of the international student pie. For example, 30 percent of its computer science students are foreigners.

CASE STUDY

The Canada AI Hub is working with ISL Adapt, an AI engineering firm, to develop solutions for controlling water treatment processes and supplying clean drinking water to the residents of Drayton Valley, Alberta.[129] The research team is using reinforcement learning, a form of machine learning that trains agents through a system of rewards and incentives, to predict how often to initiate cleaning processes and streamline services that minimise disruption to the town's drinking water. The experiment includes messing up the filters to pin down how many sensors are needed to track the changes.

ICT INFRASTRUCTURE

The ICT sector contributes substantially to Canada's GDP. In 2020, ICT accounted for 5.1 percent of GDP, and the curve is continuing its upward trajectory. The sector was responsible for 27.2 percent of GDP growth between 2015 and 2020. Indeed, since 2015, the ICT sector has posted a stronger annual growth than the total economy. Canada's semiconductor industry consists of over 90 domestic and international companies conducting R&D on microchips. The Minister of Innovation, Science and Industry, François–Philippe Champagne in March 2022 launched the Semiconductor Challenge Callout and assigned funds to the National Research Council of Canada's Canadian Photonics Fabrication Centre amounting to US$189 million[130] to strengthen Canada's position in this domain internationally. On cloud infrastructure, IDC in its December 2021 report, *Canadian ICT Forecast, 2021–2025*[131] stated that Canada will adopt a path of startup acquisitions and cloud marketplaces to assist with software sourcing to address the shortage in skilled developers.

DATA ECOSYSTEM

In its own compilation and assessment of national AI strategies published in May 2020, Canada has a note of 'N/A' listed against data and data infrastructure.[132] Taking a broader view of what 'data' means, this report lists certain key elements that find mention in the national strategy, although not under the "data" column. Canada has two federal privacy laws[133] that are enforced by the Office of the Privacy Commissioner of Canada: the Privacy Act,[134] which covers how the federal government handles personal information; and the Personal Information Protection and Electronic Documents Act (PIPEDA),[135] whose purview is how private-sector organisations collect, use, and disclose personal information.[136] It also applies to the personal information of employees of federally-regulated businesses such as banks, airlines, and telecommunication companies.[137] PIPEDA outlines 10 fair-information principles as ground rules for the collection, use, and disclosure of personal information, as well as for providing access to personal information. They give individuals control over how their personal information is handled in the private sector. A reform of PIPEDA is ongoing, in a bid to build additional regulation that creates the conditions for trust in the digital economy. *Canada's Digital Charter: Trust in a Digital World*,[138] published in 2019, supplements the effort towards societal trust in digital technologies and safety of data.

109
Canada's total count of AI Chairs, after CIFAR announced 29 more in 2021.

114   Pan-Canadian AI Strategy, CIFAR, https://cifar.ca/ai/.

115   Accenture & CIFAR, *Pan-Canadian AI Strategy Impact Assessment Report*, October 2020, *https://cifar.ca/wp-content/uploads/2020/11/Pan-Canadian-AI-Strategy-Impact-Assessment-Report.pdf.*

116   "DeepMind expands to Canada with new research office in Edmonton, Alberta", *DeepMind,* July 05, 2017,
https://www.deepmind.com/blog/deepmind-expands-to-canada-with-new-research-office-in-edmonton-alberta.

117   "Microsoft announces significant expansion of Montreal research lab, new director", *Microsoft,* January 24, 2018, https://news.microsoft.com/en-ca/2018/01/24/microsoft-announces-significant-expansion-montreal-research-lab-new-director/.

118   "Thomson Reuters Celebrates its Toronto Technology Centre's First Anniversary with $100M Expansion", *Thomson Reuters,* October 11, 2017,
https://www.thomsonreuters.com/en/press-releases/2017/october/thomson-reuters-celebrates-its-toronto-technology-centres-first-anniversary-with-100m-expansion.html.

119   "Pan-Canadian AI Strategy Impact Assessment Report," October 2020   .https://cifar.ca/wp-content/uploads/2020/11/Pan-Canadian-AI-Strategy-Impact-Assessment-Report.pdf

120   The Conference and Workshop on Neural Information Processing Systems or NeurIPS is one of the most prestigious conferences in the AI domain. It has provided a platform for researchers to present credible research since 1987   . Oral Presentations represent the most prestigious class of papers at NeurIPS, with an acceptance rate of 0.5 percent in 2019.

121   Aaron Brindle, Leah Morris, Daniel Mulet, "2021 Primer: Canada's AI Research Ecosystem", Radical Ventures, https://radical.vc/2021-primer-canadas-ai-research-ecosystem/#_ftn6.

122   "2021 Primer: Canada's AI Research Ecosystem", Radical Ventures,
https://radical.vc/2021-primer-canadas-ai-research-ecosystem/.

123   "The Montréal Declaration on Responsible Development of Artificial Intelligence", Université de Montréal,
https://recherche.umontreal.ca/english/strategic-initiatives/montreal-declaration-for-a-responsible-ai/.

124   The Global Partnership on Artificial Intelligence-GPAI, https://gpai.ai.

125   Virginie Soffer, "Global consultation on the ethics of AI begins in Montreal", *udemnouvelles,* September 07, 2020,
https://nouvelles.umontreal.ca/en/article/2020/07/09/global-consultation-on-the-ethics-of-ai-begins-in-montreal/.

126   "Pan-Canadian AI Strategy Impact Assessment Report, October 2020".

127   Accenture & CIFAR, Pan-Canadian AI Strategy Impact Assessment Report, October 2020, https://cifar.ca/wp-content/uploads/2020/11/Pan-Canadian-AI-Strategy-Impact-Assessment-Report.pdf.

128   Bruno Lanvin and Felipe Monterio, *The Global Talent Competitiveness Index: Global Talent in the Age of Artificial Intelligence,* France, INSEAD, 2020,

https://www.insead.edu/sites/default/files/assets/dept/globalindices/docs/GTCI-2020-report.pdf.

129   "ISL Adapt," https://isladapt.com/.

130   Alexander Schummer, "Canada to invest C$240 mln to develop semiconductor industry", *Reuters*, March 01, 2022,
https://www.reuters.com/technology/canada-invest-c240-mln-develop-semiconductor-industry-2022-02-28/.

131   Anu Mehta, Jason Bremner, April Zhang, and Tony Olvet, "Canadian ICT Forecast, 2021-2025", *IDC*, November 2021, https://www.idc.com/getdoc.jsp?containerId=CA47050121.

132   Johnny Kung, *Building An AI World: Report on National And Regional AI Strategies- Second Edition*, CIFAR, 2020, *https://cifar.ca/wp-content/uploads/2020/10/building-an-ai-world-second-edition.pdf.*

133   "Privacy Laws in Canada", Office of the Privacy commissioner of Canada, https://www.priv.gc.ca/en/privacy-topics/privacy-laws-in-canada/.

134   "The Privacy Act", Office of the Privacy commissioner of Canada, https://www.priv.gc.ca/en/privacy-topics/privacy-laws-in-canada/the-privacy-act/.

135   "The Personal Information Protection and Electronic Documents Act", Office of the Privacy commissioner of Canada, https://www.priv.gc.ca/en/privacy-topics/privacy-laws-in-canada/the-personal-information-protection-and-electronic-documents-act-pipeda/.

136   "Summary of Privacy Laws in Canada", Office of the Privacy commissioner of Canada, https://www.priv.gc.ca/en/privacy-topics/privacy-laws-in-canada/02_05_d_15/#heading-0-0-1.

137   "List of Federally Regulated Industries and Workplaces", Government of Canada, https://www.canada.ca/en/services/jobs/workplace/federally-regulated-industries.html.

138   "Canada's Digital Charter: Trust in a digital world", Government of Canada,
https://www.ic.gc.ca/eic/site/062.nsf/eng/h_00108.html.

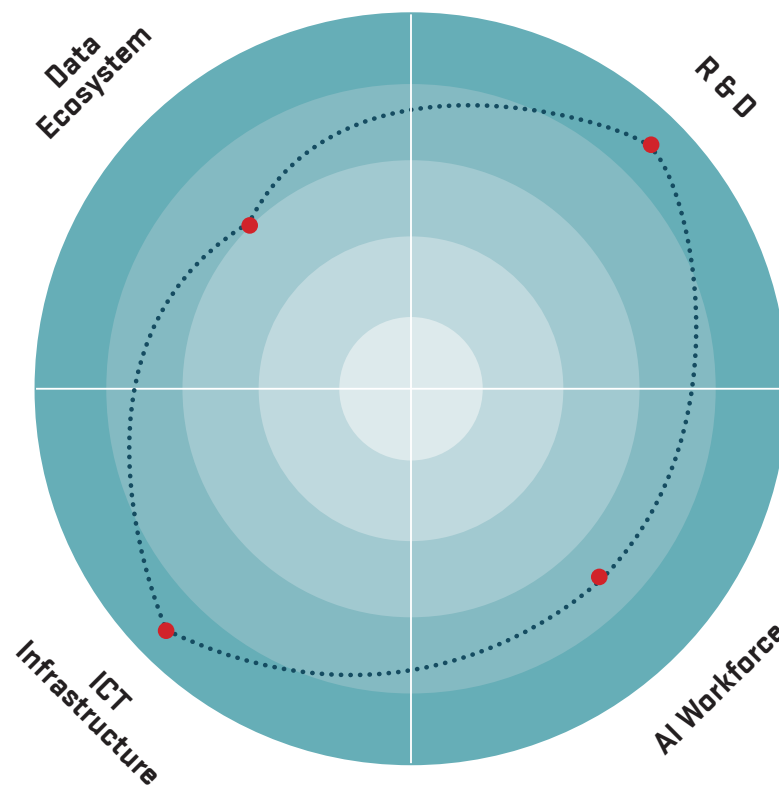# CHINA: BREATHING FIRE

UNLEASHING STATE POWER

INVESTING FOR INFLUENCE

ASSERTIVENESS VIS-À-VIS STANDARD SETTING

"AlphaGo's victories were both a challenge and an inspiration. They turned into China's 'Sputnik Moment' for artificial intelligence."

Kai-Fu Lee
Chairman and CEO of
Sinovation Ventures

OVERALL STRATEGY

Until 2016, China was lagging behind other countries in AI adoption, but as Kai-Fu Lee writes in his book, *AI Superpowers: China, Silicon Valley, and the New World Order,* [139] the triumph of Deep Mind's computer program AlphaGo over Lee Sedol in 2016 was China's "sputnik moment" in its AI journey. Perhaps this triumph by Western technology firms in one of the most respected Chinese games signalled the West extending its dominance in the AI space. Indeed, the Chinese leadership has been keeping a close eye on AI developments by the United States[140] and has now become a formidable counterweight. Through the flagship Belt and Road Initiative, and its components the Silk Road Economic Belt and Maritime Silk Road,[141] China is enhancing regional connectivity with its neighbours and promoting its soft power through a network of roads, railways, ports, pipelines, and technological infrastructure across East Asia, Africa, and West Asia.

To be sure, China has had some AI plans in motion prior to 2016. However, the pace of efforts has hastened since then. The Chinese government plays a key role in defining and achieving the country's AI plans, with support from private sector enterprises such as Baidu, Tencent, and Alibaba which continue to reinvest their profits in AI R&D. The State

provides access to open data and infrastructure to the industry, and the industry, in turn, focuses on data integration and use cases.

The Chinese government, in partnership with, notably, the Ministry of Science and Technology, National Development and Reform Commission, Ministry of Industry and Information Technology along with the Cyberspace Administration of China in May 2016 released the three-year national AI plan.[142] In China's *13th Five-Year Plan (2016-20)*,[143] the country committed to becoming a Science & Technology leader by pushing the public and private sectors to accelerate AI adoption in image and biometric recognition, smart controls, and human-machine interfaces.

In 2017, *the Next Generation AI Development Plan*[144,145] (新一代人工智能发展规划) was released by China's State Council to outline long-term industrial goals for AI to drive economic growth by 2020, assist in breakthroughs in theoretical AI research by 2025, and for China to become a global AI innovation centre by 2030 and build a US\$150-billion AI industry.[146] This turned out to be China's most detailed and comprehensive plan on R&D, talent development, industrialisation, standard-setting, regulations, ethical norms, and security. It has also laid emphasis on partnerships with technology companies to establish and maintain leadership in AI research and industries by building AI research technology parks in Beijing worth US\$2.1 billion. In 2018, China released another three-year action plan to build on the New Generation of Artificial Intelligence Plan. Other related strategies include *Made in China 2025*,[147] *Special Action on Intelligent Hardware Industry Innovation and Development* (2016-2018), and *National Hi-tech Zone Internet Cross-border Integration Innovation Zhongguancun Demonstration Project* (2015-2020).[148]

In January 2018, China established groups for National AI standardisation. The Ministry of Industry also established the National Standardisation Management Committee with support from the China Electronic Standardisation Institute. With increased focus on standards globally, China also laid bare its intent to lead the global governance on AI. Since the country is at the forefront of developing a majority of AI use cases and transferring them through several bilateral agreements to developing economies, these standards will be crucial in seeding its dominance. However, stakeholders across the globe are concerned that the Chinese Communist Party's prioritising political security and state control over individual rights will be mirrored in global AI governance discussions.

RESEARCH & DEVELOPMENT

Chinese AI enterprises cover the entire value and industry chain with numerous exceptional use cases and enterprises using natural language processing, robots, and computer vision. Investment and support in making military AI "intelligentised"—or increasing the scope of AI use in national defence to prepare China for the future of warfare—has been a core element of China's approach on AI. It has been exporting autonomous military systems to countries in West Asia, such as Saudi Arabia and UAE, and surveillance systems to countries across Asia, Africa, and Latin America. The National Innovation Institute of Defence Technology also established in 2018 two research centres to focus on Research & Development in AI militarisation—the Artificial Intelligence Research Centre, and the Unmanned Systems Research Center. With ongoing research on dual-use technologies, among other innovations, these centres have become crucial to China's growing ambitions. Moreover, in academic research, China has remained a leader in publishing in AI journals, and in getting their publications cited in other research.[149] The number of applications for patents has also increased rapidly in recent years, as has the approval rate, albeit only slightly.

AI WORKFORCE

Like its counterparts and rivals, China is focusing on building a strong AI workforce to sustain its enormous national ambitions. Sharing the sentiments of other countries on the centrality of an AI skill force to achieving its AI vision, China's 2017 Plan has designed a detailed blueprint to build an AI talent pool that can provide scientific and technical support.[150] The 2017 Plan proposes improvements in innovation systems at academic institutions, improvements in AI training, and the commercialisation of science and technology innovations by academic institutions. China has also outlined guidelines to develop vocational training programs for product development of Internet Of Things (IoT) and Unmanned Aerial Vehicles (UAVs) for Chinese institutes to streamline training students and

workforce development. Private enterprises like CHL Rob and Shanghai Step Electric Corp. are also playing important roles in training the workforce through creation of vocational training hubs.

In 2018, China's Ministry of Education had urged higher education institutions to incorporate AI in their curricula and design 100 "AI+X" models to nurture AI talent, and build AI colleges and research centres. The Ministries of Education, and of Finance and National Development, and the Reform Commission then released a joint circular to promote postgraduate and master's studies in the domain.[151]

ICT INFRASTRUCTURE

The Internet Plus Initiative,[152] launched in 2015 for 2016-18, was envisioned to spur economic growth through the spread of Internet, d e v e l o p m e n t of platform ecosystems and included AI hardware capacity, and AI applications to address socio-economic concerns. Most AI applications developed by private enterprises seek to address infrastructural gaps such as easy access to credit checks and now use Facial Recognition Technologies to bridge the gaps. Shenzhen—known as the hardware capital of the world—was the location for the country's first National Innovation City where the government has implemented policies to foster entrepreneurship, multi-stakeholder R&D collaboration, and market openness. At the same time, the Pearl River Delta region near Shenzhen takes care of the entire supply chain of AI-enabled industry applications. However, the bottlenecks created by the reliance on the import of semiconductors and sanctions by the United States have emerged as a critical concern for China.

INBOUND AND OUTBOUND STUDENT MOBILITY, 2013 - 2019
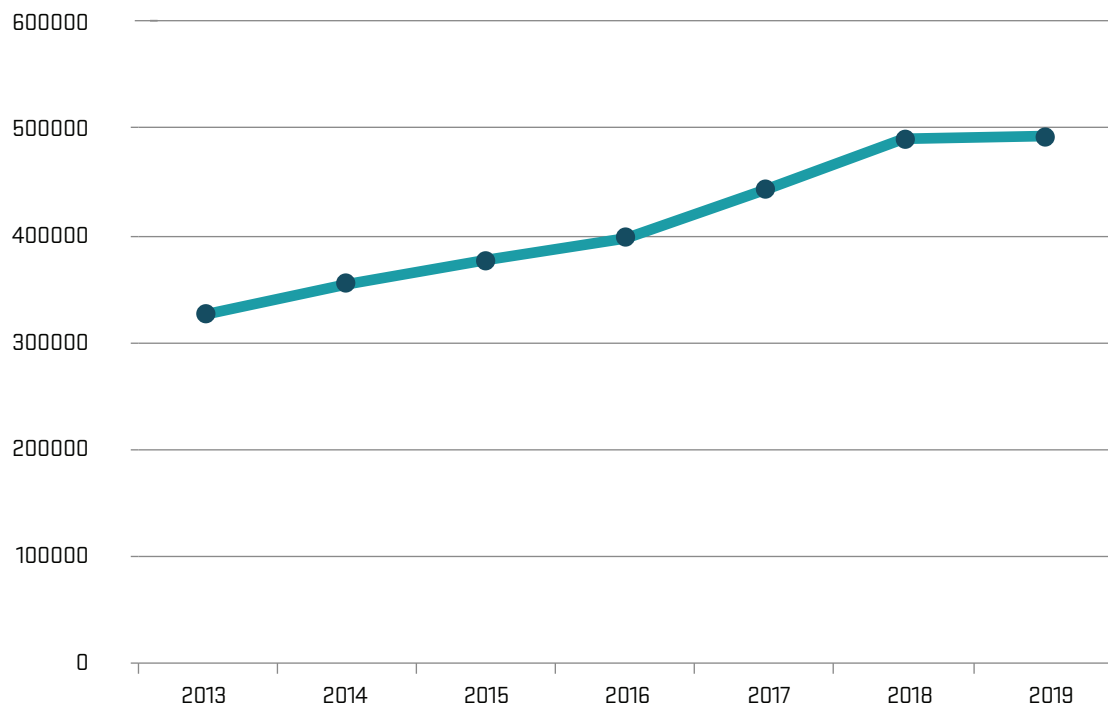
Source - The Power of International Education: China, https://www.iie.org/Research-and-Insights/Project-Atlas/Explore-Data/China/

DATA ECOSYSTEM

China released its Data Security Law in September 2021,[153] and the Personal Information Protection Law[154] (PIPL) in November of the same year. Through fines and penalties, the country is attempting to protect personal information collected and processed by enterprises doing business in China. The implementing body for PIPL is the Cyberspace Administration of China. It draws from the GDPR. The law mandates instituting consent mechanisms for transferring personal information to external entities, communicating data breaches, and adjusting privacy policies and data request procedures by data subjects.

139   Kai-Fu Lee, *AI Superpowers: China, Silicon Valley, and the New World Order* (Boston: Houghton Mifflin Harcourt, 2018), pp. 10. http://www.ime.cas.cn/icac/learning/learning_3/201907/P020190705337161500594.pdf.

140   Gregory Allen, *Understanding China's AI Strategy*, CNAS, 2019, https://www.cnas.org/publications/reports/understanding-chinas-ai-strategy#fn1.

141   Eleanor Albert, *China's Big Bet on Soft Power*, Council on Foreign Relations, 2018, https://www.cfr.org/backgrounder/chinas-big-bet-soft-power#chapter-title-0-6.

142   Graham Webster, Rogier Creemers, Paul Triolo and Elsa Kania, *Full Translation: China's 'New Generation Artificial Intelligence Development Plan' (2017)*, New America, 2017, https://www.newamerica.org/cybersecurity-initiative/digichina/blog/full-translation-chinas-new-generation-artificial-intelligence-development-plan-2017/.

143   Central Compilation & Translation Press, *The 13th Five-Year Plan For Economic And Social Development Of The People's Republic Of China (2016–2020)*, Beijing, China, https://en.ndrc.gov.cn/policies/202105/P020210527785800103339.pdf.

144   State Council, *Next Generation AI Development Plan*, Guo Fa [2017] no. 35, July 2017, http://www.gov.cn/zhengce/content/2017-07/20/content_5211996.htm.

145   Graham Webster, Rogier Creemers, Paul Triolo and Elsa Kania, "Full Translation: China's 'New Generation Artificial Intelligence Development Plan' (2017)", New America, August 01, 2017, https://www.newamerica.org/cybersecurity-initiative/digichina/blog/full-translation-chinas-new-generation-artificial-intelligence-development-plan-2017/.

146   Huw Roberts, Josh Kowls, et al. "The Chinese approach to artificial intelligence: an analysis of policy, ethics, and regulation", AI & Society, 36, pages 59–77 (2021), https://link.springer.com/article/10.1007/s00146-020-00992-2#Sec2.

147   State Council, *Made in China 2025*, July 07, 2015, http://www.cittadellascienza.it/cina/wp-content/uploads/2017/02/IoT-ONE-Made-in-China-2025.pdf.

148   Wang Yuntao, "What we do to embrace the Intelligence New Norm-China's AI development Policies and our work", *China Academy of Information and Communication Technology & Artificial Intelligence Industry Alliance*, https://www.itu.int/en/ITU-T/studygroups/2017-2020/03/Documents/What%20we%20do%20to%20embrace%20the%20Intelligence%20new%20norm%20-%20WANG%20Yuntao.pdf.

149   Nestor Maslej, Erik Brynjolfsson, John Etchemendy, Terah Lyons, James Manyika, Helen Ngo, Juan Carlos Niebles, Michael Sellitto, Ellie Sakhaee, Yoav Shoham, Jack Clark, and Raymond Perrault, The AI Index 2022 Annual Report, AI Index Steering Committee, Stanford Institute for Human-Centred AI, Stanford University, March 2022, https://hai.stanford.edu/research/ai-index-2022.

[150]   Romi Jain, "Crossroads of Artificial Intelligence: Higher Education and Research in India and China", *Observer Research Foundation*, Occasional Paper No. 281, 2020 https://www.orfonline.org/research/crossroads-of-artificial-intelligence/.

[151]   Janzz.technology, "Building the AI-ready workforce: China's Artificial Intelligence Plan pushed by both central and local governments", 2021, https://janzz.technology/building-the-ai-ready-workforce-chinas-artificial-intelligence-plan-pushed-by-both-central-and-local-governments/.

[152]   "Premier Li and Internet Plus", The State Council-The People's Republic of China, https://english.www.gov.cn/policies/infographics/2015/12/31/content_281475263938767.htm.

[153]   "Data Security Law of the PRC", China Law Translate, https://www.chinalawtranslate.com/datasecuritylaw/.

[154]   "The PRC Personal Information Protection Law (Final): A Full Translation", *China Briefing*, August 24, 2021, https://www.china-briefing.com/news/the-prc-personal-information-protection-law-final-a-full-translation/.
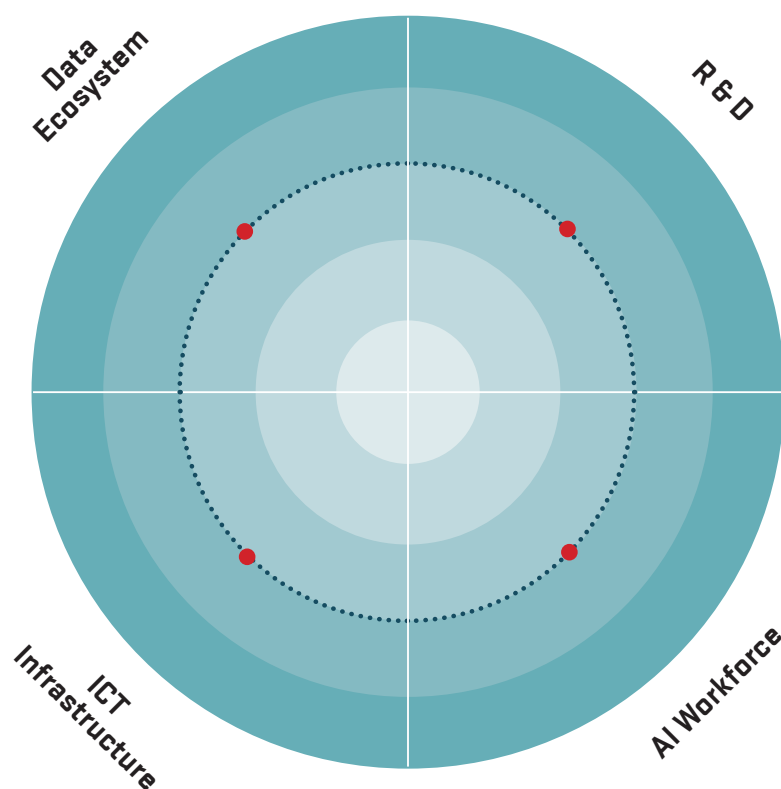
FRANCE: IN THE HOT SEAT

DATA
PORTABILITY

TECH
SOVEREIGNTY

PLAYING
HARDBALL

"France and Europe will not necessarily take their place on the world AI stage by creating a 'European Google', and instead, they must design their own tailored model."

Cedric Villani
Chairman and CEO of
Sinovation Ventures

OVERALL STRATEGY

Headlined *AI for Humanity*,[155] France's first-ever AI strategy document in 2018 was developed by Member of Parliament and renowned mathematician Cédric Villani. At the helm of the rotating EU presidency, France must pass a string of digital-focused rules, ranging from online content and digital competition to AI and data governance. It plans to invest US$1.85 billion to the development of AI by the end of 2022. The Czech Republic will succeed France in July 2022.

Since winning the presidential elections in April 2022, President Emmanuel Macron has been challenging Big Tech and pushing for technological sovereignty for the 27-country bloc. This includes efforts to compete globally with the United States and China on a multitude of commodities, from semiconductors to AI, guided by the battlecry, "Make Europe Great Again". As for the homeland itself, the French strategy is to draw on its comparative advantage, and not "merely attempt to create a 'European Google".[156] The four areas where the country believes it has sufficient maturity to launch "major transformation operations" are health, transport, environment, and defence and security.

The French presidency has begun on a high note. It is making the case that data minimisation—i.e., limiting the collection of personal information to what is strictly necessary—should remain a priority agenda throughout the lifecycle of an AI system. Diplomats from the region have reportedly pencilled in three meetings a month in which they will attempt to iron out the AI Act.[157] France's presidency comes at a key moment in Europe's digital policymaking and Paris has a long track record of standing its ground against US tech giants. President Macron has talked often about the "innate ambivalence" in grappling with the possibility of "machines playing God." Unless France shifts gears, the world could see a massive contest in the future.

RESEARCH & DEVELOPMENT

France has made it clear that it will not tolerate the asymmetry between what it calls "high-level researchers" and those that are "properly trained specialists". There is a short supply of the latter, as the best and the brightest of France are being lured by the same Big Tech giants which France is wanting to rein in. The 2018 strategy document goes into great detail on every piece of the puzzle that is holding French R&D back. The country is looking to Canada for inspiration in its R&D strategy.

AI WORKFORCE

For the French government, the future of jobs will see greater complementarity between human and machine labour. The AI strategy leans into the Employment Advisory Council's 2017 report[158] that defines four main criteria for determining whether a task can be readily automated:

(1) No flexibility: The work pace is set by a machine speed and the task is regulated by hourly production standards and involves continually repeating the same series of movements and operations.

(2) No capacity for adaptation: There is no need to interrupt an ongoing task to carry out another unscheduled one, and the task entails a strict application of orders or instructions.

(3) No capacity for solving problems: When an abnormal situation arises,

the worker calls in other people to solve the problem.

(4) No social interaction: Contact with the public is limited and the pace of work is not set by outside demand.

The Employment Advisory Council's report draws inspiration from tests in other geographies such as Denmark and Germany to inform how it proceeds.

ICT INFRASTRUCTURE

France has achieved nearly 100 percent penetration of 4G mobile connections per 100 people and 43 percent of homes have fixed broadband. However, France is on the lower end of the spectrum for fixed broadband pricing in the EuroZone. The disruptions in the supply chain of semiconductors impacted European private enterprises that manufacture commodities like appliances, heavy vehicles like trucks, and aircraft. Macron, as part of the EU presidency agenda, in January 2022 emphasised the need for an economic model for Europe that is based on technology sovereignty. Nonetheless, the agenda of technology sovereignty has to be substantiated with increased funding and investments in not just Research & Development on semiconductors but also raw materials, such as critical minerals required to produce them.[159] The European Commission, at the onset of the pandemic, launched two alliances that bring together enterprises and EU member states to collaborate and co-invest in cloud computing and semiconductors.[160] As part of France's Technology Development Plan to 2030, the country has also promised an investment of around US$6.42 billion in the semiconductor industry.[161]

DATA ECOSYSTEM

France lists three big focus areas: encouraging companies to pool and share data and also release data according to case; create data in the public interest; and support the right to data portability. The French government, using the *data.gouv. fr,* has been at the forefront of publishing structured data collected by public and private actors such as ministries, and public and private establishments. It allows citizens and enterprises to publish and

reuse data in domains such as environment, public health, and employment, to enhance democratic transparency and stimulate innovation. France is also pushing hard for the right to data portability, which it sees as one of the most important innovations in recent French and European policymaking. As the Villani report states, "In a world where technologies are becoming key to our future, artificial intelligence must not become yet another tool for exclusion."[162] It will give any individual the ability to migrate from one service ecosystem to another without losing their data history.

155   French Strategy for Artificial Intelligence, *AI For Humanity*, 2018, https://www.aiforhumanity.fr/en/.

156   French Strategy for Artificial Intelligence, AI For Humanity, 2018

157   European Commission, *Proposal For A Regulation Of The European Parliament And Of The Council-Laying Down Harmonised Rules On Artificial Intelligence (Artificial Intelligence Act) And Amending Certain Union Legislative Acts,* COM(2021) 206 final, Brussels, 2021, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52021PC0206.

158   Conseil d'orientation pour l'emploi, *Automation, digitalisation and employment,* January 2017, https://www.strategie.gouv.fr/sites/strategie.gouv.fr/files/atoms/files/coe-rapport-vol-1-impacts-on-job-numbers-janvier-2017.pdf.

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160   Goda Naujokaityte, "New alliances to beef up investments in microchips and cloud technologies", *Science Business,* July 20, 2021, https://sciencebusiness.net/news/new-alliances-beef-investments-microchips-and-cloud-technologies.

161   Nick Flaherty, "France 2030 aims to boost semiconductor production, smart farming, electric vehicles and develop small nuclear reactors", *E E News,* October 12, 2021, https://www.eenewseurope.com/en/france-in-e6bn-boost-for-semiconductors/.

162   French Strategy for Artificial Intelligence, AI For Humanity, 2018

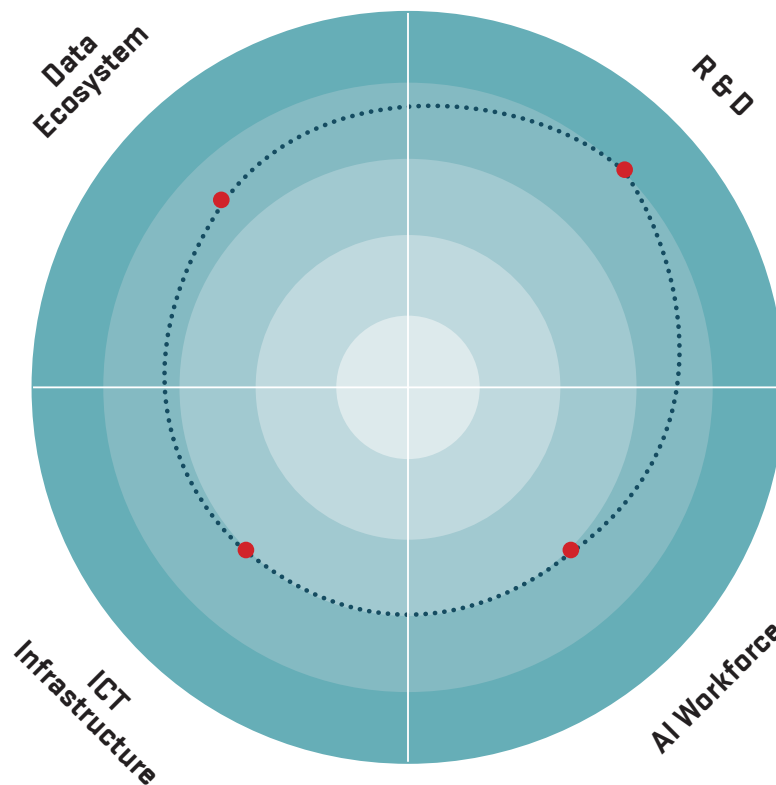# GERMANY: MAXIMISING VALUE

SAFEGUARDING COMPETITIVENESS

AI FOR PUBLIC GOOD

LABOUR-CENTRED ETHICAL FRAMEWORK

*"Artificial Intelligence (AI)
made in Germany is to become a
globally recognised quality mark."*

**Germany's National
AI Strategy**

OVERALL STRATEGY

In November 2018, Germany launched its *National AI Strategy*,[163] jointly developed by the federal ministries of Education and Research, Economic Affairs and Energy, and Labour and Social Affairs. A year later, Germany published an interim report on the main measures implemented thus far, presenting facts and figures, and outlining fields of actions and perspectives for the coming years.[164]   In the same year, a month before the interim report came out, Germany's Federal Government's Data Ethics Commission released its ethical guidelines and specific recommendations on AI, algorithm-based decision-making, and data use.[165]

In October 2020, the Study Commission on Artificial Intelligence – Social Responsibility and Economic, Social and Ecological Potential of the 19th German *Bundestag* (federal parliament) presented its final report with specific recommendations for action.[166]   Fourteen months later, the country adopted an updated AI strategy – Artificial Intelligence Strategy of the German Federal Government: 2020 Update,[167]   drawing up an interim balance, relevant developments at national, European and international level, and measures to be implemented by 2022. The latest report is the product of seven thematic forums that were held with experts from the fields of business and industry, science, and politics for updating the AI Strategy. The main subjects of the expert forums were research, transfer, Industry 4.0, mobility, healthcare and long-term care, environmental and climate protection, and the regulatory framework

for the human-centric use of AI at work and in society. With the economic stimulus and future package to promote AI innovation and research in the wake of the COVID-19 pandemic,[168] Germany committed to increase the planned expenditure of US$3.2 billion for the promotion of AI by an additional US$2.17 billion, for a total of US$5.4 billion by 2025.

RESEARCH & DEVELOPMENT

Germany has envisioned several funding schemes and support initiatives for its AI agenda, including the setting up of research centres. The Federal government has doubled the funding of the competence centres to further excellence and competitiveness in AI research until 2022. The German Federal Agency for Technical Relief (THW)[169] has also launched a "reality lab" for AI in Civil Protection and is attempting to build a network of AI research centres at universities in Munich, Tübingen, Augustin, Berlin, Dresden/Leipzig, and Dortmund/St. Augustin with other application hubs. The reality lab offers an interface between the Security Research Community, AI researchers, and industry. The lab aims to test and develop solutions that make AI-based technologies accessible and useful for practitioners. Germany has also been working on several initiatives to support SMEs, such as the *EXIST* programme,[170] *Tech Growth Fund,*[171] *Central Innovation Programme for SMEs* (ZIM);[172] and *Gruender platform*[173] —an online platform to support start-ups, including AI ones, from initial research to concrete AI applications. Along with these initiatives, the process of AI innovations is being accelerated by launching transfer initiatives, digital test beds[174] and regulatory sandboxes,[175] and promoting pilot and flagship AI projects such as those that benefit the environment and mitigate climate change.

Germany has identified healthcare, environment and climate, aerospace, and mobility as priority sectors that will benefit first from its drive for AI. Within the funding programme[176] for digital innovations for the improvement of patient-centred care in the health care system, the German Federal Government has so far funded 22 projects for up to 36 months over the period 2020-2023, with a total funding amount of approximately US$52 million. Germany has also initiated government funding of AI technologies in agriculture, health and nutrition, food chains, and rural areas. A total of 82 plans were submitted, covering 305 sub-projects and worth funding of about US $96 million. It is also funding a large-scale research project which, using AI, combines elements of classic traffic planning with mobility and innovation management.[177] At least 10 sub-projects on digital and autonomous mobility are being implemented in parallel, and monitored in order to deduce how digitalisation can effectively contribute to achieving the climate goals in the mobility sector.
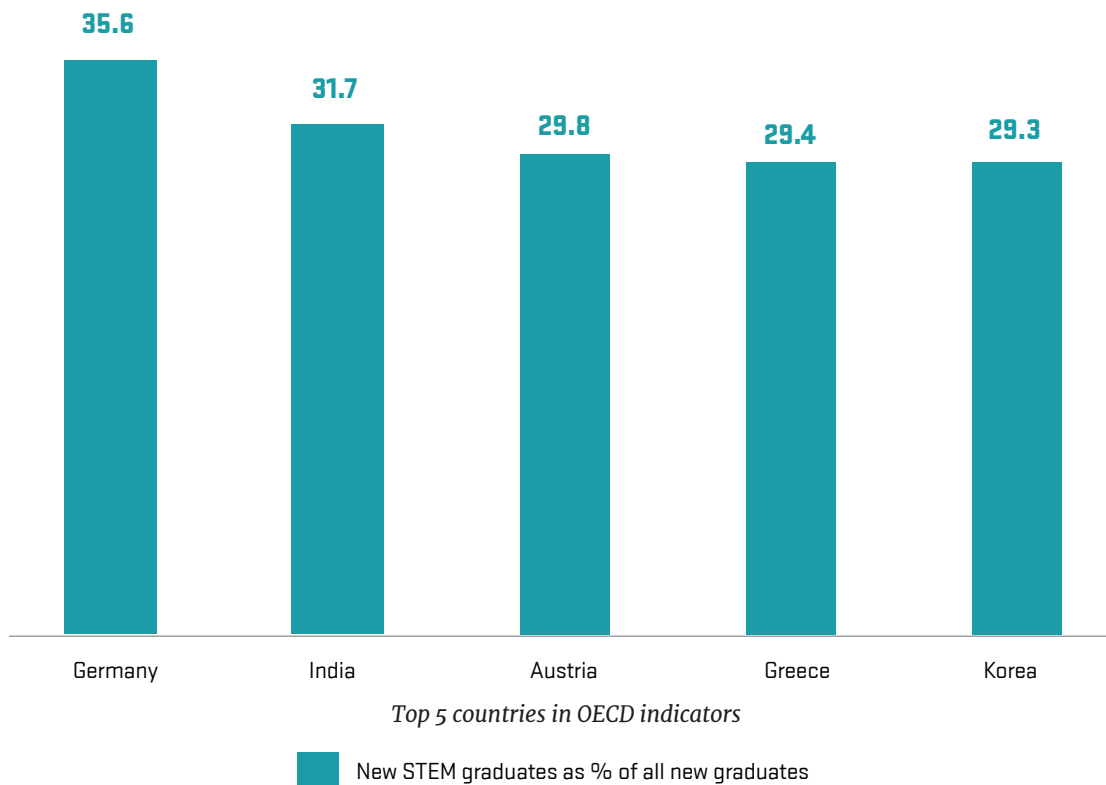
AI WORKFORCE

The German strategy proposes several policy reforms and initiatives for formal training and education, with special focus on educators, trainers, and the general public to guarantee high-quality levels of education in AI. These include expanding learning platforms such as the AI Campus[178] to develop a skills base in AI through courses, videos, podcasts and knowledge exchange, and at least 100 additional professorships to ensure that AI has a foothold within the higher education system. AI professorships are planned at the centres of excellence for AI and in the scope of both the Tenure Track Programme and the Excellence Strategy. It also includes getting more students involved in STEM subjects [179] as part of the STEM Action Plan.[180]

HUMAN CAPITAL IN THE DIGITAL AGE

	Germany	India	Austria	Greece	Korea
New STEM graduates as % of all new graduates	35.6	31.7	29.8	29.4	29.3

Top 5 countries in OECD indicators

Source: OECD Going Digital Toolkit, based on OECD Education Database.

On top of formal education and training reforms, Germany has launched qualifications initiatives[181] with attention for lifelong learning and for reskilling and upskilling employees throughout their careers and advanced vocational training in digital and AI-related aspects, among others.[182] The Mittelstand 4.0 centres of excellence[183] for SMEs have deployed and expanded AI trainer programmes to support skills development for businesses; INVITE (Digital Platform for Continuing Vocational Training) innovation competition projects for the design of an innovative, user-oriented and coherent digital continuing education and training area; Expansion of AI education such as the online course on Elements of AI (with patronage from the government).[184]

ICT INFRASTRUCTURE

Germany foresees expanding its current data infrastructure to create optimal conditions for the development of cutting-edge AI applications. The objective is to obtain a trustworthy data and analysis environment to strengthen AI research and facilitate data interoperability as well as access to government data. The German strategy aims to develop the current telecommunications and digital infrastructure to ensure better connectivity of the network and improve cyber security. Lastly, Germany is setting up funding to foster learning capabilities and experimentation in AI by improving the digital infrastructure in the education system. The German strategy has proposed investment in cloud platforms and establishment of National Research Data infrastructure (NFDI)[185] for the improvement of the infrastructure in AI. It is also providing funding from the Digital Pact for Schools programme to improve access to broadband connections and WiFi.

Cornerstone initiatives in Germany's preparation for the next-generation data infrastructure are the GAIA-X project[186] and the *Federal Government Data Strategy.* The objective of the GAIA-X project, initiated by Germany and France, is to create a secure, federated data system that meets high standards of digital sovereignty while promoting innovation. Other notable initiatives include mCloud[187] and Mobility Data Marketplace (MDM),[188] and the Smart Data Innovation Lab (SDIL).[189]

DATA ECOSYSTEM

Germany's *Data Strategy*[190] identifies four fields of action: the improvement of data provision and access, the promotion of responsible data use, the increase of data competencies in society, and the development of a data culture for data sharing and use. Germany uses an "ethics by design" approach throughout all development stages and use of AI-based applications like self-driving cars.[191] The Data Ethics Commission (DEC) presented their recommendations in October 2019, containing general principles to ensure the ethical design and use of data and algorithmic systems.

The Federal Data Protection Act codifies data protection regulation and privacy (i.e. safeguard the control on personal data), compliant with EU law. The cybersecurity directive or the directive on security of network and information systems (NIS) requires member states to adopt a national cybersecurity strategy. In Germany, the cybersecurity strategy is implemented by the NIS Implementation Act of June 2017.

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INDIA: 'AATMANIRBHAR' AS NORTH STAR

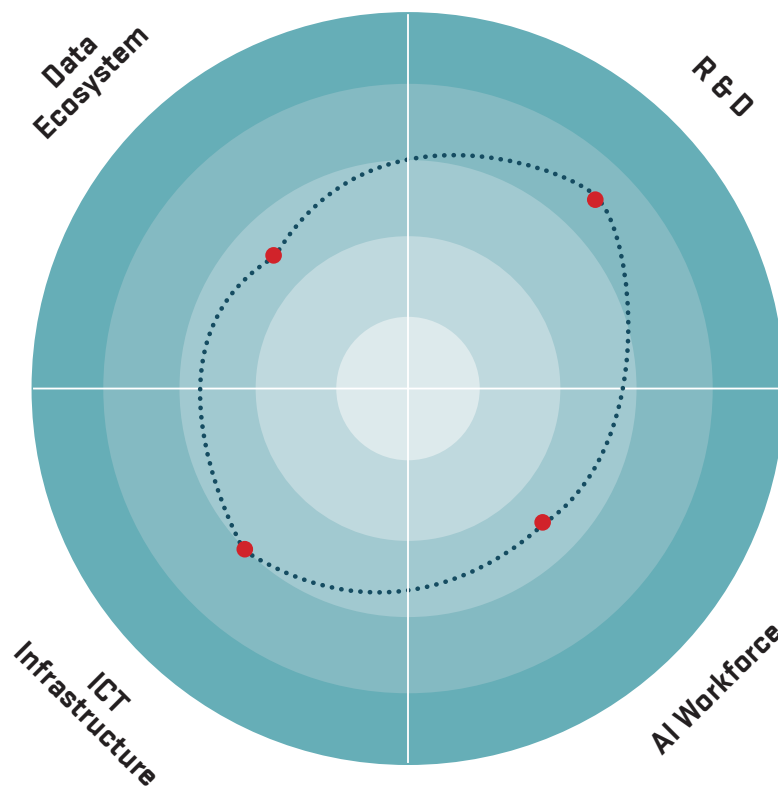**PREFERRED PARTNER OF LIKE-MINDED DEMOCRACIES**

ACCELERATED BUT SCATTERED ADOPTION

RISK-BASED GOVERNANCE

*"We need to make Artificial Intelligence in India and make Artificial Intelligence work for India."*

Narendra Modi
Prime Minister of India

OVERALL STRATEGY

India has found itself uniquely placed as a strategic partner for like-minded democracies looking for alternative economic and political partners to China. Its legacy as a pioneer[193] in Information Technology services,[194] accompanied by rapid urbanisation, low trade barriers, and elimination of import duties on technology products, have become its selling propositions in attracting foreign direct investment and various forms of collaboration. There have been numerous government initiatives to facilitate the development of Special Economic Zones and Software Technology Parks as well.

MARKET SIZE OF INDIA'S IT INDUSTRY
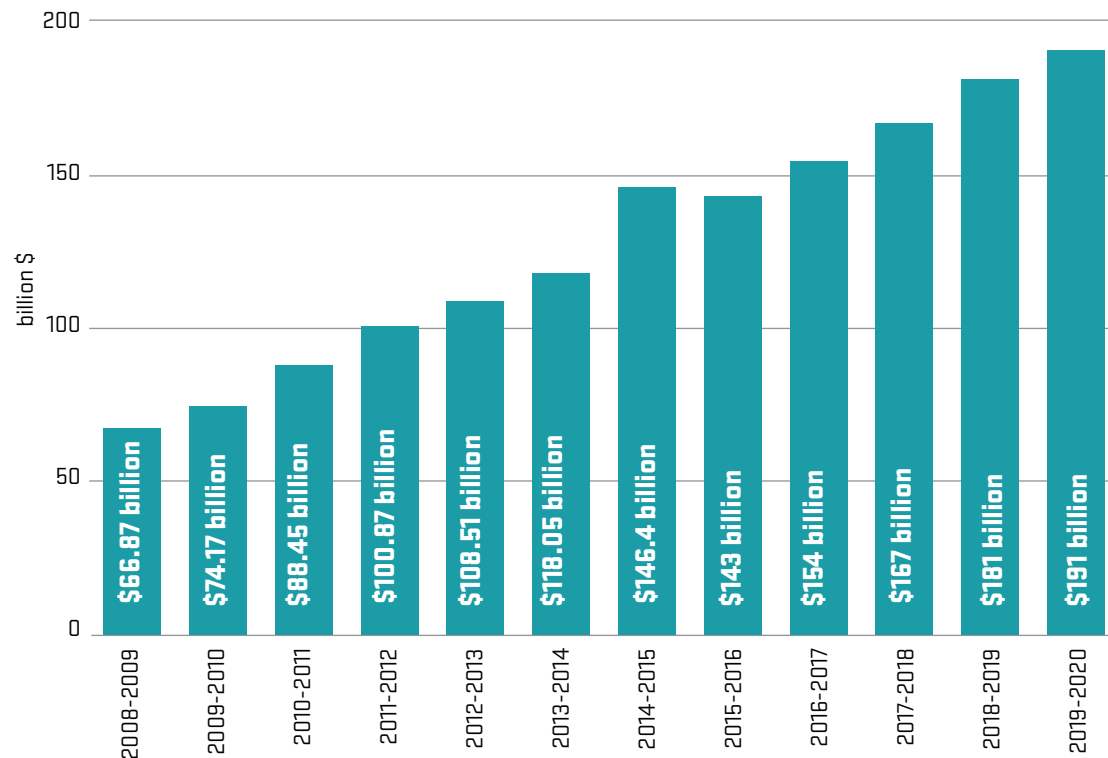
Source - Anuj Kumar Sirohi, "IT Industry: Boosting India's Growth", The Diplomatist, August 29, 2020, https://diplomatist.com/2020/08/29/it-industry-boosting-indias-growth/

The AI market in India was valued at US$7.8 billion[195] in July–August 2021, representing a notable increase of 22 percent from the same period in 2020. It is estimated that AI has the potential to contribute US$957 billion to India's economy by 2035.[196] With over 60,770 start-ups recognised by the Department for Promotion of Industry and Internal Trade in 2021, India was the third largest ecosystem for startups globally in that year.[197] In January 2022, FractalAI became India's first AI startup to enter the unicorn club.[198] In a report by KPMG in 2021, Bengaluru was noted as one of the leading technology innovation hubs in the world, and India as a promising nation for developing innovative technologies.[199]

The COVID-19 pandemic, and the strategic decoupling of nations that predated it, provide huge possibilities to India as it is gears towards becoming a global leader in AI,[200] enhancing its domestic production capabilities or Atmanirbharta (self-reliance), and addressing its domestic priorities using technology. Considering the needs of its citizens, India is focused on extracting social value from AI, with its vision of #AIForAll. Echoing these sentiments, Prime Minister Narendra Modi at RAISE2020 stated, "We need to make Artificial Intelligence in India and make Artificial Intelligence work for India."[201]

According to Amitabh Kant, CEO of the government think-tank NITI Aayog, India will soon position itself as the "tech garage" of the world, given India's complex challenges

that require the use of technology, data, and innovation "at scale."[202] NITI Aayog had released India's *National Strategy For Artificial Intelligence*[203] (NSAI) in June 2018, and the *Responsible AI Principles*[204] in February 2021; the operationalisation mechanism for the Responsible AI principles were released in August 2021.[205] NSAI has identified the following as priority sectors for India's AI thrust: agriculture; healthcare; smart cities and infrastructure; education; and smart mobility. India is poised to launch its highly anticipated National Programme on AI (NPAI) soon and is awaiting approval from the Cabinet.[206] NPAI aims to lay a strong foundation for a sustainable ecosystem for AI. The Ministry of Electronics and Information Technology (MeitY) aspires to facilitate AI Research & Development, innovation, use, and adoption, all while investing in the AI workforce and public awareness with NPAI.

In the absence of a central mission to push AI development and adoption, states have started developing initiatives and policies to foster AI innovation while addressing its risks. There are, for example, the *Telangana AI mission,*[207] *Karnataka Digital Economy Mission,*[208] and *UP Start-up Policy 2020.*[209] Specifically, Telangana AI mission has made a momentous mark on the AI industry in India. The state has adopted a two-pronged approach to facilitate the growth of emerging technologies, including AI, by building a conducive environment and facilitating government adoption.[210] Rama Devi Lanka, director of emerging technologies in the state of Telangana, has emphasised that their aim was to leverage technologies like AI, blockchain, robotics, and IoT for the government to improve service delivery, or internal governance processes.[211] Telangana has released seven policies and frameworks to deal with emerging technologies and has safely adopted several use cases in agriculture.

RESEARCH & DEVELOPMENT

India has filed over 5,000 AI patents over the last decade, over 94 percent of which were in the last five years alone.[212] The Global Innovation Index 2021[213] database had noted India as one of the three top innovation economies by region in Central and Southern Asia. In India's *AI Journey: 75@75,*[214] MeitY in collaboration with IndiaAI portal –

(National AI Portal of India) collated 75 use cases adopted by government, industry, and academia and provided a glimpse of the socio-economic challenges that AI can solve. These include those in the domains of ICT infrastructure, healthcare, sanitation, education, and last-mile delivery of public services.

The country has launched more than 10 centres of excellence to support efforts on AI Research & Development in collaboration with industry players and

academic institutions for innovation-driven entrepreneurship,[215] public finance management,[216] and advanced research on AI,[217] amongst others.[218] The government also established the National Research Foundation[219] under the Budget FY 2020-21, giving it an outlay of US$ 6.4 billion over five years to strengthen partnership between industry and the academia for Research & Development, on subjects including AI.[220] This is an important development, as Indian experts have recorded lower citation scores and published less compared to their peers. Moreover, there is a lag in the transition of AI research to real products.

AI WORKFORCE

Engineering and Technology is the fourth major stream of enrolment in Indian universities, with 3.727 million students in 2019-20, 9 percent of whom are females.[221] MeitY, in collaboration with NASSCOM, the National e-Governance Division, and private players has introduced programs like *FutureSkills Prime*[222] and *Responsible AI for Youth*[223] to skill and re-skill India's youth.[224] The Ministry of Education has also integrated AI and coding in school curricula as proposed under the *National Education Policy 2020.* Top universities such as the Indian Institute of Technology (IIT) Madras, IIT Delhi, and Indian Institute of Science (IISc) have established research centres to promote Research & Development on AI and build a talent pool of researchers.[225] With tech giants like Samsung, Apple, and Amazon starting to reimagine China's role after decades of relying on it, India will need to gear up and seize the awaiting economic and employment opportunities.[226]

ICT INFRASTRUCTURE

Internet penetration in India was recorded at 45 percent[227] in January 2021 despite various government initiatives to enable digital and financial inclusion.[228] According to the *Economic Survey 2021,*[229] reducing the cost of establishing broadband highways can assist the government in expanding the consumer base of internet services. The Telecommunications Regulatory Authority of India,[230] in its 298-page report in 2021 proposed that the government pilot a Direct Benefit Transfer scheme to reimburse 50 percent of the

monthly broadband charges to residents of rural areas.[231]

The National Informatics Centre (NIC) under MeitY through NIC AI Cloud is planning to build a platform to assist in data annotation and training models using open-source tools and AI development frameworks.[232] Using MeghRaj or GI Cloud, GoI is also planning to use cloud computing to enhance cost-effective delivery of e-services. To further its mission of *Atmanirbhar Bharat* and become a hub for electronics system design, the government of India has also released a Production-Linked Incentive scheme to support and promote development of IT hardware.[233] Additionally, it approved a program to build a sustainable manufacturing ecosystem for semiconductors and display, giving it an outlay of US$ 10 billion in December 2021.[234]

DATA ECOSYSTEM

India was among the first countries to set an open government data platform—*data.gov.in*[235]—to facilitate access to datasets published by the government sector across different domains. It currently provides access to more than 0.16 million resources across 33 sectors from 109 government departments. However, there are concerns surrounding the completeness, comprehensiveness, and AI-readiness of the data. Recognising the need to enhance the use and access of quality datasets, MeitY released in February 2022, the *Draft India Data Accessibility & Use Policy 2022.*[236] For digital personal data, the Joint Parliamentary Committee (JPC) tabled the highly awaited report on *Personal Data Protection 2019* in the Winter session of Parliament in 2021.[237] The report proposes to expand the ambit of data contained in the revised Data Protection Bill 2021 to include non-personal data as well.[238] It proposes data localisation to ensure protection of a citizen's sensitive and critical personal data while providing data support in developing a better AI ecosystem.[239] However, proposals on data protection and privacy have to be accompanied by a parallel framework on data security, given the 37-percent increase[240] in cyberattacks between 2019 and 2020 alone, and the delay[241] in the drafting of a revised cybersecurity policy.

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# INDONESIA: A RISING DIGITAL ARCHIPELAGO

DEMAND-DRIVEN INNOVATION

BANKING ON 'SUPER APPS'

INTRODUCING *PANCASILA* VALUES IN AI

"The development of science and the global situation will accelerate the application of AI in various fields and will have a massive impact on the world of work in the future. This will be unavoidable, and we cannot stop it. This leaves us with no choice but to prepare ourselves to handle AI through character intelligence."

Nadiem Makarim
Indonesia's Minister of Education, Culture, Research and Technology
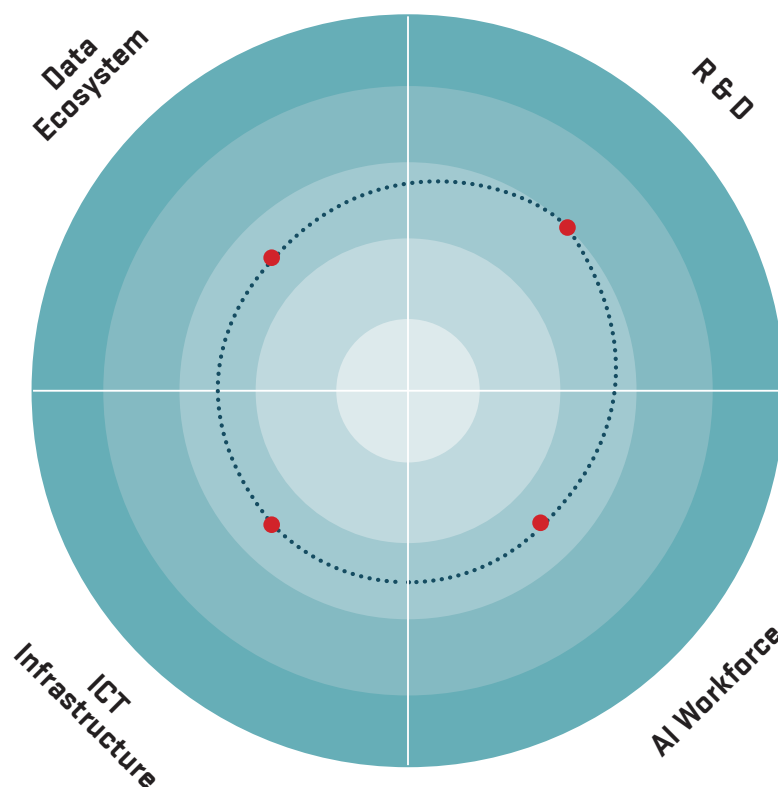
OVERALL STRATEGY

Indonesia's strategic position at the heart of the Indo-Pacific and maritime trade routes has attracted the attention of the big economies. Countries like the US,[242] Japan,[243] China,[244] and South Korea[245] are pouring in significant investments in Indonesia's technology start-ups, and cybersecurity and other infrastructure through government and private sector entities. From the US's 'Pivot to East Asia'[246] and China's BRI,[247] this South East Asian economy could potentially tilt the balance of power in favour of any country it chooses to side with but is cautiously treading the path of diplomatic balance.

This path of "neutrality" is reflected in its *National Strategy for Artificial Intelligence (NSAI).* Indonesia is determined to build a prosperous and advanced economy that is not dependent on imports of emerging technologies, and is leading the Asia-Pacific market in the adoption of, and plans for AI. Of the 10 unicorns in South East Asia, five are Indonesian. There has been a push from the government to develop domestic cloud computing infrastructure as well. Indonesia released its NSAI or *Stranas KA*[248] (*Strategi Nasional Kecerdasan Artifisial*) on 10 August 2020, which it has declared its National Technology Awakening Day. The 194-page document, *AI Towards Indonesia Vision 2045,* has identified four key focus areas: talent development; data infrastructure; industrial research;

and innovation with ethics and policy. Artificial Intelligence Research and Innovation Collaboration (KORIKA), an independent institution has been established within NSAI and is set to play a central part in building a collaborative ecosystem to foster innovation and drive Indonesia from a "natural resource-based country to an innovation-driven country", as envisioned by Bambang Brodjonegoro, Former Minister of Finance of Indonesia in its strategy document.

RESEARCH & DEVELOPMENT

Some 186 programmes have been identified in the strategy to assist in streamlining efforts including pilot schemes, regulations, plans, policies, and monitoring activities to enhance five national priorities—i.e., bureaucratic reform; food security; education and research; health services; and mobility and smart cities. The National Research and Innovation Agency (BRIN) has declared that AI will be used to support strategic sectors such as agriculture, energy, and cybersecurity, as well as the creative industries.[249]

With the launch of the NSAI, the Minister of Research and Technology also set in motion the electronic innovation catalogue to assist domestic technology developers in marketing their offerings and engaging with government procurement offices.[250] In 2021, Jakarta witnessed a market increase in investments in domestic start-ups or what it calls its "super apps". The country has set its focus on strengthening the quadruple helix that will foster innovation—it includes the government, enterprises, researchers or academics, and the people.

AI WORKFORCE

To become a digital economic powerhouse, Indonesia as part of its strategy has proposed approaches to enhance the AI mastery of its workforce.[251] BRIN is the agency responsible for

supporting AI mastery. However, AI will also have implications for the future of work. Indonesian officials recognise that the application of AI will only accelerate in the coming days and will have a massive impact on the future of work. As Nadiem Makarim, Minister of Education, Culture, Research and Technology has noted, this leaves Indonesia "with no choice but to

prepare ourselves to handle AI through character intelligence."[252]

Skills like creativity, resilience, sense of global unity, and teamwork are all traits that fall within "character intelligence" that need to be imbibed to thrive in this ever-evolving era of technology. Indonesia is also planning to introduce AI in universities and educational institutions to enhance the quality of knowledge dissemination as part of its *Freedom Study-Freedom Campus* initiative, to reduce administrative tasks, and personalise lesson plans. In 2021, the Ministry collaborated with Google for the Bangkit program to build a skilled talent pool in cloud computing, machine learning, user experience and user interface design.[253] The Ministry of Communications and Informatics has also been partnering with IBM since 2018 for the Digital Talent Scholarship (DTS) Stimulant Program that aims to hone the skills of the younger generation in data science, cybersecurity, and AI. These initiatives are part of the larger directive given by President Joko Widodo to build a skilled task force of nine million in the next 15 years.[254] Other programs like Bekraf Digital Talent and JuaraGCP are also intended to bridge the gaps in skills.[255]

> *During this pandemic, the President often told us that COVID-19 should be (seen as) a new stepping point. (It should be seen as a time for) Rebooting, restarting all of our engines. (This includes) the economic engine, digital-related education, the machine for accelerated digital transformation, welcoming Indonesia or pushing Indonesia to become a digital nation, Indonesia Towards Digital Nation.*

Johnny G Plate
Indonesia's Minister of Communication and Informatics.[256]

ICT INFRASTRUCTURE

The five-year national medium-term development plan for 2020-24[257] laid out investments for ICT infrastructure with the establishment of S&T parks, digital transformation, and industry 4.0. The Government is working on Indonesia's Digital Roadmap 2021-2024,[258] whose focus areas are digital infrastructure, digital government, digital economy, and digital citizens.[259] The country is one of the largest markets of cellular phones in the world. The state-owned telecommunication operator, Telkomsel, in 2021 started providing 5G services, amidst difficulties in providing broadband services given Indonesia's complex geography.[260]

DATA ECOSYSTEM

As part of the G20 Sherpa Track in 2022, Indonesia has been at the forefront of initiating the Digital Economy Working Group (DEWG) to prioritise digital-based transformation and promotion of sustainable development through digital economy. The DEWG has identified three priorities under Indonesia's presidency: connectivity; digital skills and literacy; and cross-border flows of trustworthy data.[261]

Indonesia is also the founding member of the Open Government Partnership (OGP), a multilateral initiative founded in 2011 to promote open governments,[262] and has made open data a critical area in its national action plan to enhance transparency and public service delivery.[263] Indonesia has a One Data Policy to improve data sharing and governing practices of internal government data. It identifies the responsibility and role of each stakeholder involved in the data cycle and ensures compliance with data standards and principles of data interoperability.[264] However, there remain issues around the quality and accessibility of data.

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263 Glenn Maail, "Key Challenges in Achieving Inclusive Open Data Governance in Indonesia", *Heinrich Böll Stiftung,* March 08, 2021, https://hk.boell.org/en/2021/03/08/key-challenges-achieving-inclusive-open-data-governance-indonesia.

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ITALY: TOWARDS A 'RADICAL UPGRADE'
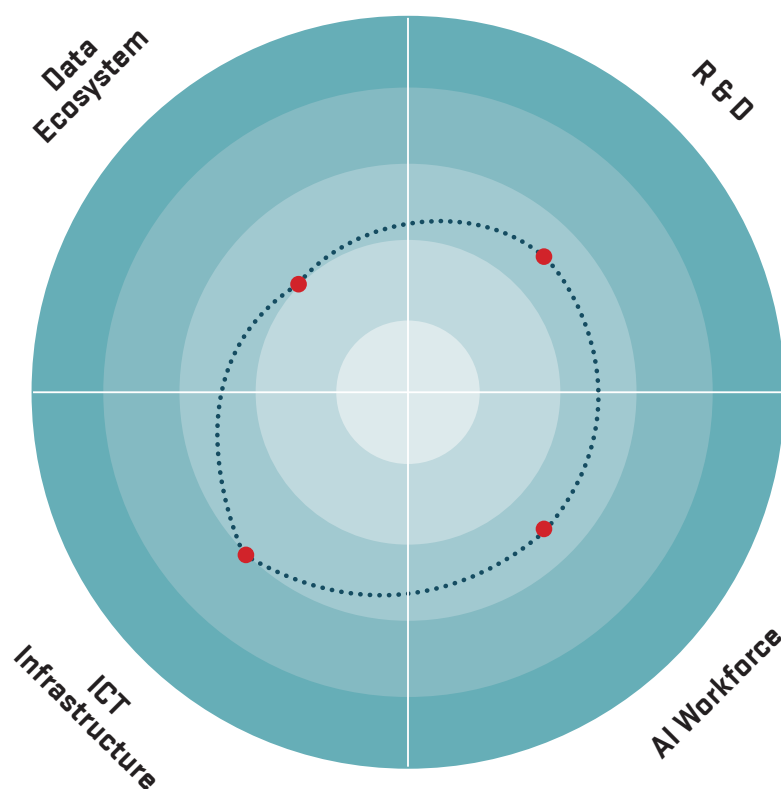
TALENT
HUNT

ENTREPRENEURIAL
COMPETITIVENESS

REGULATORY
SANDBOXES

"The ecosystem is characterized by vibrant research communities but these often lack scale and struggle to attract foreign talent."

Strategic Program for Artificial Intelligence

OVERALL STRATEGY

In October 2020, the same year that Italy took the reins of G20's 2021 presidency, the country's Ministry of Economic Development released a draft version of its *National AI Strategy*[265] for public consultation. The draft took stock of policy recommendations contained in a proposal for the Italian AI strategy[266] published in July 2020. At the time of writing this report, the final version of the Italian AI strategy is awaited. In late 2021, Italy released a *Strategic Program for AI*,[267] a "bridge" document, in consultation with the working group on AI which lays out six goals of the Italian strategy, 11 priority sectors where Italy intends to focus investments, and three areas of intervention. The Italian strategy envisions a public investment of US$1.05 billion. Italy's core AI strategy document is focused on the sustainable development of AI, competitiveness, AI-based skills and competencies, research, ethical framework, and a robust data infrastructure. Priority sectors are industry and manufacturing, food and farming, culture and tourism, health and well-being, environment, smart cities, and infrastructure and networks. Till date, Italy has logged less than 10 AI initiatives on the OECD dashboard.[268]

The national strategy emphasises the importance of public campaigns to inform citizens on the opportunities, risks, and potential misuse of AI. Broadly, the government is committed to better regulation, demand-side innovation policies, and fiscal incentives. The draft attempts a long-term vision for the sustainable development of AI with the following actions to facilitate AI development and competitiveness in Italy:

- Improving AI education at all levels, and providing lifelong learning and reskilling opportunities to the labour force;
- Fostering AI research and innovation to enhance entrepreneurial competitiveness;
- Establishing an ethical regulatory framework for a sustainable and trustworthy AI;
- Supporting (international) networks and partnerships;
- Developing a data infrastructure for AI applications;
- Improving public services through a wider adoption and use of AI systems.

RESEARCH & DEVELOPMENT

The Italian AI research ecosystem counts on a range of national centres of excellence such as the Artificial Intelligence and Intelligent Systems Laboratory (AIIS)[269] of the Italian Interuniversity Consortium for Informatics (CINI),[270] the Italian Institute of Technology (IIT),[271] and the Institute for Calculation and Networks for High Services (ICAR)[272] of the National Research Council (CNR).[273]

National R & D markers	Germany	France	U.K.	Italy
Share of GDP in Research (All, 2019)	3.17%	2.19%	1.76%	1.45%
Share of GDP in Research (government, 2019)	0.46%	0.28%	0.13%	0.20%
R&D expenses (All, millions Euros, 2019)	109544	53158	44364	25910
R&D personell per millions inhabitants (FTE, 2018)	8500	6950	7000	5150

Source: Italian Government, Strategic Programme on Artificial Intelligence 2022-2024, November 2021, Rome, https://wp.oecd.ai/app/uploads/2021/12/Italy_Artificial_Intelligence_Strategic_Programme_2022-2024.pdf.

In April 2021, the first laboratory dedicated to AI—the Pervasive Artificial Intelligence Laboratory (PAI Lab)— was inaugurated in Pisa. The PAI laboratory was born from the need to aggregate skills, infrastructures and resources to address the scientific challenges of AI that is transforming into a pervasive technology. Italy also put in place regulatory sandboxes to facilitate controlled experiments with innovative products, including AI. The initiative, called Sperimentazione Italia, provides grants to companies, universities, research bodies, university start-ups and spin-offs from any sector to test pilot projects in the field of digitalisation and tech innovation. Priority sectors for AI developments in Italy are industry and manufacturing, food and farming, culture and tourism, health and well-being, environment, smart cities, and infrastructure and networks.

AI WORKFORCE

Italy envisions various initiatives to strengthen AI education at all levels, such as improving teachers' digital skills; introducing applied AI courses in the higher technical institutes;[276] fostering female participation in AI subjects; and setting up a challenge to promote AI courses among students in the last two years of upper secondary schools and in the first three years of university.

As for higher education, Italy plans to integrate AI courses in Bachelor's, Master's, and doctoral programmes by including AI credits in academic courses for Master and Bachelor degrees; creating national training programmes in AI, and interacting with stakeholders in the labour market (companies, public services, tertiary education) to align education and required professional skills; and developing an investment strategy for doctoral studies, and training skilled professionals in cooperation with the industries where AI applications could most likely emerge.

ICT INFRASTRUCTURE

Although not specifically mentioned in its national AI strategy, Italy is also aiming for the development of a digital and telecommunications infrastructure. CINECA,[277] the computing centre, is a not-for-profit consortium set up by the ministries of Education and of Universities and Research, 69 universities, and 21 national institutions. CINECA aims to provide information services to the Ministry of Universities and Research, to the universities and the other consortium members, to the scientific community, and to the public education sector. This is done by guaranteeing performance infrastructure services for the Italian research system, and access to the European network of high-performance scientific computing centres. Moreover, Italy participates in the Joint Undertaking to develop a competitive European computing ecosystem (EuroHPC).[278] In terms of connectivity, Italy is expanding its ultra-broadband optical fibre network and exploring ways to extend its 5G network.

DATA ECOSYSTEM

Italy intends to define a data policy that promotes the collection, exchange, and re-use of data, while respecting privacy rights and ensuring interoperability based on standards. The strategy foresees creating a data market platform to support SMEs' data collection and exchanges; encouraging data-sharing agreements to promote the data economy; fostering the provision and re-use of public data in public service; and providing financial support to create an Italian Data Space with private and public stakeholders.

265   Ministero Dello Sviluppo Economico, *Strategia Nazionale per l'Intelligenza Artificiale,* September 2020, https://www.mise.gov.it/images/stories/documenti/Strategia_Nazionale_AI_2020.pdf.

266   Ministero Dello Sviluppo Economico, *Proposte per una Strategia italiana per l'intelligenza artificiale,* July 2020, https://www.mise.gov.it/images/stories/documenti/Proposte_per_una_Strategia_italiana_AI.pdf.

267   Italian Government, *Strategic Programme on Artificial Intelligence 2022-2024,* November 2021, Rome, https://wp.oecd.ai/app/uploads/2021/12/Italy_Artificial_Intelligence_Strategic_Programme_2022-2024.pdf.

268   The OECD.AI Policy Observatory maintains a dashboard of AI initiatives proposed or implemented by central or state governments of over 60 countries.

269   "Artificial Intelligence and Intelligent Systems- CINI National Lab", CINI, https://www.consorzio-cini.it/index.php/it/artificial-intelligence-and-intelligent-systems.

270   CINI- Consorzio Interuniversitario Nazionale per l'Informatica, https://www.consorzio-cini.it/index.php/en/about-us/union.

271   IIT-Istituto Italiano di Tecnologia, https://www.iit.it/.

272   ICAR-CNR: Istituto di Calcolo e Reti ad Alte Prestazioni, https://www.icar.cnr.it/en/#,

273   CNR- Consiglio Nazionale delle Ricerche, https://www.cnr.it/en.

274   "Nasce a Pisa il Laboratorio sull'Intelligenza Artificiale Pervasiva", *Consiglio Nazionale delle Ricerche,* May 06, 2021, https://www.cnr.it/it/nota-stampa/n-10232/nasce-a-pisa-il-laboratorio-sull-intelligenza-artificiale-pervasiva.

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276   "ITS Routes", Ministry of Education, https://www.miur.gov.it/percorsi-its.

277   CINECA, https://www.cineca.it/en.

278   "The European High Performance Computing Joint Undertaking", European Commission, https://digital-strategy.ec.europa.eu/en/policies/high-performance-computing-joint-undertaking.
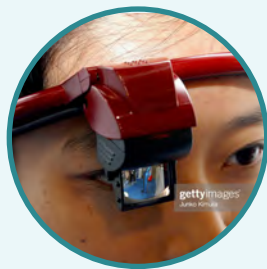
JAPAN: SOCIETY 5.0
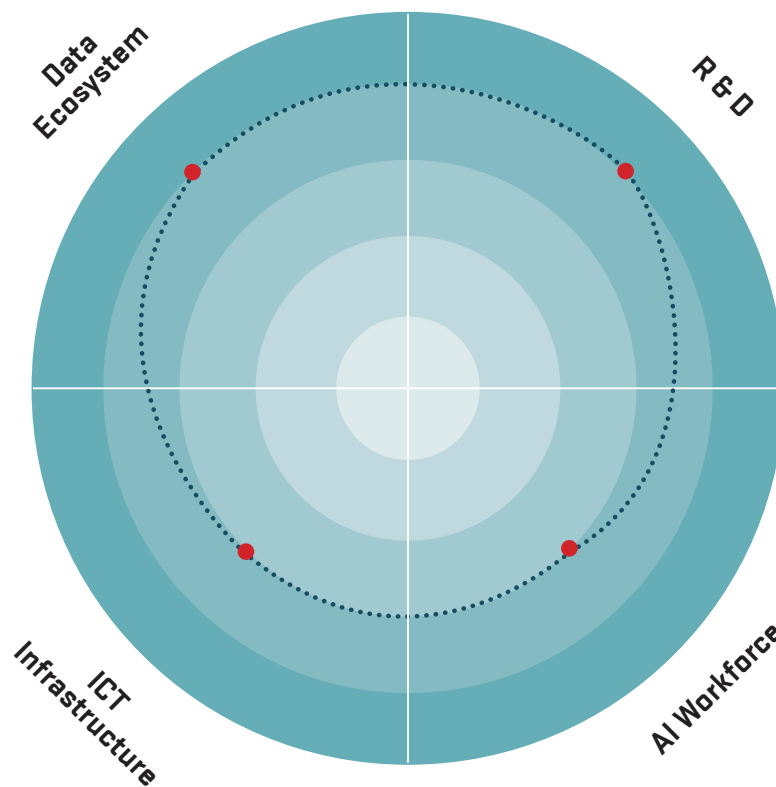
REAL-WORLD APPLICATIONS

DEEP TALENT POOL

DIVERSITY AT THE HEART OF SUSTAINABLE SOCIETY

"It is necessary to coordinate technology and social mechanisms in a transformational way in order to realize a sustainable society that incorporates diversity."

Japan's AI Strategy
2019

OVERALL STRATEGY

J apan was the second country after Canada to develop a national AI strategy. In June 2019, the Integrated Innovation Strategy Council, chaired by the chief cabinet secretary and the Minister for science and technology, released Japan's first comprehensive AI strategy, meant to be reviewed and revised annually. The most recent version, *Guidelines for the Practice of Artificial Intelligence ('AI') Principles,* [279] was released in January 2022 and is targeted at companies that develop AI systems, companies that operate AI systems, and data providers.

The strategy document highlights the country's trust that AI will define technology competitiveness and economic power, and that it can improve the quality of life and enable new kinds of mobility. At the same time, Japan is not agreeable to mass surveillance. As such, its strategy confronts a fundamental issue—how to maximise the benefits of AI and minimise the risks.

Japan's basic values on AI are aligned with those of the OECD countries. In March 2019, the country determined three social principles of human-centric AI: dignity, diversity and inclusion, and sustainability. The AI strategy document lists four strategic visions: 1) human resources; 2) develop and deployment to the

real world; 3) technologies for inclusion: and 4) international cooperation. The AI strategy identifies GPAI as a practical international framework initiative to align with global standards for AI and data governance. Japan is working with Australia, India, and the United States to promote the use of AI in line with democratic norms and values. Till date, Japan has logged 23 AI initiatives on the OECD dashboard.

RESEARCH & DEVELOPMENT

The AI Japan Research & Development Network was established in December 2019 by the National Institute of Advanced Industrial Science and Technology, the Institute of Physical and Chemical Research, and the National Institute of Information and Communications Technology.

AI WORKFORCE

Although Japan's core goals address the issues of AI talent shortage, the need to create new education programmes, attract talent with AI centres, and increase salaries, its approach to the AI workforce is based on a gap analysis and business-related pain points, with a commitment to stay agile and innovate. A 2021 Ministry of Economy, Trade and Industry guidebook focuses on employee development in AI and data science.[280] A similar manual also details concerns among SMEs about automation.[281]

> " *Human resources aligned with the needs of the AI era are not a uniform type of person.*

Japan's AI Strategy 2019

ICT INFRASTRUCTURE

Japan scores high on sophistication and access parameters of ICT infrastructure, including the government's online services and e-participation, but much of this is taken as given and not mentioned in detail in the strategy documents. The OECD AI Policy Observatory lists only two initiatives as it pertains to AI infrastructure. The "Fugaku" supercomputer acts as a central core connecting key supercomputers and storages of universities and research institutions in Japan via high-speed networks.

DATA ECOSYSTEM

Japan has taken an interesting approach to the data question. In keeping with its broader role in risk mitigation (for instance, consumer and social protection), the AI documents offer a string of case studies that seek to explain scenarios related to data use in varying contexts. Providing users with sufficient information on potential gaps and measures to address these is a pattern that runs throughout Japan's AI strategy documents, both for the consumer and the producer. Under the Unfair Competition Prevention Act, which came into force in July 2019, Japan established civil measures against the unauthorised acquisition or use of "data provided for limited business purposes".

279   Expert Group on How AI Principles Should be Implemented & AI Governance Guidelines WG, *Governance Guidelines for Implementation of AI Principles Ver. 1.0*, July 2021 https://www.meti. go.jp/shingikai/mono_info_service/ai_shakai_jisso/pdf/20210709_9.pdf.

280   "AI Data Guide", Ministry of Economy, Trade and Industry,   https://www.meti.go.jp/policy/ it_policy/jinzai/AIdataguide.pdf

281   "AI Utilisation", Ministry of Economy, Trade and Industry, https://www.meti.go.jp/policy/ it_policy/jinzai/AIutilization.html

282   "Unfair Competition Prevention Act", Ministry of Economy, Trade and Industry, https:// www.meti.go.jp/english/policy/economy/chizai/chiteki/index.html.

REPUBLIC OF KOREA: ASPIRATIONAL A.I. POWERHOUSE

COVERING ALL BASES TO BECOME 'LIGHTHOUSE FACTORIES'
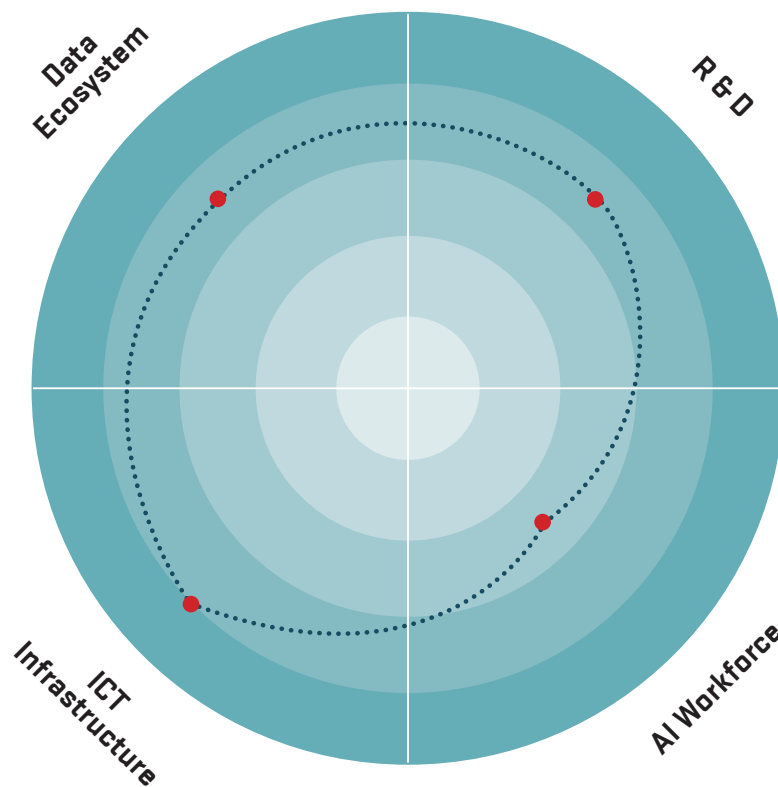
APPROVE FIRST, REGULATE LATER

OPENNESS BY DEFAULT ON PUBLIC DATA

"The advancement of AI will lead humanity into a world never experienced before. AI will not only affect industrial sectors but also solve many issues facing our society."

Moon Jae-in
Former President of the
Republic of Korea

OVERALL STRATEGY

In March 2016, a five-game Go match between AlphaGo, a computer programme developed by the UK-based DeepMind Technologies firm, that was trained to play the game using AI, and Lee Se-dol, a professional 9 dan rank[284] Go player from South Korea, was considered "the match of the century."[285] AlphaGo won four games out of five. The main challenge for AlphaGo was to beat one of the world's best players in a complex game that relies on creativity, strategic thinking, and intuition.[286] When announcing his retirement in 2019, Lee said there was now an "entity (AI) that cannot be defeated."[287]

AlphaGo's win perhaps propelled South Korea to prioritise AI to reap the benefits of the technology.[288] Indeed, just two days after Lee's defeat in 2016, the country announced a US$822-million investment in research on AI and allied information technologies over five years to facilitate private sector investment in flagship AI innovations. In December 2016, it also released the *Mid- to Long-Term Master Plan in Preparation of Intelligent Information Society*[289] to respond to the challenges and benefits of the "Intelligence Information Society" by establishing test beds.

In 2018, South Korea announced a US$1.95 billion investment as part of its five-year *AI Information Industry Development Plan,* with the central objective of enhancing AI Research & Development by securing AI talent through scholarships, trainings, and research institutes; increasing AI development in medicine, national defence, and public safety; and investing in infrastructural support for SMEs, such as AI startup incubators and semiconductor support.[290]

South Korea has made remarkable progress in building a stable foundation to capitalise on AI with investments in its technological infrastructure (ICT and 5G), technology innovations, and skill base. The Ministry of Science, ICT and Future Planning released the *National Strategy on AI*[291] in 2019 at DEVIEW, South Korea's largest AI developers' conference. The document establishes the country's vision—'toward AI world leader beyond IT'. In the preface, then-President Moon Jae-in stated, "The advancement of AI will lead humanity into a world never experienced before. AI will not only affect industrial sectors but also solve many issues facing our society."

In 2020, the Ministry of Economy and Finance released the *Korean New Deal: National Strategy for a Great Transformation*[292] to drive economic recovery amid the COVID-19 pandemic, and announced an investment of over US$249 billion to generate employment and boost the social safety net. The country also released the *National Guidelines for Artificial Intelligence Ethics*[293] in 2020, followed by the *Strategy to realise trustworthy artificial intelligence*[294] in 2021.

South Korea's successful transition from a low-income to high-income economy by leveraging its technological capability to increase exports of ICT infrastructure, mobile phones, and mobile chips,[295] led the World Bank to partner with it in 2021 to derive lessons for emerging economies under the Korea Digital Development initiative*.*

RESEARCH & DEVELOPMENT

The private sector is leading the charge on commercialising AI innovations, with the public sector providing infrastructural and investment support. South Korea has registered over 6,000 AI-related patents[297] in the past decade. Choi Yanghee, Minister of Science, ICT and Future Planning, stated in the *Mid- to Long-Term Plan in Preparation of Intelligent Information Society* released in 2016,[298] "I hope that the current public-private partnership will continue to flourish, as it will make it possible to

achieve the massive transformation and innovation required in all economic, social and other related systems of the Korean Nation."[299] Market leaders like Samsung, LG, Naver, and Hyundai have committed to invest in various projects in collaboration with other AI companies for on-device AI, AI chips, and Explainable AI.[300] The country has also established an AI-oriented startup incubator and investment funds to support AI startups. With an 'approve first, regulate later' approach, the government is looking to develop AI to gain market dominance and solve social and security issues, including public health, social welfare, women's safety, and crime.[301] In 2019, the government announced investments to make military capabilities "smarter" in order to support strategic autonomy.[302]

AI WORKFORCE

In addition to investing in more AI graduate schools and innovation academies, South Korea is also enhancing investments in preparing teacher trainers and introducing AI in school curricula. Existing universities have also been encouraged to develop more courses and departments related to high-tech fields and address the gap in demand in the industry.

ICT INFRASTRUCTURE

Building on the country's reputation as ICT leader with some of the fastest internet speeds globally and many large private sector companies, the national AI strategy demarcated investments and action strategies for cloud computing, semiconductors, and innovation clusters. However, South Korea's increased connectedness has come at the cost of its security and has made it the second-most exposed country to cyberattacks in the APAC region.[303] In 2019, the country released its first cybersecurity policy,[304] which relies on collaboration with foreign companies and increased investments in domestic cybersecurity solutions. South Korea is also planning to develop a 'Personal AI Shield' to identify and remedy security threats.[305]

DATA ECOSYSTEM

A core part of South Korea's infrastructural plan is its investment in increasing data supply by the public sector to be reused and reutilised for AI innovations. In 2020, the 4th Public Data Strategy Committee[306] announced the public data utilisation support strategy to promote innovation using public data during COVID-19, proper pseudonymisation of personal data in accordance with the updated laws, and consumer-oriented policies for the utilisation of public data. South Korea has been at the forefront of opening and using public data, especially with the 2013 Act on Promotion of the Provision and Use of Public Data; the push for 'openness by default' is balanced by data protection legislations that respect personal privacy, national security and intellectual property.[307]

283   Go is a two-person board game played majorly in Northeast Asia. On a 19x19 board, the game requires players to compete for most territory on the board by placing white and black stones.

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MEXICO: STRUGGLING ON THE OTHER SIDE OF THE SMART WALL

BOTTOM-UP
PUSH FOR AI

STRAINS IN
KNOWLEDGE
TRANSFERS

SOLVING FOR
PRODUCTIVITY

"The members of this movement have been working since the beginning of 2018 under a philosophy of co-responsibility of government, academia, industry and civil society, seeking that Mexico does not lag behind in the 4th Industrial Revolution, strategically take advantage of the benefits of AI and mitigate the possible ethical and social risks."

Coalition IA2030Mx
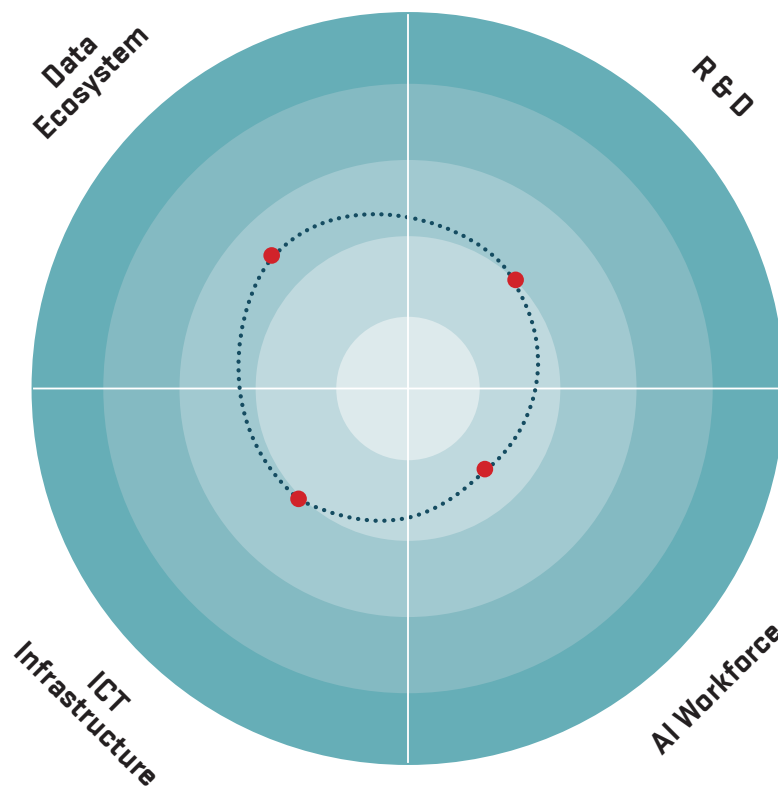
OVERALL STRATEGY

In 2018, Mexico became the first Latin American country to release a white paper on AI—*Towards an AI Strategy in Mexico: Harnessing the AI Revolution*[308] —and laid the foundation for a national AI strategy. The paper was commissioned by the British Embassy in Mexico in 2017 and was developed in collaboration with C Minds, a think tank based in Latin America and Oxford Insights, a policy consultancy based in England. Over 60 experts were interviewed across five thematic areas: data and digital infrastructure; government and public services; Research & Development; ethics; and capacity, skills, and education for the AI strategy. While the white paper was officially acknowledged shortly after its release by the Enrique Peña Nieto administration, its implementation was halted due to the change in government.[309] Similarly, the implementation of the Principles for the Administration of Artificial Intelligence released in November 2018 to guide the ethical use of AI by the public sector has also been stalled.[310]

Nonetheless, IA2030Mx,[311] a multisectoral coalition of academia, startups, and public agencies, has taken charge on AI adoption and policymaking in Mexico with the philosophy of "co-responsibility". The coalition is encouraging academic

institutions, enterprises, public agencies, professionals along with other significant actors in the digital ecosystem to participate in the creation of a National AI Agenda 2030 and the promotion of OECD AI principles to ensure Mexico does not lag behind in the 4IR. Additionally, C Minds, the Inter-American Development Bank and Meta Inc are partnering with industry and local regulators to build an AI transparency prototype[312] to enhance AI explainability.[313]

Mexico has been investing in AI research since 2004, with the establishment of the Artificial Intelligence Research Centre by the National Council of Science and Technology. As per the Government AI Readiness Index Report 2021,[314] Mexico has consistently scored well on its digital infrastructure and open data policies. However, on AI adoption in the government sector, it is doing only marginally better than the world average due to huge gaps in innovation, skills, and digitalisation. Importantly, Mexico's economy is driven by its manufacturing sector and job losses due to automation is a significant risk. Regionally, the infamous push for "building the wall" from the United States has made US tech firms deploy numerous technological tools like drones, surveillance cameras, robots to ensure the proverbial wall stands and monumentally increases public safety risks for Mexicans.

RESEARCH & DEVELOPMENT

At the state level, the Jalisco government stands out in defining an AI agenda to support government innovation through a subnational AI department, Ministry of Innovation, Science and Technology of Jalisco to support automation of public service delivery. The Mexican startup ecosystem has significantly expanded with enterprises like Artificial Nerds, Prosperia Labs, Nearshore Solutions, and Territorium Life offering numerous services to enhance efficiency of public service delivery using AI. The intersectoral and multistakeholder collaborations within Mexico allows its startups an enabling environment to ideate and design large-scale projects to address social challenges using AI. For instance, Universidad Nacional Autónoma de México has collaborated with the Secretaria de Relaciones Exteriores (foreign ministry) to develop AI solutions for migrant communities and has established an AI Lab with Microsoft.

AI WORKFORCE

In recent years, there have been significantly greater opportunities for graduates in AI and data science in public and private institutions like Tecnológico Nacional de México, the Instituto Politécnico Nacional, and Universidad Nacional Autónoma de México. Training courses on AI, data science, and user experience design are also being offered by startups like Dev.f, Laboratoria and Saturdays.AI to assist in building an AI-ready skill force, reducing gender gaps in technology, and motivating individuals and startups to use AI to solve social problems.

ICT INFRASTRUCTURE

In 2017, Mexico released its *E government Strategy*[315] to build and enhance the domestic technological infrastructure such that it can be leveraged for AI development. The strategy's focus areas include digital economy, government transformation, educational transformation, civil innovation, and effective universal health care. In 2019, the Andrés Manuel López Obrador administration proposed establishing a Social Coverage Program to provide telecommunications, network, and radiofrequency services to marginalised communities at the risk of digital exclusion. It also commenced public bidding for 5G frequencies in 2020. Mexico moved up to the 59th spot in the 2021 Network Readiness Index from 76 in 2020 among 130 countries. *Gob.mx*, an integrated platform has been instrumental in digitising most public services across strategic sectors and enhancing the efficiency of the government by facilitating the process of information exchange between state agencies.

DATA ECOSYSTEM

The Ministry of Economy along with Datawheel, a private enterprise that builds data integration solutions launched Data México[317] to improve the analysis that goes into informing public policies using data integrations from databases (such as on employment and education) to create visualisations to promote innovation and the diversification of the Mexican economy. Data México has also defined the terms of data usage and open-sourced the data for all stakeholders. The AI Strategy in Mexico white paper also focused on investing in 'resilient open data infrastructure' to facilitate the exchange of good quality data while maintaining individual privacy. Moreover, the E-government Strategy also mentioned open data and digital interoperability as enablers for the government to achieve its objectives.

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RUSSIA: BETTING ON AUTOMATION IN THE BATTLEFIELD
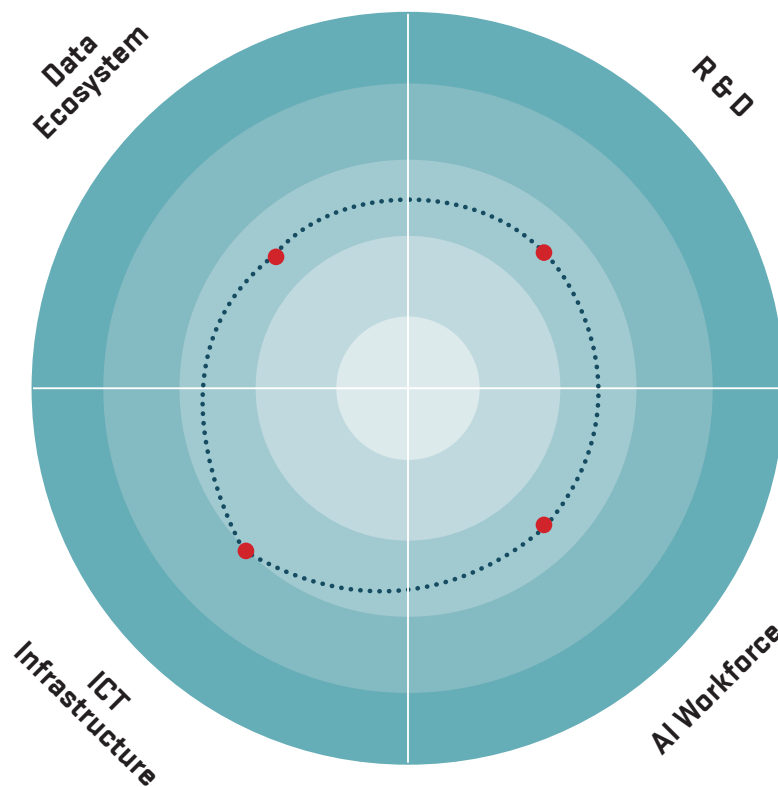
STATE-BACKED INNOVATION

FROM DIGITALISATION TO INTELLECTUALISATION OF MILITARY

'HUMAN IN THE LOOP' FOR OTHER NATIONS, COMPLETE AUTONOMY FOR US

"Whoever becomes the leader in this sphere [Artificial Intelligence] will become the ruler of the world."

Vladimir Putin
President of Russia

OVERALL STRATEGY

Although Russia views innovation as key to its global positioning and continues to increase sectoral investments, its standing in global rankings, such as the Global Innovation Index 2021,[318] remains low. The ongoing war on Ukraine has led to many international actors exiting partnerships in Research & Development projects[319] or placing sanctions on the Russian state and entities. The partial removal of Russia from the global SWIFT banking system has also isolated the country and will significantly impact its AI investments.

In July 2017, the government released the *Digital Economy of the Russian Federation,*[320] a strategy focused on enhancing AI development by creating a favourable legal and policy environment, and incentivising state companies to build competence centres or research communities for AI Research & Development and standards for AI. State-backed companies have played a key role in investing in various AI projects and fostering public-private partnerships in Russia. The Russian AI association was also designed to encourage technology transfers and collaboration between researchers in academia and enterprises. In March 2018,

the ministries of defence and education announced a 10-point plan for AI to create a consortium of stakeholders across sectors, establish a fund to source expertise on AI systems, build an AI lab, provide specialised AI education, and organise war games to determine the impact of autonomous systems in the military.[321]

In October 2019, Russia released the *Decree of the President of the Russian Federation* on the Development of Artificial Intelligence in the Russian Federation, its national strategy for AI development.[322] The strategy set out a number of initiatives and goals for the short- (till 2024) and medium-term (till 2030) to improve the entire lifecycle of AI development and demarcate allocations in the federal budgets between 2020 and 2030. It builds on the previous strategies, such as *Digital Strategy* released in 2017, *Strategy for the Development of an Information-Oriented Society* published in 2017, and *Roadmaps for National Technology Initiative* started in 2014, that provided the vision for leveraging the evolving digital

landscape. The strategy identified the availability of a skilled workforce specialising in mathematics, information science, and physics as a strength, alongside the country's information and communication infrastructure and the global demand for AI tools that employ computer vision, such as self driving cars. Despite establishing principles for AI development that underpin the protection of human rights, the demand for recognising new and emerging military threats has pushed the Russian leadership to invest in technological tools that can assist in such tasks.[323] The defence ministry has been central in the intellectualisation of military applications in AI through investments in research, development, test and evaluation. Notably, in December 2021, Russia opposed negotiations at the United Nations to ban the use of Lethal Autonomous Weapon Systems (LAWS).[324] While Russia has not employed LAWS yet, it has used AI in the war on Ukraine to support information warfare by creating deep fakes and spreading misinformation. [325]

Clusters of companies by AI research	
Computer vision	63
Business Intelligence and Analytics	63
Natural Language Processing	48
Healthcare	48
Data analysis	46
Advertising	27

Legaltech	26
Financial technologies	18
Robotics	16
Cyber security	14
Retail	13
Industry	11
Internet of Things	10
Speech recognition	10
Logistics	7

Source - Jeffrey Edmonds, Samuel Bendett, Anya Fink, Mary Chesnut, Dmitry Gorenburg, Michael Kofman, Kasey Stricklin, and Julian Waller, *Artificial Intelligence and Autonomy in Russia,* CNA, 2021,
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RESEARCH & DEVELOPMENT

According to Stanford's AI Index 2021,[326] Russian researchers published fewer than 50 AI-related academic papers in peer-reviewed journals in 2019. Russian AI outputs are most visible in military use, such as in surveillance systems, deep fakes, information warfare and autonomous drones. However, the secretive nature of its military and defence companies makes it difficult to accurately assess current investments, ongoing research projects, and publications. While it appears that Russia and China are collaborating closely, given the increase in the number of research hubs that enterprises like Huawei have established recently,[327] Russia is more likely to collaborate with its US counterparts for research, as noted in the Stanford AI Index report. However, considering the latest Western sanctions and their firms ceasing operations in the country, Russia will likely be forced to closely partner with China to build on its AI advancements and cloud computing infrastructure.

In its national strategy for AI development, Russia envisions the use of technology that cuts across the various sectors of the economy to enhance efficiency, productivity, employee safety, customer satisfaction, and the quality of public services, including healthcare and education. It also acknowledges that deployment by public authorities could assist in generating demand for AI. By 2024, Russia aims to augment its rank in the global citation index, registration of results from intellectual activities, and applied technological solutions.

AI WORKFORCE

The impact of the ongoing Ukraine war is being felt deeply by the Russian IT industry. According to the Russian Association of Electronic Communication, around 70,000 IT professionals have moved to other parts of the world as Western sanctions limited their access to resources required to perform their jobs.[328] Nevertheless, Russia's national AI strategy states that it is looking to create high-productivity AI jobs that attract and retain talent from within and outside the country by providing competitive financial packages and favourable work conditions. To prepare the existing workforce, the strategy proposed introducing educational modules and financial incentives for training and retraining citizens in the field of programming, mathematics, data analytics, and machine learning. It also proposed improving the quality of natural science and mathematical education in schools and integrating it with humanities, along with public information and organisation of technological tools. Russia is aiming to address the gaps in skilled workforce by 2030.

ICT INFRASTRUCTURE

Russia's IT market has emerged as one of the largest in the world in recent years, and is expected to accommodate more than 120 million domestic internet users by 2025. Russia is leading the IT sector in the provision of services, software, and hardware solutions. The pandemic-induced economic stress pushed the country to institute mechanisms to reduce corporate tax rates, provide innovation support to startups, facilitate digitisation processes for SMEs, increase the adoption of Internet of Things, among other initiatives, to make the IT industry internationally competitive. One of the core objectives identified within the national AI strategy was increasing the availability of hardware required to facilitate AI development, including computing system architecture and high-performance data processing centres, by implementing state-back support measures for development and sourcing.

DATA ECOSYSTEM

One of the primary objectives of the national strategy for AI development is to improve the access, quality, and quantity of structured data to develop AI. Russia is attempting to do this by formulating structured methodologies for collecting, labelling, and describing data, and evaluating compliance with the procedure. To enhance access to such datasets, the strategy proposes building public platforms by 2024 based on the priority areas identified by the Russian leadership and according to the requirements identified by law.

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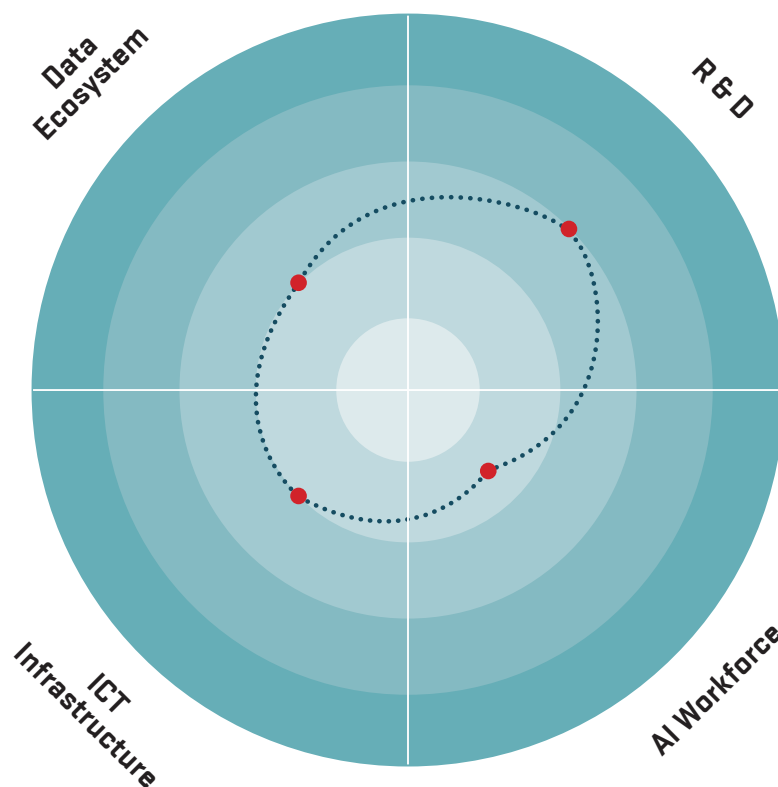
SAUDI ARABIA: OIL TO DIGITAL

MULTI-PHASE PLAN

OPENING AI GATEWAYS OF WEST ASIA FOR CHINA

BANKING ON TEST-BED OPPORTUNITIES

"We are ready to lead a knowledge-based economy. I hope that Riyadh will be a hub for AI."

Dr. Abdullah Sharaf Al–Ghamdi
President of Saudi Authority for Data and Artificial Intelligence

OVERALL STRATEGY

I n 2020, the Kingdom of Saudi Arabia hosted the 15th G20 Summit, the theme of which was 'Realising Opportunities of the 21st Century for all'. The Chair at the G20 Digital Economy Ministers Meeting[330], stressed on digital transformation being the "largest transformational lever for growth and acceleration…with three agenda items, digital and physical focusing on youth and women, how we safeguard the planet, and shape new frontier." Among other commitments for a global coordinated response to the COVID-19 pandemic, Saudi Arabia was also able to secure a historic consensus among the G20 Digital Economy Ministers on trustworthy AI, data flows, and the digital economy.

By granting complete citizenship and legal personhood to a robot named Sophia[331] in 2017, Saudi Arabia leapfrogged the process of embracing AI, which commenced in 2016 with the *Saudi Vision 2030*[332] document and *National Transformation Program 2020.*[333] The vision document sets the goal for the country for the next 15 years by building on three pillars: an ambitious nation, a vibrant society, and a

thriving economy using technology. The pillars find their footing in Saudi Arabia's intrinsic strengths due to its geographical position in West Asia and the potential of becoming an investment powerhouse by connecting Africa, Asia, and Europe.

Saudi Arabia is also working on the NEOM city project,[334] which is set to integrate AI and robotics in all aspects of the city, such as healthcare and education (like Smart Pharmacy Robot, Doctor B2 and TEQANI).[335] To build a robust AI ecosystem, Saudi Arabia has also set up a nodal agency, Saudi Data and Artificial Intelligence Authority (SDAIA), which houses the National Centre for AI (NCAI)[336], National Information Centre,[337] and National Data Management Office.[338] SDAIA released the *National Strategy for Data and AI – Strategy Narrative*[339] in 2020, which proposes a multiphase approach with the initial focus on addressing national priorities and creating a niche in the AI domain for a competitive advantage by 2030, followed by becoming a leading exporter and utiliser of AI after 2030. SDAIA is also responsible for ensuring the implementation of the G20 AI principles for sustainable development, wellbeing, and inclusive growth.

Majid AlShehry, a spokesperson for SDAIA, while describing the strategy document stated, "Data and AI are at the heart of Saudi Arabia's Vision 2030."[340] Saudi Arabia has incrementally increased investments in its private sector enterprises to amplify entrepreneurship and technological capabilities for the country's economic growth.

The United States has had a central role in supporting the Gulf Cooperation Council countries navigate their complex regional security challenges.[341] However, the possibility of a "post-American future" has forced countries like Saudi Arabia to forge partnerships with India, the European Union, South Korea, Japan, and China.[342] While the idea is to not challenge the status quo, China's growing importance in the region as Saudi Arabia's largest trading, strategic infrastructure, and economic partner has pushed the nation to rival the United States and China.[343] In the attempt to become a test bed for emerging technologies for other countries, Saudi concerns around China potentially exuding influence using data generated by Saudi Arabia and its detention of Uyghur Muslims[344] have taken a backseat. For Saudi Arabia, investing in its relationship with China and cooperating on the Maritime Silk Road initiative[345] is in sync with its Vision 2030 document, which seeks to diversify the Saudi economy and decrease the dependence on oil for international trade. Chinese firms[346] like Huawei[347] and Alibaba[348] have signed memoranda of understanding (MoUs) with Saudi Arabia to offer

support through each stage of technological innovation. Additionally, SDAIA has collaborated with international firms like IBM to deploy AI uses cases across sectors,[349] with the UN to build global cooperation on issues around fostering capabilities,[350] with International Telecommunication Union to optimise benefits for sustainable development from AI,[351] and with the World Bank to ensure that developing countries are not left behind in the AI race.

VALUE OF CHINESE INVESTMENTS AND CONTRACTING IN SAUDI ARABIA BY SECTOR, 2013-2019
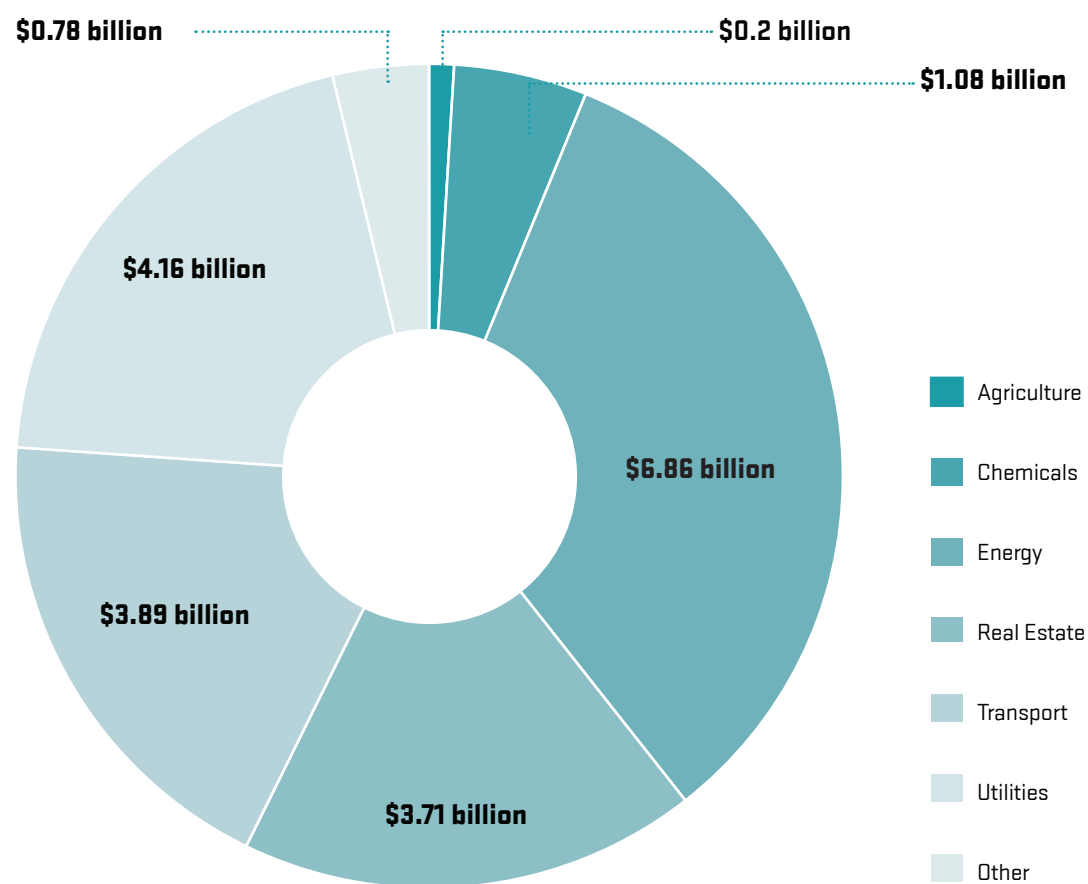
Source: Jonathan Fulton, "Strangers to Strategic Partners: Thirty Years of Sino-Saudi Relations", Washington DC, Atlantic Council, 2020, https://www.atlanticcouncil.org/wp-content/uploads/2020/08/Sino-Saudi-Relations_WEB.pdf

RESEARCH & DEVELOPMENT

The NCAI is responsible for driving research and innovation on AI solutions, the execution of AI strategy, and building AI expertise. In 2021, Saudi Arabia launched 'Hima', a US$670-million initiative to support innovation among private enterprises.[353] Notably, Saudi Arabia has also made multi-billion investments in Uber, Softbank, Tesla, and the Virgin Group to attract foreign private enterprises to invest, develop and deploy AI in the country.[354] Saudi Arabia has signed MoUs with foreign technology enterprises like Royal Philips[355] and IQVIA[356] to enhance its AI footprint in healthcare. It has also committed to invest US$20 billion over the course of a decade and seeks to establish 300 AI startups by 2030.[357] SDAIA and King Abdullah University of Science and Technology also signed a MoU to join hands for research on AI and modern technologies on health, energy, water, healthcare and so on with academic programs.[358] Saudi Arabia also established the AI Centre for Advanced Studies[359] and the King AbdulAziz City for Science and Technology[360] to facilitate AI research and innovation.

Saudi Arabia envisions its smart cities and centres of innovation as creating an environment for international collaborations and of becoming a testbed for innovation on AI. In 2021, the Saudi Centre for International Strategic Partnerships hosted a roundtable with the Italian Trade Commission; the Association of Italian Manufacturers of Machine Tools, Robots, Automation Systems and Ancillary Products; the Italian Embassy in Riyadh; the Polytechnic Institute of Turin; and the Italian Institute of Technology to discuss how NEOM city could be a testbed for advanced AI innovation.[361]

AI innovation in healthcare systems is a core interest area for Saudi Arabia, with investment plans aimed at "democratising healthcare" to provide universal access to all.[362] Through the Research Products Development Company, the national centre for technology development and commercialisation, Saudi Arabia founded a public investment fund to assist in the commercialisation of AI research. It is also expanding the investment focus to environment by using AI to monitor the growth of trees and efficient irrigation,[363] and inaugurated an AI centre for energy in 2021 as part of SDAIA's MoU with the Saudi Ministry of Energy.[364] The NCAI will also be collaborating with Alibaba Cloud to develop AI for smart cities to enhance efforts on mobility, energy, urban planning, education and health.[365]

In 2020, Saudi Arabia hosted the virtual Global Artificial Intelligence Summit,[366] under the theme 'AI for the good of humanity', with the participation of experts, policymakers, specialists, investors, and technology enterprises from 144 countries.

The country hosted a similar large-scale technology meet, LEAP International Technology Conference, with the theme 'eye on the future' in 2022. LEAP is a strategic attempt led by the Saudi Federation for Cyber Security and Programming   and Ministry of Communications and Information Technology, to position Saudi Arabia as a technology powerhouse and improve investment opportunities for tech startups.[367]

AI WORKFORCE

In 2021, Saudi Arabia launched a series of initiatives to foster a skilled AI workforce. It allocated US$1.2 billion to improve the digital skills, including cybersecurity, AI, programming, and gaming, of about 1,00,000 youngsters by 2030. School curriculums are also being updated to introduce modules on AI and special training courses and boot camps on machine learning and AI as developed by the Ministry of Communications and Information Technology. Additionally, increased cooperation across academic institutions is being fostered to develop certification programmes on data and AI skills.

For the most part, Saudi Arabia is relying on private enterprises to attract and train talent to assist with the ambitious plan laid down in the 'Vision 2030' document. Artefact, an AI and data services-focused consulting firm, is currently establishing its operations in Saudi Arabia and will invest in domestic talent.[368] The Saudi Digital Academy within the Ministry of Communications and Information Technology is responsible for building digital capabilities and signed a MoU with Huawei in 2022 to jointly sponsor and train 8,000 citizens on AI, cybersecurity, 5G uses, and cloud computing at Huawei accredited centres.[369] Google has also committed to open five innovation hubs in the country to train citizens in programming skills.[370]

ICT INFRASTRUCTURE

Saudi Arabia has planned to invest US$27 billion in ICT infrastructure[371] —such as the Internet of Things, cloud computing, blockchain, and metaverse—by 2025. It announced funding of over US$6.4 billion during the 2022 LEAP Conference, including a US$1-billion investment in NEOM Tech & Digital Company.[372] NEOM is also planning to launch its metaverse. Prosperity 7, state-owned oil firm Aramco's venture capital firm, will invest US$1 billion in enterprises working on novel technologies such as blockchain.[373] The National Information Centre also launched the government's cloud, Deem, to enhance efficiency in providing e-services, high information security standards, and reduce digital infrastructure costs.[374] Additionally, as part of LEAP, Saudi Arabia signed agreements with two leading AI enterprises, Roche and Microsoft Arabia to utilise AI and cloud computing to diagnose early-stage cancer.[375]

DATA ECOSYSTEM

The National Information Centre is responsible for collecting and hosting all government data, essentially operating like a government data bank. The centre's Estishraf platform[376] was instituted to assist the government in decision-making by providing data insights using AI. The insights are supervised by multidisciplinary teams to ensure that they serve the government's key priorities and assist in improving the lives of citizens using better public service delivery. The National Data Management Office is responsible for developing policies, standards, and regulations to ensure national data is utilised as an asset while maintaining data privacy. The availability and standardisation of open data is identified as a priority area and the government has invested in platforms that facilitate its sharing. SDAIA has released a host of laws and policies related to data governance, such as the *Personal Data Protection Law,*[377] *Data Classification Policy,*[378] *Open Data Policy,*[379] *Data Sharing Policy,*[380] and *Freedom of Information Policy.*[381]

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SOUTH AFRICA: UPHILL CLIMB

THREAT OF DEEPENING AI DIVIDE
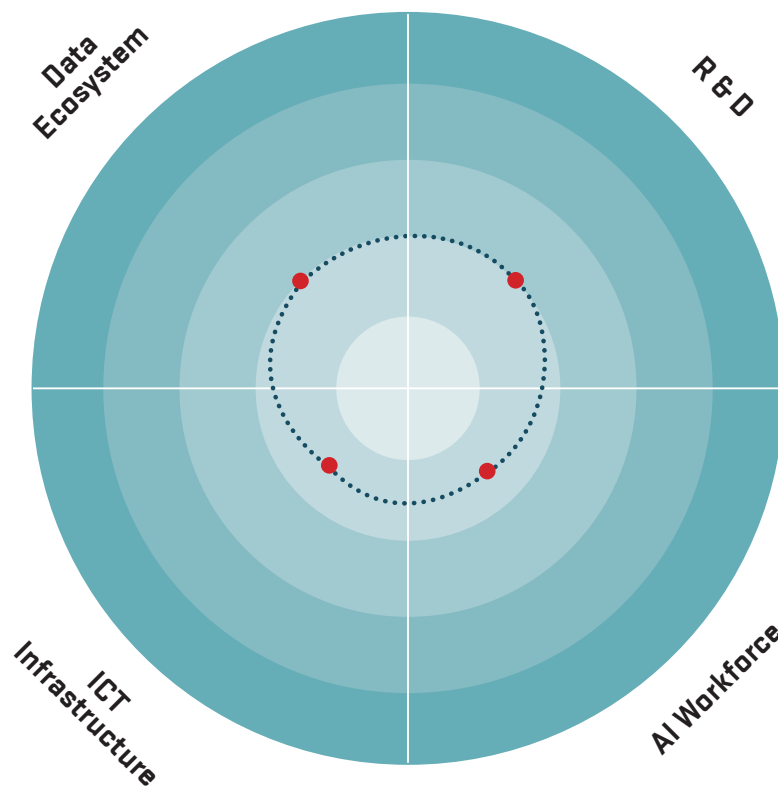
SOLVING FOR STRUCTURAL CHALLENGES THROUGH AI

SEEKING LIFE SUPPORT FROM CHINA

"Our prosperity as a nation depends on our ability to take full advantage of rapid technological change."

Cyril Ramaphosa
President of
South Africa

OVERALL STRATEGY

South Africa has yet to release an AI strategy. However, in its attempt to foster technological innovation and play catch-up with other economies, it became the first country to grant a patent to an AI system, when the Companies and Intellectual Property Commission[382] issued a patent to DABUS (Device for the Autonomous Bootstrapping of Unified Sentience) in 2021.[383] It acknowledged DABUS as the inventor of a food container that is designed to make pick and stack easy for robots using fractal geometry. However, concerns around an AI system's capability to possess or exercise intellectual property rights remain unaddressed. Nonetheless, the goal of improving efficiency and addressing socioeconomic challenges through technological solutions guides South Africa's approach towards AI. President Cyril Ramaphosa has placed 4IR at the forefront of his growth strategy, stating that the country's prosperity is dependent on the "ability to take full advantage of rapid technological change".[384]

The country has been working to systematically address the gaps in the policy environment to foster innovation. It has made serious attempts to reform its patenting system through the *Intellectual Property Policy of the Republic of South*

Africa 2018,[385] the Department of Science and Technology's 2019 White Paper on Science, Technology, and Innovation,[386] the Presidential Commission on the Fourth Industrial Revolution in 2019,[387] and the proposed National Data and Cloud Policy in context of Electronic Communications Act 36 of 2005[388] in 2021. However, changes in the policy environment must necessarily be accompanied by investments that address structural concerns around infrastructure, datasets, and innovations to ensure economic growth.

RESEARCH & DEVELOPMENT

In 2018, the country launched the *Intsimbi Future Production Technologies Initiative*[389] (IFPTI) to promote the development of industrial capacities for 4IR. IFPTI chairperson Bob Williamson has stated that the initiative will assist in addressing challenges from 4IR to enhance the manufacturing sector and build innovative solutions by adapting to the use of technologies such as AI, robotics, nanotechnologies, and quantum computing.[390] The IFPTI has rebranded and expanded on the National Technologies Implementation Platform from the earlier *National Tooling Initiative Programme* to guide South Africa to maximise the socio-economic benefits from 4IR. The country's vibrant innovation and entrepreneurial spirit has given it a lead in AI R&D among its regional counterparts, but surpassing the G20 economies will be a long road ahead.

AI WORKFORCE

While the Global Innovation Index 2021 ranks South Africa in the top three innovation leaders in Sub-Saharan Africa, the gaps in human capital, such as engineers and scientists, remains a challenge for the economy as it prepares for 4IR. Its market and business sophistication, and knowledge and technology outputs are notable, but there remain significant weaknesses in the number of science and engineering graduates, pupil-teacher ratio, and tertiary enrolment needs.

ICT INFRASTRUCTURE

Access to, and affordability of digital services is a pressing concern for South Africa. This is despite performing well on 4G penetration with 94 percent of citizens having access to it and digitally deliverable services trade is at 28 percent. However, the penetration of fixed broadband (2.2 percent) and SIM cards per 100 people (13.8) percent remain muted.[392]

DATA ECOSYSTEM

The Protection of Personal Information Act (POPIA) was introduced in 2014 in South Africa but came into effect in 2020. The law is intended to protect the personal information of citizens and ensure their privacy. Established under the Open Government Partnership, Open Data South Africa,[393] has been a recourse for public data sources to encourage use of government data by the communities. The project is a joint initiative by the Department of Public Service and Administration, Centre for Public Service Innovation, OpenUp, Innovation hub, Open Cities Lab, Human Sciences Research Council, and Geekulcha. Open Data South Africa has also been fostering community engagements to explore novel uses of government data. To ensure such efforts are sustainable, there is a need to establish permanent data processes with support from stakeholders across the board.

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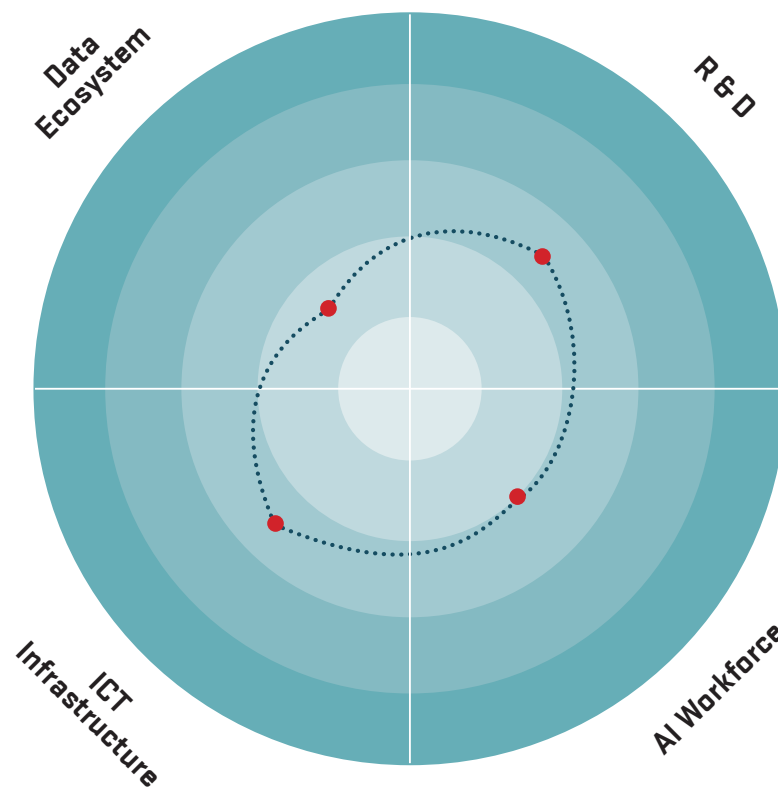# TURKEY:
TAKING CHARGE
ON MILITARY A.I.

MUDDLED
PRIORITIES

FOR INDEPENDENT
FOREIGN POLICY
SEEPING INTO AI

GENERATING
GLOBAL DEMAND
FOR DOMESTIC
ENTERPRISES

"The field of artificial intelligence is not a matter of choice, but one of the biggest bearers of our development goals."

Recep Tayyip Erdogan
President of Turkey

OVERALL STRATEGY

After years of speculation around Turkey's AI strategy, the Presidency of Turkey's Digital Transformation Office (DTO) and the Ministry of Industry and Technology (MoIT) released the *National Strategy on AI* (NSAI)[394] in August 2021. "The field of artificial intelligence is not a matter of choice, but one of the biggest bearers of our development goals," President Recep Tayyip Erdogan noted in the preface of the AI strategy. The launch was held in Turkey's Informatics Valley in Kocaeli and featured the use of holograms and AI characters.[395] The delay in releasing the NSAI is not an indication of the country's pace of AI adoption. Indeed, Turkey is leading in the adoption and export of military applications of unmanned aerial vehicles[396] to countries like Poland,[397] India,[398] Ukraine,[399] and Azerbaijan.[400]

While Turkey's economy has reached record-high inflation of around 36 percent and the value of its currency dropped by 44 percent in 2022,[401] the country is witnessing an increase in exports[402] and the indigenisation of technology.[403] Despite the Uyghur Muslim issue, Turkey has maintained strong ties with China to back its manufacturing boom and exports to Europe with capital equipment and semi-finished goods.[404]

Turkey made an official commitment to AI in 2019 as part of its *Eleventh Development Plan (2019-2023)*.[405] The plan noted that the country could strengthen its public service delivery and the economy by amplifying vertical and horizontal AI adoption. Notably, the strategy does not mention the use of AI in the defence sector under its priority sectors,[406] despite Turkey's inclination to lead in the development of military AI. Turkey has recognised the multisectoral impact of the development and deployment of AI across different sectors in industry, education, cybersecurity, smart cities, and transportation, and has prepared multiple thematic strategy documents to support the NSAI.

The Science, Technology, and Innovation Policies Council is also working on developing an AI technology roadmap to include targets for AI adoption in priority sectors and R&D projects. Turkey has also established the Department of Big Data and Artificial Intelligence under the Ministry of Justice's Directorate-General for Information Technologies, the Artificial Intelligence and Wearable Technologies Unit under the Ministry of Health's General Directorate of Health Information Systems, and the Department of Process Management and Artificial Intelligence within the Ministry of National Defence's Department of Communications and Information Systems.
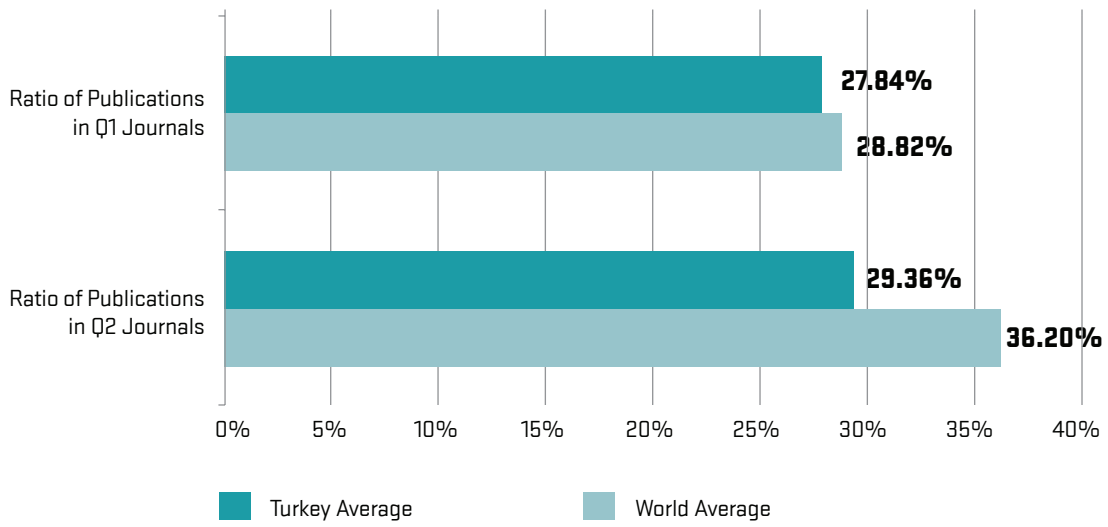
RESEARCH & DEVELOPMENT

Turkey is ranked 41 in the Global Innovation Index 2021. The country has seen an incremental rise from 2009 in investment in AI Research & Development projects by TÜBİTAK (Scientific and Technological Research Institution of Turkey) and a number of venture capitalists. With over US$115 million invested in some 1,715 projects, TÜBİTAK funds most of the AI R&D projects. Much of the focus of private enterprises is on investing in and registering patents for dual-use technologies that can be used for military purposes. Many research centres have also been established to foster research—these include the Turkish National Science e-Infrastructure with TÜBİTAK National Academic Network and Information Centre; the Neuroscience and Neurotechnology Centre of Excellence with the International Telecommunication Union; development and training centres; and robotics and AI laboratories with Boğaziçi University. The DTO's Big Data and AI Department[407] is responsible for coordinating the application of AI in public priority sectors. MoIT's General Directorate of National Technology is responsible for policy recommendations and strategies that enhance R&D and human capabilities in advanced technologies like AI, big data, and cybersecurity along with businesses in critical sectors.

WORLD AND TÜRKIYE AI PUBLICATION QUALITY RATIOS, 2009-2018

Ratio of Publications in Q1 Journals
- Turkey Average: 27.84%
- World Average: 28.82%

Ratio of Publications in Q2 Journals
- Turkey Average: 29.36%
- World Average: 36.20%

Legend: Turkey Average | World Average

Republic of Turkiye-Ministry of Industry and Technology, Presidency of the Republic of Turkiye-Digital Transformation Office, National Artificial Intelligence Strategy 2021-2023, August 2021, https://cbddo.gov.tr/SharedFolderServer/Genel/File/TRNationalAIStrategy2021-2025.pdf

DISTRIBUTION OF TÜBÌTAK AI FUNDS AND GRANTS, 2009-2019
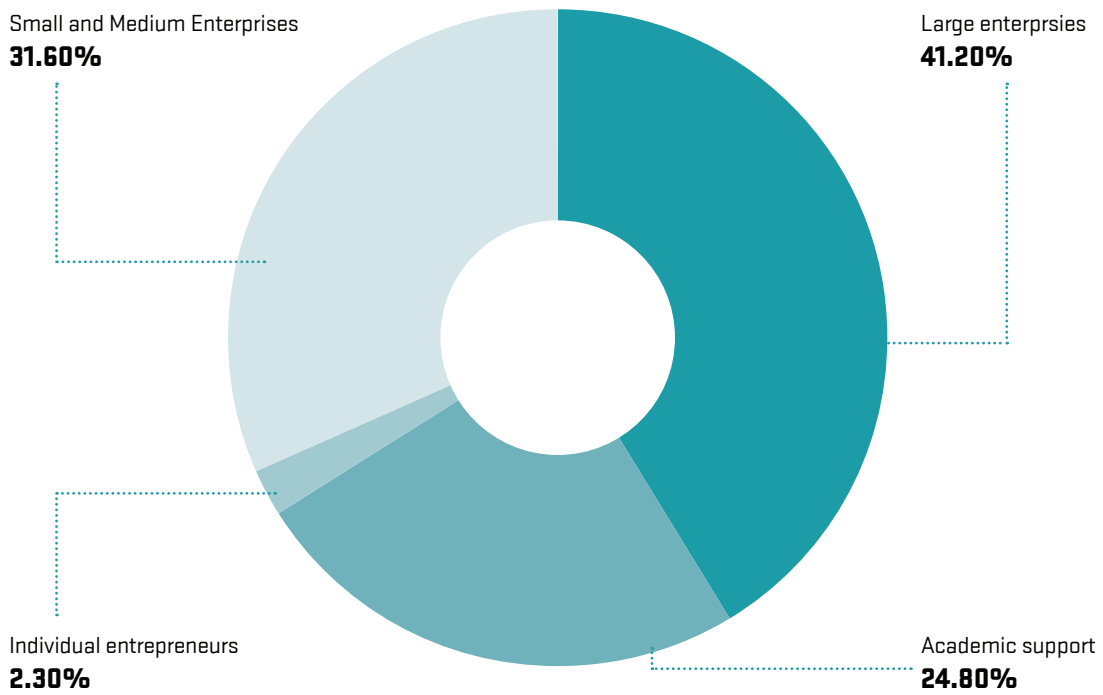
- Small and Medium Enterprises: 31.60%
- Large enterprsies: 41.20%
- Individual entrepreneurs: 2.30%
- Academic support: 24.80%

Republic of Turkiye-Ministry of Industry and Technology, Presidency of the Republic of Turkiye-Digital Transformation Office, National Artificial Intelligence Strategy 2021-2023, August 2021, https://cbddo.gov.tr/SharedFolderServer/Genel/File/TRNationalAIStrategy2021-2025.pdf

Turkey has several market-entry barriers for established Western technology firms, giving domestic startups the space to generate demand in the local market and gradually expand globally.[408] Indeed, several domestic startups and game developers, such as Hepsiburada, Trendyol, Getir, and Peak Games, have reached the billion-dollar evaluation mark.[409] However, gaps in bureaucratic structures and a complex tax regime continue to constrict new startups.

AI WORKFORCE

TÜBİTAK AI Institute was established in 2020 to facilitate interdisciplinary and multistakeholder interactions among researchers for training, developing AI solutions, and fostering the AI startup ecosystem. Over the years, the domestic labour market has adapted to the sectoral employment trends.[410] However, Turkey was ranked 76 in the 2021 Global Talent Competitiveness Index,[411] behind many countries that are yet to make a mark in AI adoption. The Ministry of Treasury and Finance launched the "1 Million Employees" project that aims to train one million citizens in AI through its BTK Academy training platform.[412] Turkey Open Source Platform is also designed to train 500,000 software developers to produce international-level software products. MoIT has also established a National Technology Academy to offer training to equip individuals with critical competencies.

ICT INFRASTRUCTURE

Around 19.84 percent of all households have access to broadband internet, and 97 percent households access the internet through mobile phones.[413] State investment is expected to grow in the domestic ICT market, including electronic communications and hardware, software, IT services, 5G, smart city, Internet of Things, cloud solutions, and semiconductors.[414] Turkey is partnering with telecommunication firms like Ericsson,[415] Nokia,[416] and Huawei[417] to speed up the deployment of 5G services, and has earmarked US$5 billion in its ICT budget to support the deployment. The New Generation Mobile Communication Technologies Turkey Forum (also known as the 5GTR Forum) by the Information and Communication Technologies Authority

(BTK) has brought together representatives from government, academia, enterprises, and NGOs to collaboratively understand and meet global 5G requirements.[418]

The National Electronics and Cryptology Research Institute is also attempting to foster the development of semiconductors at its Semiconductor Technologies Research Laboratory.[419] In 2020, Turkey invested US$26.9 billion on ICT, which is set to benefit the financial, healthcare, mobility, manufacturing, and insurance sectors. These recent technological advancements will have to be accompanied by strong cybersecurity protocols as Turkey is a high-risk region for cyber threats.[420] Various government departments, including the Ministry of Justice and Interior, BTK, Ministry of Transport and Infrastructure, and the National Police, are working on updating infrastructure to prevent and respond to cyberattacks.

DATA ECOSYSTEM

The DTO is working on a national data dictionary to build consistent definitions and standards for data sharing, usage, and responsibility. This will assist in minimising issues with inter-institutional integration and updating the national data inventory with standardised datasets.

Additionally, DTO has also proposed the development of an Open Government Data Portal[421] to enhance transparency in data collection process and accountability in public service delivery. The Presidency of Defence Industries, a civilian institution responsible for managing the domestic defence industry, has also implemented a data labelling platform (Data Hive) to make annotated and AI-ready data, such as text, video, image, and sound, available for AI development.

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UNITED KINGDOM: CRAFTING A GLOBAL INNOVATION HUB
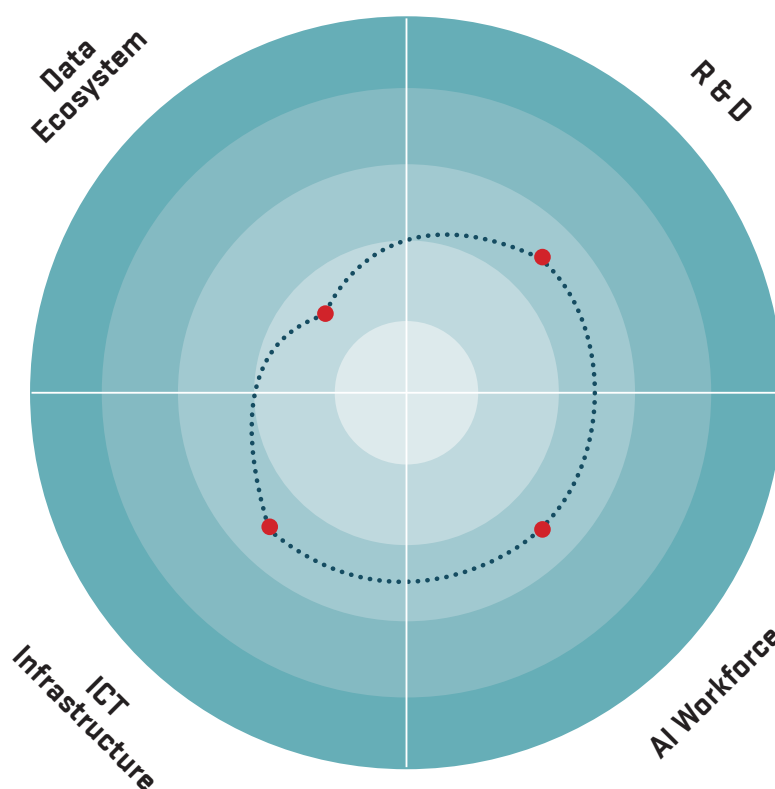
BETTER JOBS

AI COMMERCIALISATION

FOCUSING ON RESILIENCE

"...the UK has an opportunity over the next ten years to position itself as the best place to live and work with AI; with clear rules, applied ethical principles and a pro-innovation regulatory environment."

National AI Strategy, 2021

OVERALL STRATEGY

The United Kingdom (UK) released its latest *National AI Strategy*[422] in September 2021. It builds on the work that emerged from the Industrial Strategy 2017, which set out the government's vision to make the UK a global centre for AI innovation. The UK's investment in AI is low[423] compared to the United States (US) and China, which invest 50 times and eight times more, respectively. Despite slightly higher relative investment levels, the UK also lags behind France, Germany, Japan, and South Korea on AI patents.[424] The UK's national AI strategy is at the confluence of nine other frameworks,[425] at least three of which are still in the works. Among the existing frameworks, the Plan for Growth and Innovation Strategy provides proposals on enhancing skills and AI professionals to "supercharge" innovation, the *Integrated Review* is studying how a post–Brexit UK will navigate security, defence, development, and foreign policy in the digital age;[426] the *National Data Strategy* sets out a vision for the UK to become a country of digital entrepreneurs, innovators and investors, and "the best place in the world to start and grow a digital business, as well as the safest place in the world to go online";[427] the *Plan for Digital Regulation* is focused on issues arising from the accumulation, processing, portability, oversight, and verification of personal data and digital content;[428] a new *Defence AI centre* dedicated for the modernisation of Defence; and the *National Security Technology Innovation exchange (NSTIx)* to bring together national security stakeholders, academic and industry partners to build national security capabilities.[429]

Of the upcoming strategies, the UK's Digital Strategy will build on the Ten Tech Priorities[430] outlined by the Department of Digital Media, Culture and Sport; the *National Resilience Strategy 2021* [431] will establish how the UK stays on top of technological threats and National Cyber Strategy will focus on building AI models that are secure from cyberattacks.[432] The 145-page draft *Online Safety Bill 2021*[433] imposes on digital service providers the duty to moderate user-generated content in ways that prevents users from being exposed to illegal and/or harmful material online.
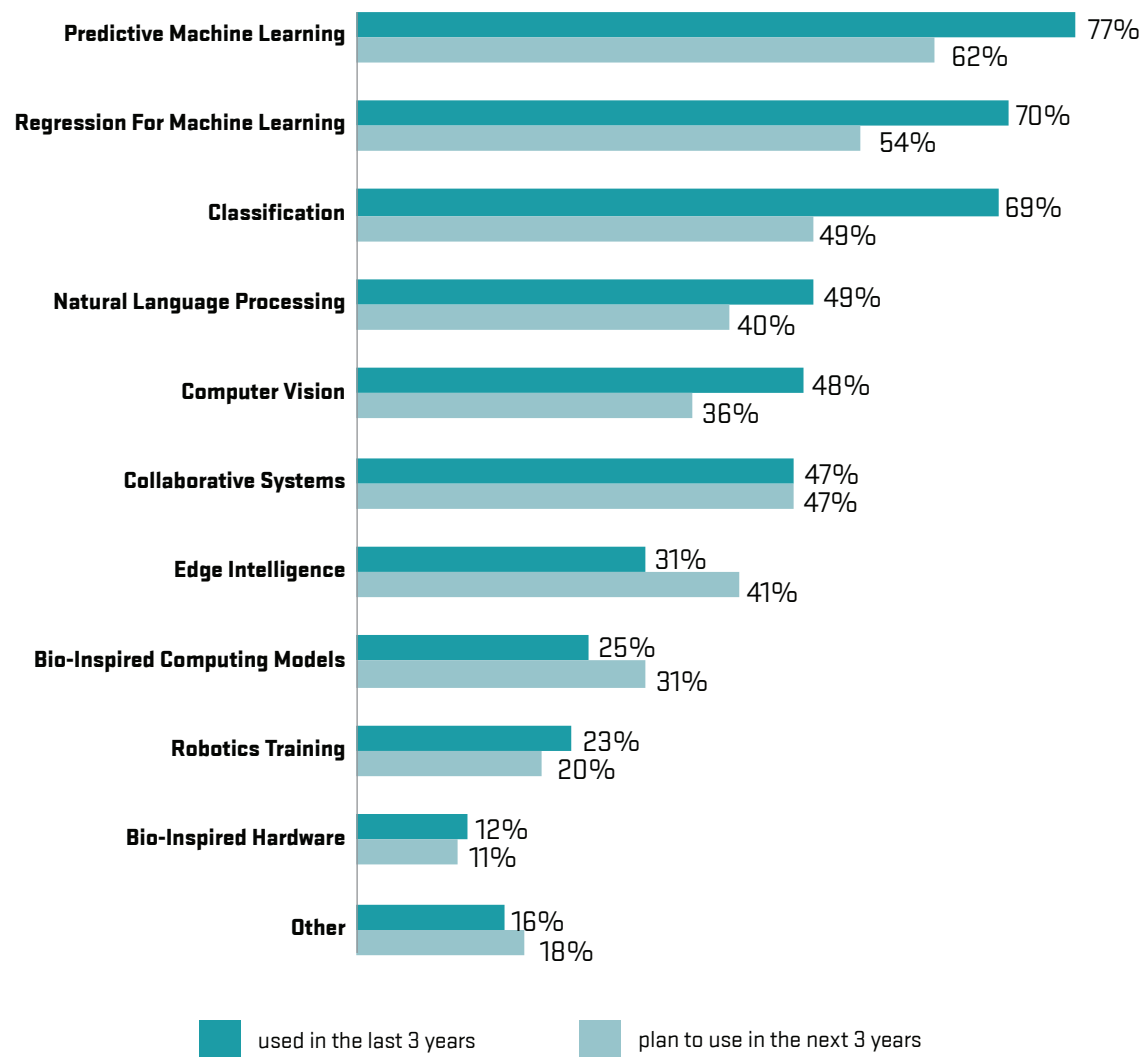
Internally, the government is pushing research in five areas: the nature of the commercialisation process for AI R&D; routes (public and private) for commercialising AI R&D; the relative effectiveness of those routes; the relative importance of AI technical standards as a route for commercialisation; and how to optimise the use of AI technical standards as a route for supporting AI R&D commercialisation. Of the 100 most promising AI startups in the world, only six are from the UK and they have attracted below-average funding.[434] Many of the world's best-known AI brands were born in the UK—DeepMind, founded in 2010, was acquired by Google in 2014 for US$500 million; SwiftKey, founded in 2008, was acquired by Microsoft in 2016 for US$250 million; natural language processing specialist VocalIQ was bought by Apple in 2015; and Magic Pony by Twitter in 2016.

RESEARCH & DEVELOPMENT

The UK did not figure in the top five R&D-spending economies even in 2019; the top five—US (+10.9 percent), China (+11.1 percent), Japan (-0.4 percent), Germany (+2.3 percent), and South Korea (+4.8 percent)—have consistently been the world's major R&D spenders since 2011. Investments in AI R&D are part of the government's target of increasing overall public and private sector R&D expenditure to 2.4 percent of GDP by 2027. The UK recognises that generating economic and societal impact through the adoption and diffusion of AI technologies is "behind where it could be".[435] In January 2022, the Alan Turing Institute, supported by the British Standards Institution and the National Physical Laboratory, was mandated to pilot a new initiative to lead in shaping global standards for AI.

Predictive Machine Learning
77%
62%

Regression For Machine Learning
70%
54%

Classification
69%
49%

Natural Language Processing
49%
40%

Computer Vision
48%
36%

Collaborative Systems
47%
47%

Edge Intelligence
31%
41%

Bio-Inspired Computing Models
25%
31%

Robotics Training
23%
20%

Bio-Inspired Hardware
12%
11%

Other
16%
18%

■ used in the last 3 years   ■ plan to use in the next 3 years

Proportion of firms working in different areas of AI in the last 3 years and planning to use in the next 3 years (base-118 firms),
Source: Krishna Dabhi, Catherine Crick, Jamie Douglas, Sarah McHugh, Gabriele Zatterin, Sam Donaldson, Rob Procter and Roger Woods, Understanding the UK AI labour market: 2020, Ipsos MORI, 2021,
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/984671/DCMS_and_Ipsos_MORI_Understanding_the_AI_Labour_Market_2020_Full_Report.pdf.

AI WORKFORCE

Data for student enrolment in 2020 shows that a diverse range of students have enrolled for AI and data science postgraduate courses funded by the Office for Students—40 percent are women, one-quarter are Black students, and 15 percent have disabilities.[436]

Nevertheless, the gap between the demand for and supply of AI skills remains significant and growing. In 2021, the UK's Office for AI published a report on AI and data science skills in the local labour market.[437] The three key findings highlight the existing gaps in the workforce—first, half of surveyed firms' business plans had been impacted by a lack of suitable candidates with the appropriate AI knowledge and skills; second, at least 67 percent of firms expected the demand for AI skills in their organisation to increase over the next 12 months; third, diversity in the AI sector was generally low. Over half of the firms surveyed (53 percent) said none of their AI employees were female, and 40 percent said none were from ethnic minority backgrounds. In 2020, the UK had over 110,000 job vacancies for AI and data Science roles.

ICT INFRASTRUCTURE

About 28 percent of homes in the UK have full-fibre broadband internet. At the same time, there are over six million 5G-enabled mobile handsets in the country, as noted in Connected Nations 2021 report, up from just 800,000 the previous year.[438] A combination of 3G, 4G, and 5G make up over 95 percent of all connections. In the area of 4G alone, the UK had more than 100 4G connections per 100 people.[439]

The UK's expertise in chip manufacturing and its innovative enterprises and conducive ecosystem has insulated it from the global semiconductor supply chain crisis. However, diversification and state support will be critical in ensuring its continued growth.[440]

DATA ECOSYSTEM

The UK's withdrawal from the European Union (EU) has disrupted the UK's data protection landscape, and a crucial question persists: To what extent will the UK now diverge from the EU's data protection regime? The proposed EU AI Regulation[441] is a case in point. The EU proposal is for cross-sector, risk-based regulation of AI.

Its view is that AI innovation depends on trust, which in turn requires a clear and certain regulatory environment. The UK government faces a difficult commercial judgement on digital trade about the balance required between UK's and EU's priorities on AI regulation.

In September 2021, the UK released a new consultation paper to proceed with developing its National Data Strategy, since it now has the "freedom to create a bold new data regime".[442] Responses to this paper will help shape future reforms.

"In the future, voice connectivity will be in every room and almost every object. Your mattress will monitor your nightmares; your fridge will beep for more cheese; your smart metre will go hustling for the cheapest electricity. And every one of them minutely transcribing your every habit in tiny electronic shorthand, stored in some great cloud of data that looms ever more oppressively over the human race, a giant dark thundercloud waiting to burst. And we have no control over how or when the precipitation will take place."

Boris Johnson
Prime Minister of UK

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425   National AI Strategy 2021, Office of Artificial Intelligence, https://assets.publishing.service. gov.uk/government/uploads/system/uploads/attachment_data/file/1020402/National_AI_ Strategy_-_PDF_version.pdf.

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432   National AI Strategy 2021, Office of Artificial Intelligence, https://assets.publishing.service. gov.uk/government/uploads/system/uploads/attachment_data/file/1020402/National_AI_ Strategy_-_PDF_version.pdf.

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435 National AI Strategy 2021, Office of Artificial Intelligence, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1020402/National_AI_Strategy_-_PDF_version.pdf

436 National AI Strategy 2021, Office of Artificial Intelligence, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1020402/National_AI_Strategy_-_PDF_version.pdf

437 Krishna Dabhi, Catherine Crick, Jamie Douglas, Sarah McHugh, Gabriele Zatterin, Sam Donaldson, Rob Procter and Roger Woods, *Understanding the UK AI labour market: 2020*, Ipsos MORI, 2021, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/984671/DCMS_and_Ipsos_MORI_Understanding_the_AI_Labour_Market_2020_Full_Report.pdf.

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440 Nocholas Fearn, "Can the UK semiconductor industry help solve the global chip shortage?", *IT Pro,* June 29, 2021, https://www.itpro.co.uk/hardware/360023/can-the-uk-semiconductor-industry-help-solve-the-global-chip-shortage.

441 "EU Proposes New Artificial Intelligence Regulation", *Norton Rose Fulbright,* April 2021, https://www.nortonrosefulbright.com/en-gb/knowledge/publications/fdfc4c27/eu-to-propose-new-artificial-intelligence-regulation.

442 "Data: A New Direction", Department for Digital, Culture Media & Sport, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1022315/Data_Reform_Consultation_Document___Accessible_.pdf.

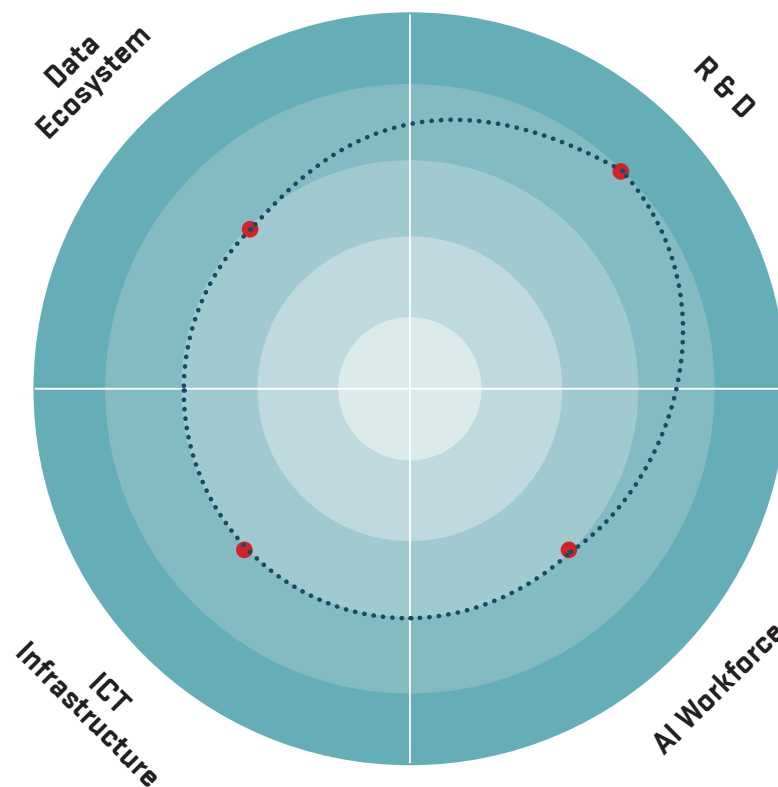# THE UNITED STATES: DEFENDING INCUMBENCY

BATTLING
THE DRAGON

PLATFORM
WARS

RALLYING
ALLIES

"China possesses the might, talent, and ambition to surpass the United States as the world's leader in AI in the next decade if current trends do not change."

The National Security Commission on Artificial Intelligence (NSCAI)

OVERALL STRATEGY

"America is not prepared to defend or compete in the AI era. This is the tough reality we must face. And it is this reality that demands comprehensive, whole-of-nation action," declared the National Security Commission on Artificial Intelligence[443] (NSCAI) in its final report presented to the US president and Congress in 2021.[444] The report sets up a sombre yet combative mood for the work that lies ahead to "win" the AI era. It is one of seven resources listed by the National AI Initiative as "strategy documents",[445] and came two years after the *National AI Research & Development Strategic Plan: 2019 Update*.[446] China's long shadows dominate the US's quest to retain AI leadership on every strategic flank, and was also emphasised in the NSCAI report: "China is a competitor possessing the might, talent, and ambition to challenge America's technological leadership, military superiority, and its broader position in the world," and its "plans, resources, and progress should concern all Americans." The report also urged that the US's AI "human talent deficit" be fixed. The lack of skilled immigration has been flagged as the "single greatest inhibitor" to buying, building, and fielding AI-enabled technologies for national security purposes.

These concerns have come to a head in the US amid a global shortage of semiconductor chips. Automobile prices soared, new vehicle sales tumbled, and inflationary pressures began to show.[447] At the same time, calls are growing to design bottom-up innovation for defence capabilities in stubbornly top-down structures. Fears are spiralling that AI innovation, if not bottom up, will not percolate in time to refine the tactical reactions of frontline US units, especially in a crisis.[448] The potential of what can and is going wrong is a key component of the country's most recent AI strategy documents. Cyberattacks, disinformation campaigns and secret extraction of data headline the action points.

Recommendations in the NSCAI report reveal the chasms that exist between regulators and algorithmically-mediated products that have been integrated into the public sphere. AI systems are increasingly influencing who gets a job,[449] which students get admitted to college,[450] how cars navigate roads,[451] what medical treatment an individual receives,[452] and who gets detained by the cops[453] in the US. These instances are reminders that AI systems contain the risks of bias and abuse in their design and values. Several documents released by various government arms between December 2018 and October 2021 contain the overarching American strategy on AI that the Joe Biden administration is referencing (see Table 1). Six strategic pillars have emerged from these: innovation, advancing trustworthy AI, education and training, infrastructure, applications, and international cooperation.

By 2022, the annual spending on AI will increase to over US$2 billion and funding for quantum information science will increase to US$860 million.[454] Given that many of the agenda items on the National AI Initiative described 2021 as a 'transition' year, it is instructive to rewind to past presidencies to see how the US's AI priorities have evolved. The Barack Obama and Donald Trump administrations adopted AI approaches that were on a continuum not very different from what Bill Clinton and George W. Bush administrations before them had used for the internet and e-commerce. The Trump administration simply picked up where the Obama government had left off and affixed its stamp on a push to tightly focus federal resources to promote AI relative to other R&D funding efforts. In federal countries like the US, local officials will play a huge role in determining AI adoption. At a high level, regulation in the US is often a patchwork of local, state, and national level policies. The government response to COVID-19 is a good example of how the US patchwork looks in practice, with each state pulling in its own direction, which may or may not align with the White House view.

RESEARCH & DEVELOPMENT

Industry is calling on the US government to 'break the mould of standard scientific research funding', and warning that the status quo at federal agencies and research entities is insufficient to propel promising technology concepts from laboratories to the field. A 2020 research study found that 82 percent of the algorithms in use today originated from federally-funded non-profits and universities, with just 18 percent originating from private companies.[455] Federal civilian agencies—agencies that are not part of the Department of Defense or the intelligence sector—allocated US$973.5 million to AI R&D in FY 2020, a figure that rose to US$1.1 billion once congressional appropriations and transfers were factored in. For FY 2021, federal civilian agencies budgeted US$1.5 billion, which is almost 55-percent higher than its 2020 request. The most recent AI strategy report by the US is calling for increased federal funding for non-defence AI R&D at compounding levels, doubling annually to reach US$32 billion per year by FY 2026. The Stanford AI Index 2022 report notes that the increasing amount spent on AI R&D by non-defence departments indicates the US government's continued strong interest in public sector funding for AI research.[456]

The US$740.5-billion defence bill[457] passed in January 2021 dedicates more than US$6.3 billion to AI R&D efforts, as well as other provisions aimed at bolstering the US's prowess in emerging technology amid increasing competition from other countries, including China. Containing China's technological clout was a pillar of the Trump administration's tech policy—and one area where there is little division with its successor. This push for the militarisation of AI was also captured in the NSCAI final report: "Defending against AI-capable adversaries operating at machine speeds without employing AI is an invitation to disaster. Human operators will not be able to keep up with or defend against AI-enabled cyber or disinformation attacks, drone swarms, or missile attacks without the assistance of AI-enabled machines."[458]

Recommended Spending
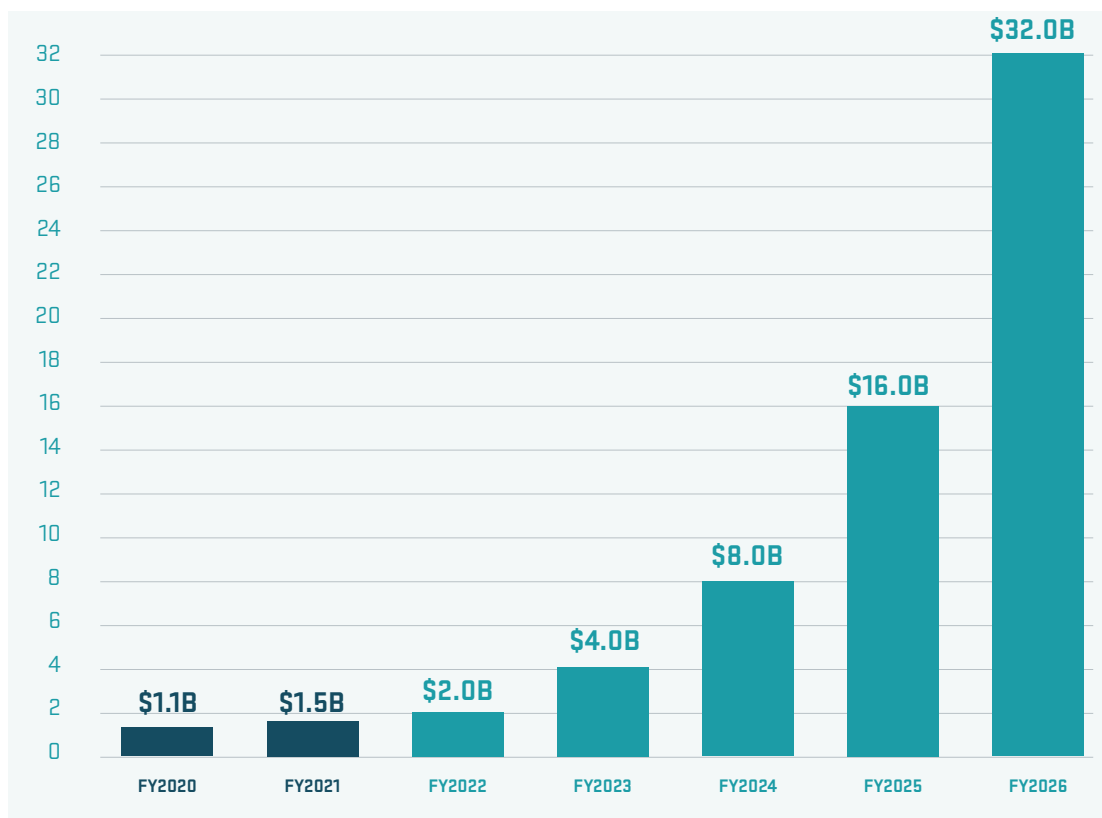
Current Spending

Name of the Department	FY 2020	FY 2021
National Science Foundation	$518.3M	$831.2M
National Institutes of Health	$193.9M	$176.8M
Department of Energy	$171.8M	$174.4M
US Department of Agriculture	$54.9M	$129.6M
Department of Homeland Security	$50.4M	$31.3M
Food and Drug Administration	$39.0M	$38.0M
National Aeronautics and Space Administration	$28.5M	$28.8M
National Institute of Standards And Technology	$27.6M	$52.7M
Department of Transportation	$17.1M	$16.3M
Department of Veterans Affairs	$14.1M	$14.1M
Department of The Interior	$5.9M	$4.2M
National Institute of Justice	$3.0M	$3.0M
National Oceanic and Atmospheric Administration	$1.6M	$1.6M
Treasury	$0.6M	$0.6M
TOTAL	$1.127B	$1.503B

Federal Funding for non-defense AI R&D - Current and recommended funding, Source: The National Security Commission on Artificial Intelligence, The Final Report, 2021, United States, https://www.nscai.gov/2021-final-report/.

AI WORKFORCE

More than 90 percent of US innovation-sector job creation occurred in just five coastal cities between 2005 and 2017. The number of domestic-born students participating in AI doctorate programmes has not increased since 1990, and competition for international students has accelerated, endangering the US's ability to retain international students. The authors of the NSCAI report declare that nurturing homegrown talent and retaining foreign students are the "only two options to sustain the U.S. lead." Data released in December 2021 show that the COVID-19 pandemic significantly impacted international migration patterns both to and from the US, resulting in the lowest levels of international migration in decades.[459]

ICT INFRASTRUCTURE

The internet service providers industry in the US is characterised by a dominant group of large players who operate nationally and many small ones who are mostly regional. In most cities, households and businesses can only choose between internet access offered by one or two cable companies and an incumbent telecommunications company.[460] More than nine in 10 US adults already own a smartphone and have a mobile data plan.[461] Most adults not only have a connected smartphone, nearly a quarter have already upgraded to a 5G-capable device.[462] While the rollout of 5G networks represents competitive threats to traditional internet service providers, companies are also capitalising on the demand for internet backbone services. External drivers pushing the numbers northwards are 7.4 percent spike in private investment on personal computing (annually, between 2017-2022).[463]

The country has also been ahead of its counterparts in defining the standards and roadmap for cloud computing. Its standard-setting body, the National Institute of Standards and Technology, released the *US Government Cloud Computing Technology Roadmap*[464] in November 2011. The *Creating Helpful Incentives to Produce Semiconductors (CHIPS) for America Act*[465] was introduced in the US Senate in 2020. The bill seeks to incentivise semiconductor manufacturing and research to ensure supply chain security in the US through income tax credits for investment in equipment or manufacturing capabilities till 2026.

DATA ECOSYSTEM

The US announced an 'action plan' [466] for its federal data strategy in October 2021. Much of the text leans into lessons learned from 2020, amid the COVID-19 pandemic and a confluence of related crises in the country in an election year. *Executive Order 13859 Maintaining American Leadership in Artificial Intelligence*[467] (signed by Trump) called on agencies to increase public access to government data and models where appropriate. The COVID-19 crisis demonstrated the need to share decision-support tools widely across agencies with urgent, emerging needs to ensure the leadership can access the necessary data for critical decision-making. The US government, in its strategy documents, acknowledges that biometric surveillance techniques such as facial recognition may be outpacing rules for proper use.[468]

AI governance remains a heavy lift for the US. The way things work together in the digital era has raised constitutional questions[469] about the circumstances in which information about people may be accessed and utilised by intelligence, homeland security, or law enforcement agencies for a legitimate national security purpose. The country does not have a federal data protection law. National Security Advisor Jake Sullivan also emphasised these concerns: "The large majority of the world actually is not ready to sign onto a vision of the future that says you have absolutely no privacy. No Trust. No security… big data owned by the government." [470]

"AI needs to be brought back down to earth. When AI research, development and deployment is rooted in people and communities, we can get in front of these harms and create a future that values equity and humanity."

Timnit Gebru
Founder and Executive Director, Distributed Artificial Intelligence Research Institute

The world's largest social networking company, Facebook, apologised after its AI programme mistakenly labelled a video that included a black man as "about primates".[471] Facebook is also facing heat from the US Congress after leaked internal research showed that its algorithms are hurting teens.[472] AI strategists and lawmakers are mulling how to offer opportunities for redress that are consistent with the constitutional principles, such as when a system error leads to benefits being denied to citizens/ residents. Computer scientist Timnit Gebru, who co-led Google's Ethical AI team, has also deeply emphasised these challenges: "AI needs to be brought back down to earth. It has been elevated to a superhuman level that leads us to believe it is both inevitable and beyond our control. When AI research, development and deployment is rooted in people and communities from the start, we can get in front of these harms and create a future that values equity and humanity."[473]

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# EUROPEAN UNION: EMPIRE OF NORMS IN THE MACHINE AGE

THROWING THE GAUNTLET

CHALLENGING ALLIES

FOSTERING TRUST

"We will be particularly careful where essential human rights and interests are at stake. Artificial intelligence must serve people, and therefore artificial intelligence must always comply with people's rights."

Ursula von der Leyen
President of the European
Commission
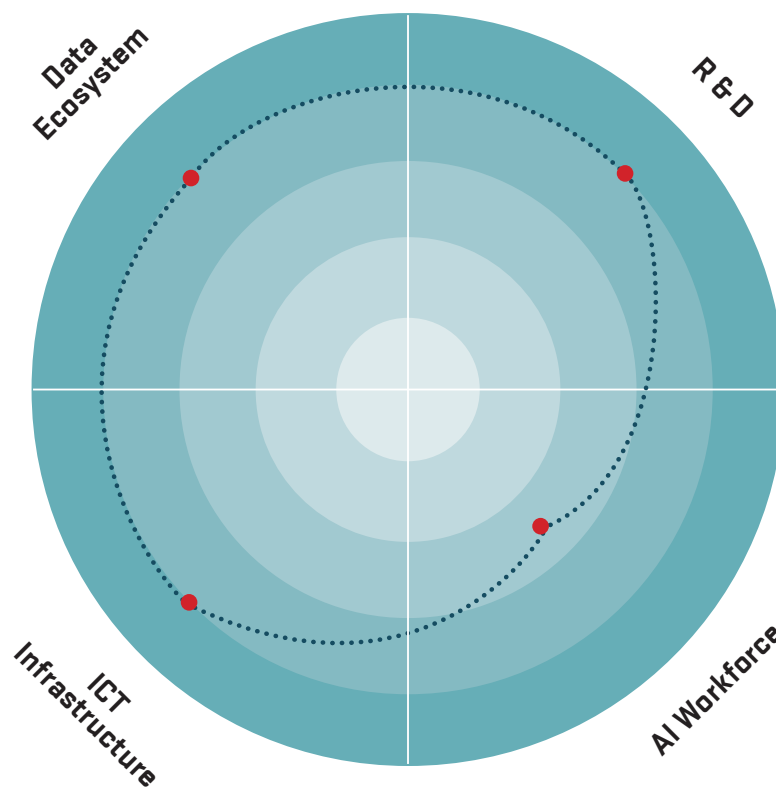
OVERALL STRATEGY

The European argument on AI has always been unambiguous. The *Digital Services Act*,[474] designed to rein in dominant digital platforms, and the *Digital Markets Act*[475] aim to create a set of rules applicable across the European Union (EU). The EU is pushing for a non-China, non-US way, a 'human centric' approach that protects technology without stifling innovation. Indeed, while defining the regulatory challenges with AI, European Commission President Ursula von der Leyen stated, "We will be particularly careful where essential human rights and interests are at stake. Artificial intelligence must serve people, and therefore artificial intelligence must always comply with people's rights."[476] Algorithms that can make or break the social safety net by sifting through job applications, creditworthiness assessments, social security benefits, visa applications, and courtroom decisions will be called out for their riskiness and subjected to extra scrutiny. Companies that do not align with the European Commission's latest regulation on how to avoid the gravest risks of AI will face financial consequences, of up to US$21 million or 4 percent of the firm's turnover.[477]

The EU is furiously pondering its most ambitious AI law yet, called the *AI Act*.[478] If it succeeds, it could set a new global standard for AI oversight. But the EU's 27 constituent countries often pull in different directions on key issues, including AI. Romanian Member of European Parliament Dragoș Tudorache, who is responsible for deciding the fate of the AI Act in the European Parliament, said, "I fear that we risk fragmenting the single digital market by the fact that we're going to create the 27 different environments in which AI is going to be deployed and developed."[479] Polish lawmakers are forging ahead with rules known as the *Freedom Act*[480] that would force social media platforms to reinstate deleted posts or pages at the behest of Warsaw. Europe's proposed rules are also likely to have a carve out allowing law enforcement authorities to use facial recognition technology to intercept terrorists and criminals. One area of convergence is antitrust action. In Italy, France, Germany, the screws are turning fast and should be in place to rein in Big Tech by the end of 2022. The onus will be on companies to explain why their takeovers will not harm competition.

"I fear that we risk fragmenting the single digital market by the fact that we're going to create the 27 different environments in which AI is going to be deployed and developed."

Dragoș Tudorache
Member of the
European Parliament

DIGITAL INVESTMENT BUDGET OF THE EUROPEAN UNION 2021-2027

Proposed investments in digital technologies by the European Union for the financial framework from 2021 to 2027 (in billion euros)	
Digital Europe Programme - Advanced digital skills***	0.70
Digital Europe Programme - Interoperability & digital transformation***	1.30
Digital Europe Programme - Cybersecurity & trust***	2
Digital Europe Programme - Artificial Intelligence***	2.50
Digital Europe Programme - High performance computing***	2.70
Connecting Europe Facility 2**	42.30
Horizon Europe*	97.60

Digital investment budget of the European Union 2021-2027, Source: Single Market, Innovation and Digital: Digital Europe Programme, European Commission, 2022, https://ec.europa.eu/info/sites/default/files/about_the_european_commission/ eu_budget/programme_statement_-_digital_europe.pdf

RESEARCH & DEVELOPMENT

The EU has plans for an AI lighthouse for Europe. Under *Horizon Europe* in 2021-22,[481] plans are being worked out to add additional networks of AI excellence centres to address research areas that are not yet covered by the existing centres.

A snapshot of investments in AI R&D[482] by EU governments:

- Germany: US$3.13 billion for 2019-2025; now increased to US$5.21 billion to promote AI innovation and research

- France: US$1.56 billion by end 2022 for AI development.

- Denmark: US $28 million to test, scale AI in the public sector, with a particular focus on healthcare, public administration, and the green transition.

- Spain: Earmarked US$ 720 million for the period 2021-2023 scientific research and technological development.

- Sweden: Funded AI projects worth US$70.4 million in 2020. In the national budget for innovation and research until 2024, at least US$57.3 million has been assigned to research

and innovation in digital technologies and AI and its use and impact on society.

- Finland: Allocated US$107.25 million over a four-year period for the 'AI business' programme. The Finnish Centre for Artificial Intelligence got US$8.6 million in initial funding for 2019-2022.

- Slovenia: US$114.7 million funding for AI until 2025.

- Czechoslovakia: Since 2019, US$128.7 million-worth of AI projects have got support.

AI WORKFORCE

ICT skills are seen as a persistent gap. As per 2019 figures, about 300,000 posts for cybersecurity professionals in Europe remain unfilled.[483] The EU's assessment suggests that to remain globally competitive, Europe needs workers with 'specialised' AI skills.[484] The EU also sees the upskilling as a way to avoid job market polarisation and a rise in inequality within and between countries. European companies are struggling to find employees with adequate AI skills. The European Commission's research wing is recommending the development of digital skills and awareness of AI technologies through all levels of education and lifelong-learning programmes to equip everyone for AI-driven transformations.[485]

ICT INFRASTRUCTURE

Fixed broadband coverage is available in nearly 100 percent of areas across major EU countries. Similarly, 4G update is robust and growing. The EU estimates that by 2025, a quarter of the connected devices in the world will be in Europe. EU rules on the security of network and information systems[486] (NIS) are at the core of the single market for cybersecurity or aligned standards for 27 countries in the EU block to reduce incidents of cyber-attacks. NIS 2 expands on the scope of the previous directive and seeks a guarantee for safety and security from the companies operating within this supply chain for their products and services.

DATA ECOSYSTEM

European lawmakers worry that the new *AI Act* could fall into patterns similar to the problems that plagued the General Data Protection Regulation.[487] For instance, Ireland, where many Big Tech companies are located, has been criticised for going too easy on privacy offenders.[488] Based on current plans, the new AI Board will consist of Europe's data protection supervisor, the European Commission, and authorities from all EU countries.

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WHAT IF ...?

IF CHINA WINS

Under its *Made in China 2025* plan, Beijing is funnelling serious money and research funds to help local companies beat international competition on the cutting edge of technological progress, including electric vehicles and robotics. The 'if China wins' scenario is inextricably linked to how the country thinks about its standoff with the United States and vice versa. Multiple reports and insiders[489] have warned that the US is falling behind on cutting-edge technology to China or that China has caught up in areas where it was lagging. Either way, China's plans, resources, and progress remain top-of-mind for American AI leaders. China's ambition to surpass the US as the world's AI leader is thundering ahead and there is no letting up. If China wins, all the signals are pointing in the direction of tighter foreign investment and export control rules being slapped on Chinese technology. The US-led backlash against Huawei, pushing more than 60 countries for an us-or-them kind of loyalty, offered a curtain raiser. That did not go very well. There are no final victories in this game.

IF THE U.S. WINS

This is going to be a heavy lift. The US has declared that only it and China have the four combinatorial ingredients to lead the world in AI—resources, commercial might, talent pool, and innovation ecosystem. But detractors are slamming the US for being stuck at "kindergarten" level AI capability. This question–What if the US wins?– is best understood through the lens of what it must do to win: fighting lots of fires at once. The US will need a hybrid approach meshing government and private-sector efforts; the government will have to level with commercial state-of-the-art in most AI categories produced in other geographies in computer vision, natural language processing and so on; it will have to fend off China's platform dominance as a way of coercing and shaping foreign cultures; and shore up its domestic microchip supply.[490] Any dramatic upside is going to come in tandem with strong White House leadership and decisions on difficult trade-offs.

IF INDIA WINS

India's ability to use technology to grapple with large and complex societal problems has won global attention. By several accounts, India is "overperforming" on innovation relative to the level of development.[491] The country is pushing ahead with a technology architecture that offers combinatorial building blocks for innovators. The momentum is undeniable. The Global Innovation Index 2021[492] has noted India as one of the top three innovation economies in Central and Southern Asia. India is already pulling ahead of developed Western economies on the AI skill index released by Fletcher School at Tufts University[493]. India is now turning its attention to shoring up AI skills among residents of Tier 2 and Tier 3 cities. Youth involvement and education in responsible AI is surfacing as an important flank. India's digital ID programme (Aadhaar) is going global.[494] India will continue to ride its advantages of being the leading ICT services exporter and churning out record numbers of graduates in science and engineering. India's AI wins will give new meaning to the country's *Atmanirbhar* (self-reliance) policy and to novel regulatory approaches far removed from Western-style control mechanisms. If there is one signature element of an Indian triumph, it will be this—billion scale.

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IV.

CONCLUSION

More multilateral and bilateral partnerships leaning on AI to provide critical enablers[495] for future force capabilities in contested environments; more conversations around ethics; more language models; and more AI regulation. These are standout trends across the spectrum of national strategies listed in this report and, more broadly, on the continuum of evolving national strategy.

Despite the overpowering narrative of the United States and China being at loggerheads over AI dominance and rising geopolitical tensions, the US and China had the greatest number of collaborations[496] in AI publications in the decade between 2010 and 2021.

Legislation that includes the words "artificial intelligence" is rising at a 5x pace since 2010. Spain, the United Kingdom, and the US passed the highest number of AI-related bills in 2021 (three each).

Cyber capabilities, resilient supply chains, and the quest to design common technical standards for the bedrock of telecommunication infrastructure are headlining cross-border partnerships. AUKUS and Quad exemplify this strand of strategic relationships.

The asymmetry between AI skills and industry needs is a pain point and every G20 country is grappling with this piece. The world's top AI minds have warned that AI is setting the world up for the fastest transition in human history that people are unprepared for; that, borrowing the words of a classic piece of literature, this will be the best of times and the worst of times.[497] The terrifying potential of automation to spark social upheaval is not lost on governments. Meanwhile, the geography of innovation is shifting and there is no single factor that is contributing unevenly to the catch-up game.

Asian economies are dealing with large and complex problems. Often, as in the case of India's effort to ramp up population-scale digital and telecommunications infrastructure, the problem definition lends itself to audacious goal-setting and deliverables.

After nearly a century of uneven development, AI is powering processes outside the tech industry and governments around the world are welcoming its potential. The AI specialist has landed a powerful seat in political nerve centres. Even as governments urge their citizens to embrace the promise of AI, the fundamental construct of national AI strategies has remained steadfast, and those in power decide which road the world would take.

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