

STATE OF IMPLEMENTATION OF THE OECD AI PRINCIPLES

INSIGHTS FROM NATIONAL
AI POLICIES

OECD DIGITAL ECONOMY
PAPERS

June 2021 No. 311

Foreword

The *State of Implementation of the OECD AI Principles: Insights from National AI Policies* was developed by the working group on national AI Policies of the OECD.AI Network of Experts. András Hlács, Vice Chair of the OECD Committee on Digital Economy Policy, and Michael Sellitto, Deputy Director, Stanford Institute for Human-Centred AI (HAI) co-chaired the working group.

This report was drafted by Laura Galindo-Romero, Karine Perset, and Nobuhisa Nishigata of the OECD's Digital Economy Policy Division, with Karine Perset conducting overall co-ordination and oversight. The experts across the OECD provided guidance, input and comments. They include Luis Aranda, Francesca Sheeka, Louise Hatem, Audrey Plonk, Sarah Box, Gallia Doar, Sandrine Kergroach, Dirk Pilat, and Andrew Wyckoff.

This report benefited from the contribution of following experts who presented their AI policy work at the working group meetings. They are: Yeong Zee Kin (Infocomm Media Development Authority, Singapore), Benoit Bergeret (Indust.AI), Ashley Casovan (AI Global), Nicolas Mialhe (The Future Society), Edward Teather (Office for AI, United Kingdom), Marc-Antoine Dilhac (University of Montreal), Li Xiuquan (Ministry of Science and Technology, China), Emilia Gómez (European Commission Joint Research Centre), Jean-François Gagné (Element AI), Françoise Soulé (Hub FranceIA), Bertrand Braunschweig (INRIA), Irene Ek (Agency for Growth Policy Analysis, Sweden), Sandrine Kergroach (OECD), Andreas Hartl (Federal Ministry for Economic Affairs and Energy, Germany), Gillian Docherty (The Data Lab), Deuk Jung Kim (National IT Industry Promotion Agency, Korea), Audrey Plonk (OECD), Yoichi Iida (Ministry of Internal Affairs and Communications, Japan), José Antonio Guridi (Ministry of Economy, Development and Tourism, Chile), Carlos Avila (Ministry of Science, Technology, Knowledge and Innovation, Chile), Sally Radwan (Ministry of Communications and Information Technology, Egypt), Mariagrazia Squicciarini (OECD), Jennifer Bernal (Deepmind), Anna Byhovskaya (TUAC), Lynne Parker (National AI Office, United States), Juha Heikkilä (DG-CONNECT, European Commission), Ferenc Kasa (Department for AI, Hungary), Elissa Strome (Canadian Institute for Advanced Research), Michel Morvan (Cosmo Tech) and Fernando Galindo-Rueda (OECD).

The experts within the working group and the delegates to the OECD Committee on Digital Economy Policy provided their comments and amendments by sharing and reviewing their countries' national AI policies. The experts include Samuel Ouellet and Ali Tejpar (Innovation, Science and Economic Development, Canada), Colombia Armando Guio-Espanol (Presidency of the Republic of Colombia), Rose Woolhouse (United Kingdom's Office for AI), Lord Tim-Clement Jones (Member of the United Kingdom's Parliament), Sonia Park (National IT Industry Promotion Agency, Korea), Robert Kroplewski (Ministry for Digitalisation of the Information Society, Poland), Lynne Parker (National AI Office, United States), Yannick Meneceur (Council of Europe), Emilia Gomez, Monserrat López, Fabienne Stordeur, Paul Desruelle and Vincent Van-Roy (European Commission) and the delegates include José Antonio Guridi, Carlos Avila and the delegation of Chile; Peter Gornischeff and the delegation of Estonia; Takahiro Matsunaga, Koichi Takagi and the delegation of Japan; Kristina Kirk and the delegation of New Zealand; Andrey Neznamov and the delegation of Russia; Yeong Zee Kin, Angela Wibawa and the delegation of Singapore; and Melisa Tekeli and the delegation of Turkey. The Secretariat wishes to thank also all these experts for their valuable

feedback on earlier drafts, and in particular, Eline Chivot, Colin Van Nord, Cailean Osborne, and Richard Wingfield.

This report leverages ongoing work streams throughout the OECD. They include work by the Committee for Scientific and Technological Policy and its Working Party of National Experts on Science and Technology Indicators; the Committee on Industry, Innovation and Entrepreneurship; the Committee on SMEs and Entrepreneurship; the Public Governance Committee and the Observatory of Public Sector Innovation; the Education Policy Committee; the Employment, Labour and Social Affairs Committee; the OECD Parliamentary Group on Artificial Intelligence; the programme on Work, Innovation, Productivity and Skills (AI-WIPS), in addition to the Committee on Digital Economy Policy and its Working Party on Communication Infrastructures and Services Policy as well as the Working Party on Data Governance and Privacy.

The authors are grateful to John Tarver for editing this report, and to Joseph Loux, Angela Gosmann and Daisy Pelham for editorial support. The overall quality of this report benefited from their engagement.

The support of the Japanese Ministry of Internal affairs and Communications (MIC) is gratefully acknowledged.

This report was approved and declassified by the CDEP on 15 April 2021 and prepared for publication by the OECD Secretariat. For more information, please visit www.oecd.ai.

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Abstract

This is the first report on the state of implementation of the policy recommendations to governments contained in the OECD AI Principles that were adopted in May 2019. This report presents a conceptual framework, provides findings, identifies good practices, and examines emerging trends in AI policy, particularly on how countries are implementing the five recommendations to policy makers contained in the OECD AI Principles. This report builds both on the expert input provided at meetings of the OECD.AI Network of Experts working group on national AI policies that took place online from February 2020 to April 2021 and on the EC-OECD database of national AI strategies and policies. As policy makers and AI actors around the world move from principles to implementation, this report aims to inform the implementation of the OECD AI Principles. This report is also a contribution to the OECD AI Policy Observatory.

Table of contents

Foreword	2
Abstract	4
Background	7
Executive Summary	9
AI policy design	10
AI policy implementation	10
AI policy intelligence to monitor implementation	15
International and multi-stakeholder co-operation on AI	15
1. AI policy design	16
AI policy stages of development	16
Policies to promote inclusive social dialogue on AI	18
Countries and inter-governmental organisations are exploring different regulatory frameworks to ensure trustworthy AI systems	28
2. AI policy implementation	36
Promoting investments in AI R&D	36
Digital infrastructure for AI	46
Shaping an enabling environment for AI	53
AI skills, jobs and labour market transformation	60
3. AI policy intelligence to monitor implementation	68
4. International and multi-stakeholder co-operation on AI	73
International AI research collaboration	73
International and multi-stakeholder co-operation on trustworthy AI	74

References	78
Annexes	85
Annex A. AI work across the OECD	86
Annex B. OECD.AI Network of experts working group on national AI policies membership	88

FIGURES

Figure 1. The expert group's analytical approach	9
Figure 2. A selection of AI policies that follow OECD AI Principle 2.1 on investing in AI R&D	11
Figure 3. A selection of AI policies that follow OECD AI Principle 2.2 on AI digital infrastructure	12
Figure 4. A selection of AI policies that follow OECD AI Principle 2.3 on shaping an enabling policy environment for AI	13
Figure 5. A selection of AI policies that follow OECD AI Principle 2.4 on AI jobs and skills	14
Figure 6. Timeline of U.S. AI policy actions	17
Figure 7. Governance approaches to national AI policy	21
Figure 8. AI publication time series by country, 2001-2020	37
Figure 9. Top 10% ranked AI publication time series by country, 2001-2020	37
Figure 10. Launch of National AI Research Institutes	40
Figure 11. Germany's Network of AI Research Competence Centres	41
Figure 12. AI Japan R&D Network	41
Figure 13. AI Hub in Korea	46
Figure 14. GAIA-X	48
Figure 15. Korea's Data Dam	49
Figure 16. AI+X Project in Korea	54
Figure 17. Germany's Hubs for Tomorrow	56
Figure 18. Cross-country AI skills penetration	61
Figure 19. Academic offer of advanced digital skills in 2019-20 (EC-JRC)	61
Figure 20. ICT Innovation Centres in Korea	63
Figure 21. Between-country AI skills migration	64
Figure 22. Digital change in the World of Work	66
Figure 23. Domestic and international AI research collaboration	74

TABLES

Table 1. Meetings of the OECD.AI expert group on national AI policies	7
Table 2. Countries' AI policies focus on a handful of sectors, selected countries	42

Background

The OECD.AI Network of Experts set up a working group on national AI policies (hereafter, “expert group”) in June 2020 to identify challenges and good practices for the implementation of the five recommendations to policy makers contained in the OECD AI Principles (OECD, 2019^[1]). The expert group is co-chaired by András Hlács, Vice Chair of the OECD Committee on Digital Economy Policy, and Michael Sellitto, Deputy Director, Stanford Institute for Human-Centred AI (HAI) (Annex B).

The expert group leveraged the OECD AI Policy Observatory www.oecd.ai (OECD.AI), containing a database of national AI policies from OECD countries and partner economies and the EU. These resources help policy makers keep track of national initiatives to implement the recommendations to governments contained in the OECD AI Principles. National policy makers are the primary audience for this report.

The expert group met monthly between June 2020 and March 2021 to discuss case studies from selected countries during 90-minute online meetings. Over this period, 24 case studies were discussed during ten virtual meetings (Table 1). These discussions provided “deep dives” into national experiences in implementing AI policies and were rich in lessons learned and good practices identified for each phase of the AI policy cycle (Figure 1).

Members of the expert group and guest speakers explained the challenges they encountered and shared insights and resources.

Table 1. Meetings of the OECD.AI expert group on national AI policies

Meeting	Agenda / Presentations
First Meeting: 11 June 2020	Discussion: the mandate and scope of the experts' group
Second Meeting: 29 June 2020	Yeong Zee Kin , (Infocomm Media Development Authority), " <i>Singapore's National Artificial Intelligence Strategy</i> " Benoit Bergeret (Indust.AI), " <i>AI for SMEs</i> " Ashley Casovan (AI Global), " <i>AI Policy Development and Interventions: A Canadian Perspective</i> " Nicolas Mialhe (The Future Society), " <i>Consultations and AI policy design</i> "
Third Meeting: 10 July 2020	Edward Teather (UK Office for AI), " <i>UK's National AI Strategy and how the UK is coordinating and monitoring its implementation</i> ". Marc-Antoine Dilhac (University of Montreal), " <i>Public consultations on AI and the pandemic in Canada</i> "
Fourth Meeting: 24 August 2020	Li Xiuquan , (New Generation AI Development Research Center, Ministry of Science and Technology), " <i>AI Policy Practices in China</i> " (Guest speaker) Emilia Gómez (European Commission Joint Research Centre), " <i>The AI Watch – Artificial Intelligence Landscape</i> "
Fifth meeting: 24 September 2020	Discussion: progress report to the OECD Committee on Digital Economy Policy (CDEP) Presentation by Jean-François Gagné , Françoise Soulé and Bertrand Braunschweig , " <i>GPAL's Working Group on Innovation & Commercialisation</i> " Irene Ek (Swedish Agency for Growth policy analysis): " <i>Navigating the AI policy learning curve: The Swedish Case</i> "
Sixth meeting: 9 November 2020	Sandrine Kergroach (OECD), " <i>National Artificial Intelligence Policies: What About Diffusion?</i> " Andreas Hartl (Federal Ministry for Economic Affairs and Energy (BMW)), " <i>German Strategy on Artificial Intelligence</i> " Gillian Docherty (The Data Lab), " <i>Scotland's data lab and insights from the design and implementation of Scotland's</i> "

	<i>AI strategy</i> ” (Guest speaker)
Seventh meeting: 19 January 2021	Deuk Jung Kim (Korean National IT Industry Promotion Agency (NIPA)), “ <i>AI Policy & Implementation of Korea</i> ” Audrey Plonk (OECD), “ <i>Going digital III: Data governance for growth and well-being</i> ” Yoichi Iida (Ministry of Internal Affairs and Communications and the Chair of CDEP), “ <i>The AI policy development of Japan</i> ”
Eight meeting: 15 February 2021	José Antonio Guridi (Ministry of Economy, Development and Tourism) and Carlos Avila (Ministry of Science, Technology, Knowledge and Innovation), “ <i>Chilean National AI Policy</i> ” Sally Radwan (Ministry of Communications and Information Technology), “ <i>AI in Egypt</i> ” Mariagrazia Squicciarini (OECD) “ <i>The Human Capital Behind AI</i> ” Jennifer Bernal (DeepMind), “ <i>DeepMind’s Scholarships Programme</i> ” Anna Byhovskaya (TUAC), “ <i>Trade union perspectives and priorities for AI policymaking</i> ”
Ninth meeting: 11 March 2021	Lynne Parker (Head of the National AI Office), “ <i>U.S. National Policies to Advance AI Research and Development</i> ” Juha Heikkilä (Head of Unit, Robotics and Artificial Intelligence, DG-CONNECT) “ <i>The EU perspective on AI: towards excellence and trust</i> ” Ferenc KÁSA (Head of Department for AI at the Digital Success Programme), “ <i>Hungary’s National AI Strategy</i> ”
Tenth meeting: 11 May 2021	Elissa Strome (Executive Director, Canadian Institute for Advanced Research (CIFAR)), “ <i>The Pan-Canadian AI Strategy: Impact and Opportunities</i> ” Michel Morvan (Co-Founder and Executive Chairman, Cosmo Tech), “ <i>Viewpoint from the private sector on priorities for public sector AI R&D investment</i> ” Fernando Galindo-Rueda (OECD), “ <i>Measuring the AI Content of Publicly Funded R&D Projects</i> ”

Representatives from inter-governmental organisations and other entities who are engaged in complementary AI initiatives and projects also participated. They include the Council of Europe, the European Commission, the Global Partnership on AI, the Inter-American Development Bank, the United Nations, UNESCO, and the World Bank. Their involvement helped to foster synergies and minimise duplication. The last section of this report, on International and multi-stakeholder co-operation on AI, provides a preliminary overview of the current work on AI governance taking place at the inter-governmental level and how these initiatives are connected.

Directorates across the OECD are analysing the opportunities and challenges that AI raises in their policy domains. The expert group and the OECD Secretariat staff involved directly in this work have begun co-ordinating with other members of the OECD Secretariat staff and delegates from OECD bodies to seek their input on the relevant policy areas that are covered by the OECD AI policy recommendations.

The expert group developed this report entitled “State of Implementation of the OECD AI Principles: Insights from National AI Policies” that identifies practical guidance and good practices for implementing the five recommendations to policy makers contained in the OECD AI Principles. The expert group finalised the report in March 2021, which was declassified by CDEP at its meeting in April 2021.

Executive Summary

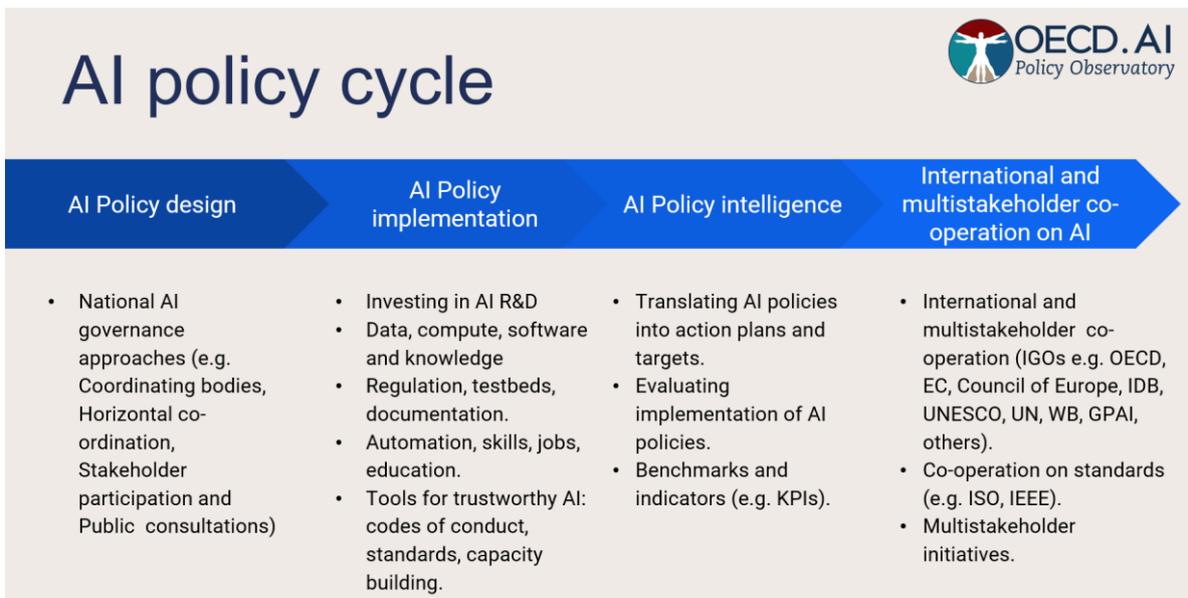
The development of national policies that focus specifically on AI is a relatively new phenomenon. This report identifies challenges and good practices for implementing the OECD AI Principles' (OECD, 2019^[1]) five recommendations to governments:

1. Invest in AI R&D;
2. Foster a digital ecosystem for AI;
3. Shape an enabling policy environment for AI;
4. Build human capacity and preparing for labour market transformation; and
5. Foster international co-operation for trustworthy AI.

The report gives practical advice for implementing the OECD AI Principles throughout each phase of the AI policy cycle (Figure 1).

- Policy design: advice for national AI governance policies and approaches;
- Policy implementation: national implementation examples to illustrate lessons learned to date;
- Policy intelligence: evaluation methods and monitoring exercises, and;
- An overview of AI actors and initiatives at the international level with approaches to international and multi-stakeholder co-operation on AI policy.

Figure 1. The expert group's analytical approach



Note: This stylised figure reflects the horizontal focus of the experts' group to analyse the practical implementation of the recommendations to governments contained in the OECD AI Principles.

Source: Authors.

AI policy design

Countries are at different stages of developing and implementing national AI strategies and policies

The development of national policies and strategies focusing specifically on AI is a relatively new phenomenon. Countries are at different stages of developing and implementing national AI strategies and policies. The EC-OECD database of national AI policies (www.oecd.ai/dashboards) contains national AI strategies and AI-related policy initiatives from over 60 countries. Strategy and policy priorities include financing AI R&D institutions and projects, addressing societal challenges, promoting AI uptake by business, fostering inclusive social dialogue, equipping the population with the skills for developing and using AI and fostering a fair labour market transition for workers.

Countries are using public and inclusive dialogue for trustworthy AI

To seek input on the design of their national AI policies and strategies, governments often involve a broad range of stakeholders including citizens, civil society groups, private companies, research organisations and others. Consultation efforts generally seek to identify and report on current and future opportunities, risks and challenges arising from the use of AI in society. They also look for ways to build public trust in AI.

Effective AI policy implementation needs to be co-ordinated across government

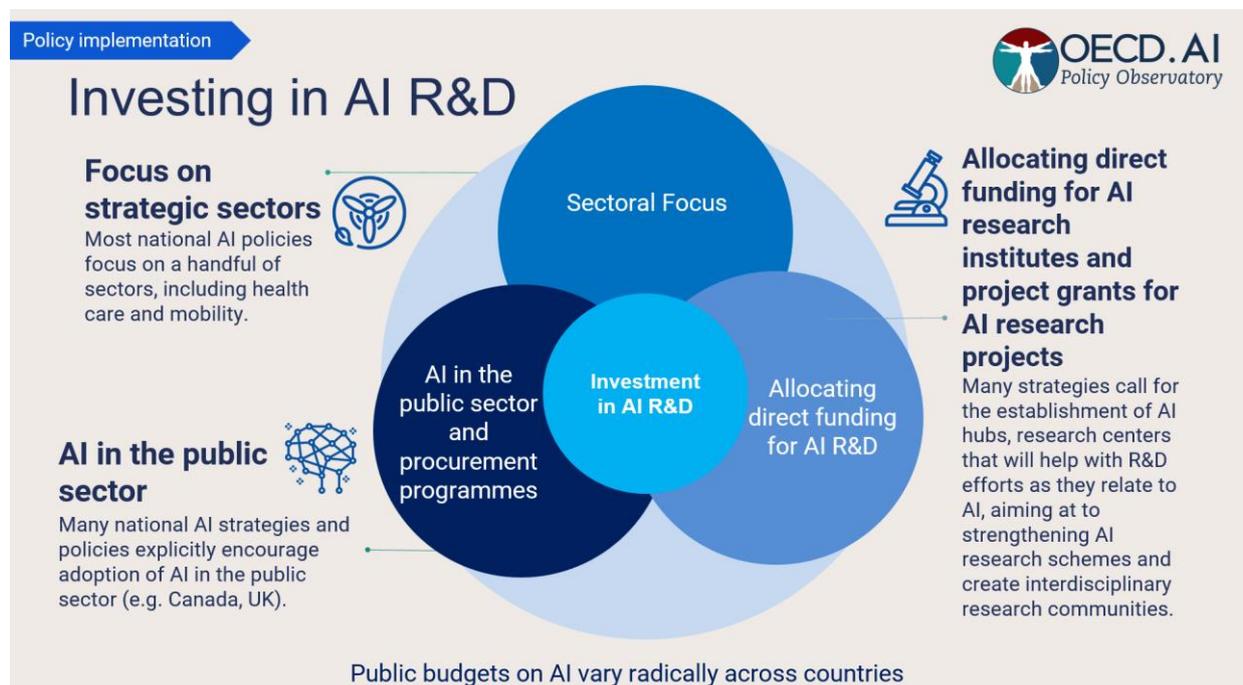
Effective implementation of national AI initiatives needs to be co-ordinated across government. AI governance models range from assigning oversight to an existing ministry or department to creating new bodies dedicated to AI. Countries are pursuing different national governance models to coordinate national AI policy implementation across government and offer regulatory and ethical oversight. Many countries are establishing national AI offices that are tasked with overseeing national AI policy implementation and ensuring policy coherence.

Several countries have established dedicated bodies to coordinate AI strategy implementation (Canada, Egypt, Singapore, United Kingdom, United States); conduct technology foresight and impact assessments (Austria, Canada, United Kingdom, United States); or address ethical issues (New Zealand, United Kingdom). In addition, AI observatories have been established at regional (Belgium - Flemish Knowledge Centre Data & Society, Quebec), national (Italy, France, Germany) and international levels (European Commission's AI Watch, AI4EU Observatory, OECD.AI).

AI policy implementation

Funds to develop national AI R&D capabilities are allocated in many different ways

To invest in AI R&D, countries are funding national AI-related research institutes and projects through grants; consolidating AI research networks and collaborative platforms; prioritising AI investments in specific economic sectors; pursuing AI-related mission-oriented innovation policies; and procuring AI systems for the public sector (Figure 2). Building on digital government approaches, many national AI strategies and policies encourage the public sector to adopt AI while ensuring that their systems are human-centred and trustworthy.

Figure 2. A selection of AI policies that follow OECD AI Principle 2.1 on investing in AI R&D

Note: This stylised figure identifies a selection of AI policy instruments used by countries to implement the OECD AI Principle 2.1 on promoting investments in AI R&D.

Source: Authors.

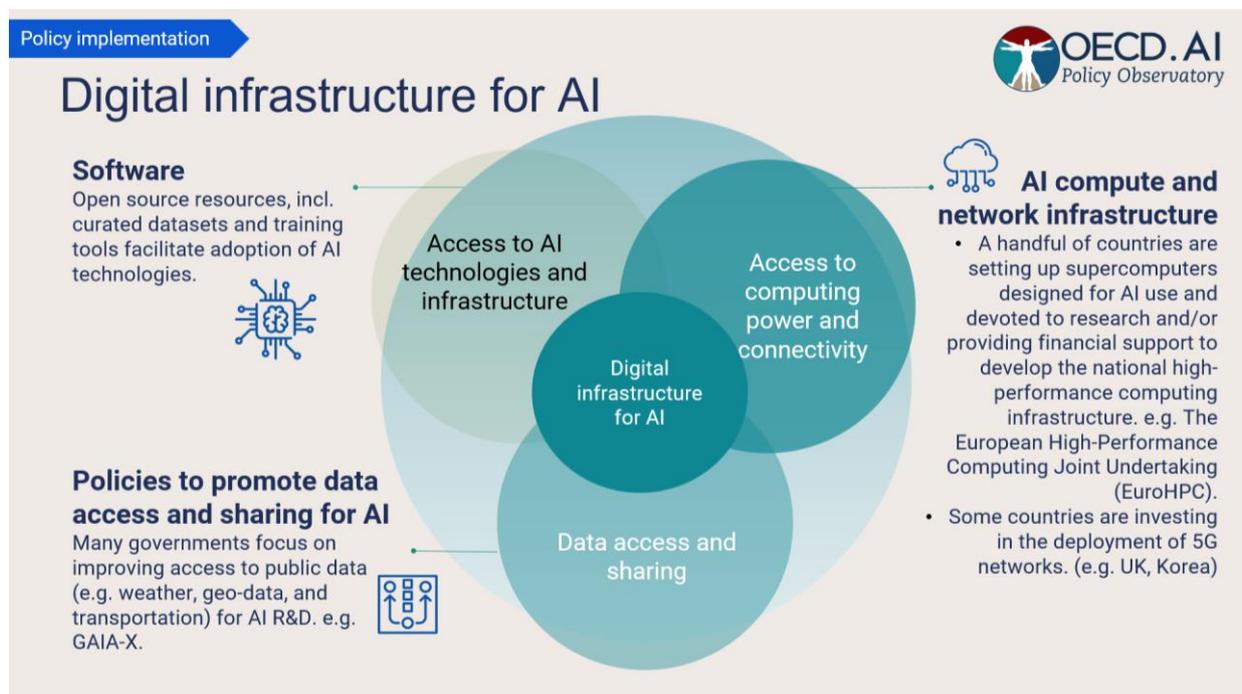
Budgets for AI R&D vary across countries. For example, since 2020 the United States dedicates USD 1 billion or more annually to non-defence AI R&D and created national AI research institutes. The *EU Horizon 2020 programme* has committed EUR 1.5 billion to AI research over two years and expected an additional EUR 20 billion in 2020 from the private sector and member states. Canada's federal and provincial governments have dedicated over USD 227 million (CAD 300 million) to AI research over 2017- 22, anchored in the three AI institutes created under the *CIFAR Pan-Canadian AI Strategy*.

Sharing data and AI compute access are growing priorities

Open access to public sector data continues to be a priority as national data strategies increasingly focus on AI to foster a robust digital ecosystem for AI and advance AI R&D. Policies to promote access to public data and initiatives that enable private sector data sharing include data trusts, data dams and data spaces. As part of their AI strategy, several countries have developed or are developing centralised, accessible repositories of open public datasets such as anonymised government health records and satellite data (e.g., Chile, Norway, Portugal, Spain, and the United States). Others are looking for ways to incentivise data sharing in the private sector (e.g. United Kingdom, European Union).

Alongside data and algorithms, AI computing capacity has emerged as a key enabler for AI and AI-enabled economic growth and competitiveness. Policies increasingly prioritise investments in digital AI infrastructure, such as high-performance-computing and cloud computing resources, to increase AI use and adoption, while providing research institutions and businesses access to these resources (Figure 3).

Figure 3. A selection of AI policies that follow OECD AI Principle 2.2 on AI digital infrastructure



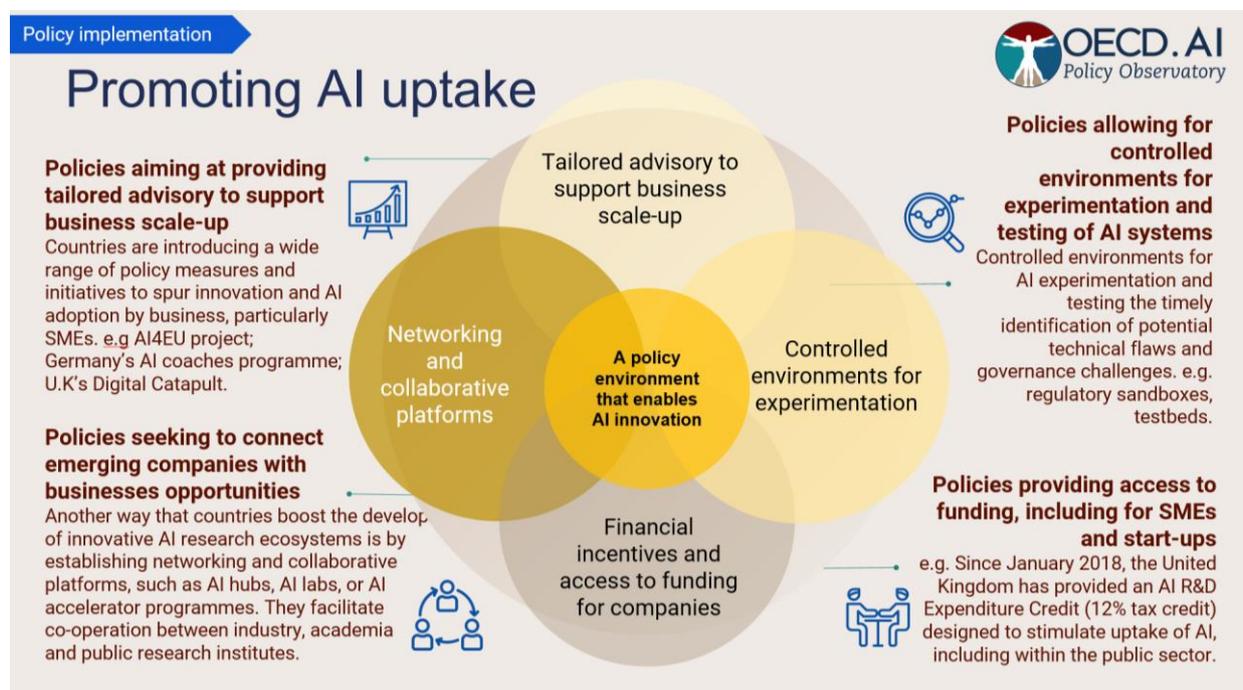
Note: This stylised figure identifies a selection of AI policy instruments used by countries to implement the OECD AI Principle 2.2 on fostering a digital ecosystem for AI.

Source: Authors.

Reviewing and adapting relevant policy and regulatory frameworks can help support an agile transition from AI R&D to commercialisation

Countries are providing innovative AI start-ups and SMEs with controlled environments for experimentation and testing of AI systems to improve the conditions for them to strive, scale up, and remove market barriers to AI adoption by businesses. Other policy initiatives include improving companies' access to funding; connecting emerging companies with business opportunities through networking and collaborative platforms, and providing tailored advice to support businesses as they scale up (Figure 4).

Figure 4. A selection of AI policies that follow OECD AI Principle 2.3 on shaping an enabling policy environment for AI



Note: This stylised figure identifies a selection of AI policy instruments used by countries to implement the OECD AI Principle 2.3 on shaping an enabling policy environment for AI.

Source: Authors.

To boost innovative AI research ecosystems, countries are turning to platforms for networking and collaboration. For example, Canada's *Innovation Superclusters Initiative*, has invested EUR 155 million (CAD 230 million) in the *Scale AI Supercluster* to advance the development of AI-powered supply chains. Other policy initiatives include Colombia's start-up incubator and accelerator *C-Emprende*, the Czech Republic's knowledge transfer partnerships programme, Denmark's digital hub for AI public-private partnerships, Finland's *AI Business programme*, Germany's *Plattform Lernende Systeme*, Hungary's AI in practice self-service online platform, Norway's AI research consortium, Slovenia's *Digital Coalitona* and *AI4Slovenia*.

A wide range of new policy initiatives aims to encourage SMEs to innovate and adopt AI. Examples include the European Commission's *AI4EU* project, Finland's AI Accelerator, the *SME 4.0 Excellence Centres* in Germany Korea's *AI Open Innovation Hub*, Turkey's SME programme *KOBIGEL*, and Singapore's *AI Makerspace*. Governments are also experimenting with controlled testing environments for AI systems, including by SMEs (Germany, Lithuania, New Zealand, United Arab Emirates, United Kingdom, United States).

Some international organisations plan to translate high-level AI principles into legal frameworks while they are considering risk-based approaches. Some countries are developing technical standards to support the implementation of trustworthy AI.

The use of AI systems whose recommendations are acted upon automatically without human involvement in the public sector has come under increased scrutiny. To ensure the development and deployment of trustworthy AI, governments are exploring a variety of regulatory approaches that include: amending existing laws; introducing requirements for the mandatory bias testing of AI systems; prohibiting or banning the use of AI systems in specific contexts, or establishing public registries to ensure that AI systems are

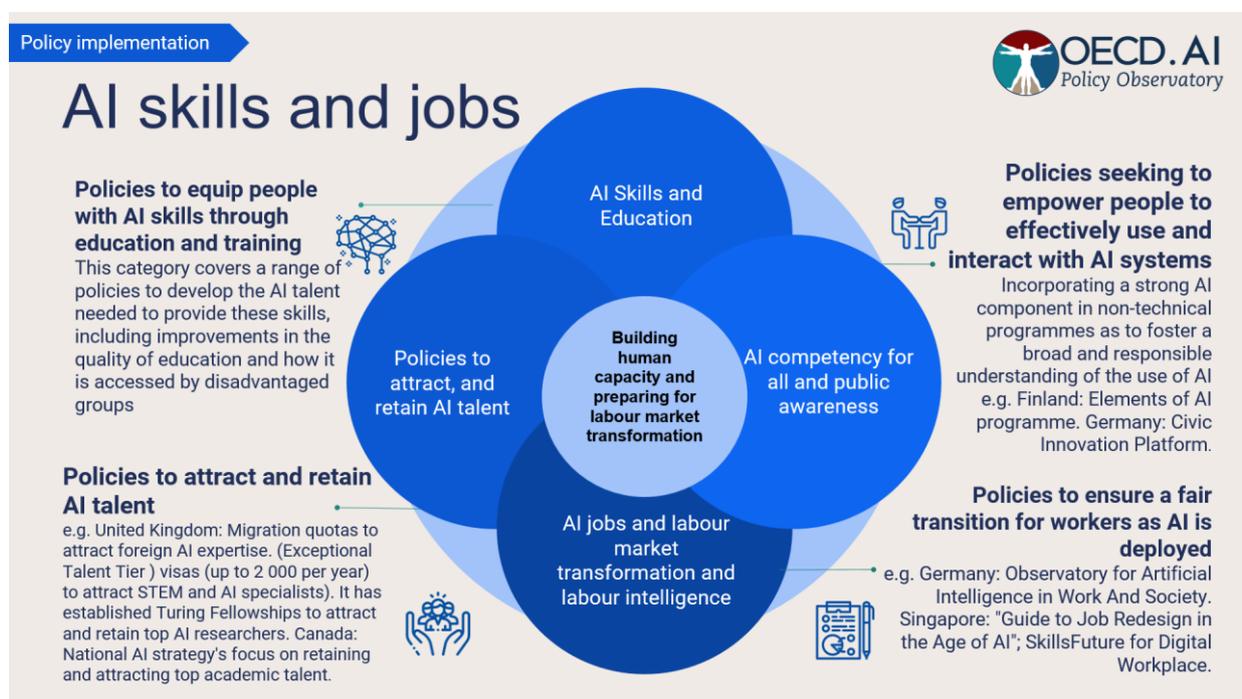
efficient and accurate. They are also establishing ethical oversight bodies to advise regulators and ensure that AI systems are used in trustworthy ways.

Most countries have introduced guidelines for trustworthy AI that are largely in line with the OECD AI Principles. Examples include *Australia's AI Ethics Framework*, *Colombia's Ethics Framework for Artificial Intelligence*, *Germany's Data Ethics Commission ethics recommendations*; *Hungary's AI Ethical Guidelines*, *Japan's AI R&D Guidelines and AI Utilisation Guidelines*, *Singapore's Model AI Governance Framework*, and the *European Commission's Ethics Guidelines for Trustworthy AI*.

Education and training programmes are building human capacity and monitoring the impact of AI in labour markets has begun

To empower people with the skills for AI and prepare for a fair labour market transition, countries are deploying a myriad of policy initiatives, including: establishing formal education programmes on STEM and AI-related fields (Australia, Finland, Turkey, United Kingdom, United States); devising vocational training and lifelong learning on AI-related programmes to help citizens keep up with technological and societal changes (Finland, Singapore); providing financial and non-financial support to retrain and attract top AI talent (Belgium, Canada, Turkey, United Kingdom); fostering academic partnerships between public and private AI research institutions (Chile, Egypt, Korea, Germany, Turkey); and monitoring the impact of AI on the labour market for policy intervention (Germany). The first four categories are more developed in the current landscape, while measures addressing broader labour market trends and challenges remain at a very early stage of development (Figure 5).

Figure 5. A selection of AI policies that follow OECD AI Principle 2.4 on AI jobs and skills



Note: This stylised figure identifies a selection of AI policy instruments used by countries to implement the OECD AI Principle 2.4 on building human capacity and preparing labour market transformation.

Source: Authors.

AI policy intelligence to monitor implementation

A few countries have launched policy intelligence activities and issued annual reports to evaluate their national AI strategy implementation, such as Canada, Germany, Singapore, the United Kingdom, the United States, and the European Commission. Several national and regional institutions have established AI observatories to oversee national AI strategy and policy implementation, and to develop indicators. At the European level, AI Watch is developing indicators in numerous areas.

International and multi-stakeholder co-operation on AI

Many countries are engaged in international co-operation for AI which is taking place in fora including the Council of Europe, the European Union, the Group of Seven (G7), the Group of Twenty (G20), the Global Partnership on AI (GPAI), the Inter-American Development Bank (IDB), the International Telecommunications Union (ITU), the OECD, the United Nations, the United Nations Educational, Scientific and Cultural Organization (UNESCO) and the World Bank. Cross-border co-operation in AI research is also a priority. For example, the French National Research Agency, the German Research Foundation and the Japan Science and Technology Agency are calling for French-German-Japanese collaborative AI research projects. Similarly, the United Kingdom and the United States are seeking to strengthen their co-operation on AI research.

In February 2020, the OECD launched OECD.AI, a platform for policy makers to monitor developments in the AI policy landscape and the OECD.AI Network of Experts (ONE AI), a multi-stakeholder expert group that is developing practical guidance to help implement the OECD AI Principles. The OECD also hosts the Secretariat of the Global Partnership on AI (GPAI), an initiative launched in June 2020 to conduct research and pilot projects on responsible AI.

1. AI policy design

This section elaborates preliminary findings on i) AI policies that are at different stages of development; ii) the role of public consultations to promote inclusive social dialogue on AI; iii) governance approaches pursued by countries to co-ordinate the implementation of their AI policies; and iv) insights on emerging national AI regulatory and non-regulatory approaches.

AI policy stages of development

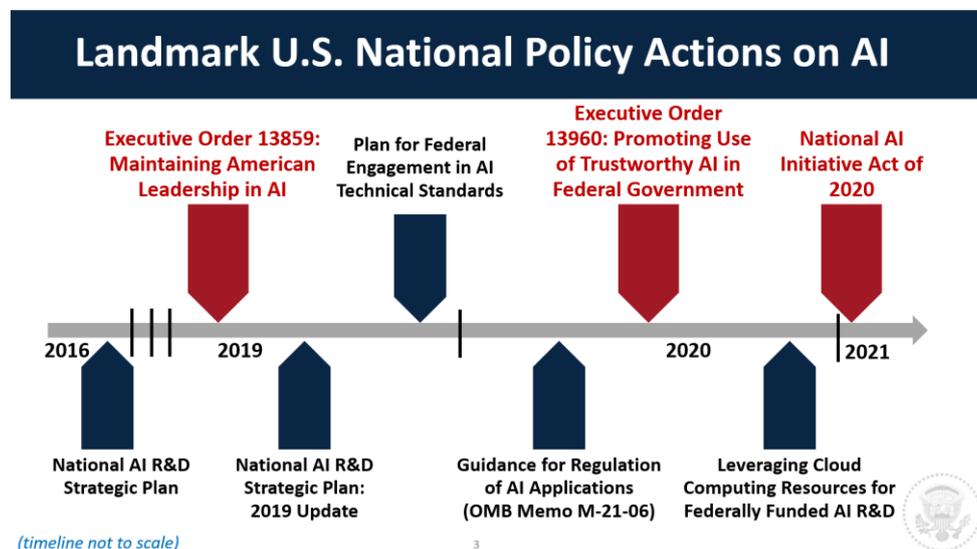
Countries are at different stages of implementation of their national AI strategies. Canada, Finland, Japan, and the United Kingdom were among the first to develop national AI strategies, setting targets and allocating budgets around 2017. Denmark, France, Germany, Korea, Russia and the United States followed suit in 2018 and 2019. In 2020, countries continued to announce their national AI strategies, including Bulgaria, Egypt, Hungary, Poland, and Spain. In 2021, Brazil launched its national AI strategy. A number of countries are in the consultation and development processes, such as Argentina, Chile, Mexico and Turkey. More are expected to be announced.

In some countries, a head of State or Prime Minister called for the AI strategy. France's Prime Minister tasked Cédric Villani in 2017, the Field Medal winner mathematician, with examining AI policies in France. The ensuing national AI strategy was published in 2018. In Japan, the expert group was created by Prime Minister Order and developed Japan's AI strategy in 2017. In some other countries, early policy responses to AI have taken place at a more administrative level. In the United States, the Office of Science and Technology Policy published its strategic plan on AI R&D in 2016. The United States launched its national AI strategy in 2019 as an Executive Order by the President. In Italy, the task force at Digital Italy published the whitepaper on AI in 2018 to identify opportunities and challenges before Italy launched its national AI strategy in 2019. In 2016, the Korean government published the *Mid-to Long-Term Master Plan in preparation for the intelligent information society*. In 2019, Korea announced its national AI strategy.

During 2019-2020, several countries updated or complemented their national AI strategy. The United Kingdom published its "AI Sector Deal" in 2018 and published an update to the Sector Deal in 2019. It also published a National Data Strategy which considered the importance of data for trustworthy AI development and use. Korea published its national AI strategy in 2019 and launched Digital New Deal in 2020 to consolidate its domestic digital ecosystem. In 2020, Russia adopted the "Concept for the development of regulation of relations in the field of AI and robotics until 2024". In December 2020, the US Congressional legislation defining the National AI Initiative Act (NAIIA) of 2020 became law, and expanded existing AI policies and initiatives of the White House and throughout the Federal Government (Figure 6) to ensure continued U.S. leadership in AI R&D; leading the world in developing and using trustworthy AI systems in the public and private sectors; preparing the U.S. workforce for the integration of AI systems across the economy and society; and co-ordinating AI R&D and demonstration activities between civilian agencies, the Department of Defence, and the Intelligence Community to ensure that each informs the work of the others.

Moreover, a few countries updated their national AI strategies and introduced annual reports monitoring their implementation.

Figure 6. Timeline of U.S. AI policy actions



Source: Presentation by ONE AI member Lynne Parker (United States), 11 March 2021 (9th meeting).

In most cases, a national AI strategy sets the objective or target followed by plans for action to implement the strategy. Some countries aim to secure a leading position in AI (Box 1). Action plans include co-ordination role of the government to ensure concerted action by all stakeholders and a whole-of-government approach to the strategy.

Box 1. A selection of national AI strategies' goals and ambitions

China: China's State Council released the Guideline on Next Generation AI Development Plan that set the following industrial goals: i) AI-driven economic growth; ii) breakthroughs in basic theories by 2025, and iii) to be a global AI innovation centre by 2030.

Finland: Finland published its first AI strategy "Finland's Age of Artificial Intelligence" in 2017 and it called for policy actions to i) enhance business competitiveness using AI, ii) ensure top-level expertise and attract top experts, iii) provide the world's best public services, iv) make Finland a front runner in the age of AI.

Germany: The German federal government published its AI strategy in 2018 and Germany aims to become a leading centre for AI, with "AI made in Germany" becoming a strong export and a globally recognised quality mark.

Korea: Korea launched its national AI strategy in 2019 that articulated the following targets: i) for Korea to be among the top three countries in terms of its digital competitiveness ranking and ii) to be among the top 10 countries in terms of the quality-of-life ranking.

United States: The United States issued an Executive Order "Maintaining American Leadership in Artificial Intelligence" in 2019. The order articulates the importance of American leadership in AI to maintaining economic and national security and to shaping the global evolution of AI. On 1 January 2021, the National Artificial Intelligence Initiative Act entered into force.

Source: www.oecd.ai/dashboards

Policies to promote inclusive social dialogue on AI

Many governments involve a broad range of stakeholders to seek input on their national AI policies at different stages of the design, implementation, and evaluation policy cycle. This section examines policies aiming at promoting an inclusive social dialogue on AI, including the role of public consultations in the AI policy design to bring diverse viewpoints and promote collaboration among stakeholders in AI policy development.

The OECD.AI national AI policy database shows that different countries pursue different types of consultations, including i) online/offline surveys; ii) conferences and public hearings, participatory workshops, and seminars; iii) expert interviews; iv) creating focus groups or expert groups; v) creating fora for online discussion, and vi) establishing permanent bodies to advise and co-ordinate the implementation of national strategies. Expert groups, participatory workshops and seminars are the most used methods of public consultation.

Consultations with experts and stakeholders are a key driver for the development of AI strategies. For example, the European Commission created a High-Level Expert Group – a committee of 52 experts that published recommendations on AI policy and investment as well as ethics guidelines for trustworthy AI in the EU. Japan created an expert group chaired by the Prime Minister to develop an AI strategy in 2016. Malta's AI Strategy was developed by Malta.AI Taskforce, a group of experts across multiple domains.¹ France consulted with over 400 experts for the development of its national AI strategy. Singapore received a wide range of contributions both locally and internationally from key AI personalities, private companies, research institutions and think-tanks and government agencies.²

In addition to expert consultations, some governments engaged the public more expansively to ensure that perspectives from citizens and consumers are considered as part of their national AI strategy. For example, ONE AI member Jose Guridi (Chile) mentioned that the Chilean government organised a series of webinars and opened a process by which any group could organise their workshops and share their insights with the government. More than 7 000 people participated in this process (Box 2). Guest speaker Gillian

Docherty (The Data Lab, Scotland) presented Scotland's public engagement program in its AI strategy development that invited the public to online workshops and provided material for students. The Scottish government published a report on public engagement in developing its AI strategy (Democratic Society, 2020^[2]).

Public consultations take place at various stages of policy development. For example, some countries consulted stakeholders at an early stage. Lithuania's 'vision' that lays out specific objectives were shaped through such consultations. Latvia consulted experts and stakeholders to identify key areas for investment and priorities of AI strategy to be developed. In February 2020, the Latvian government released its national AI strategy on *Developing Artificial Intelligence Solutions*. On the other hand, Turkey consulted experts to conduct a foresight exercise to determine where the funding for public research to be allocated.³

A growing phenomenon is the establishment of independent advisory bodies, such as new AI expert advisory councils in Canada, Egypt, Spain, the United Kingdom, and the United States.⁴ These bodies monitor not just the implementation of the national AI strategy and its impact, but also citizens' trust and perceptions of AI, to inform the government's policy responses. For example, to better understand the needs and perspectives of Canada's AI community, the Government of Canada launched an Advisory Council on Artificial Intelligence in 2019, comprised of researchers, academics, and business leaders, the Council advises the Government of Canada on how to build on Canada's AI strengths to support entrepreneurship, drive economic growth and job creation and build public trust in AI. The Council has created two working groups to date, one on Commercialization and another on Public Awareness (OECD.AI forthcoming).

Box 2. Public Engagement as a Public Consultation Process

Canada

The formulation of Canada's AI strategy involves input from both non-governmental experts and citizens in consultation processes. In 2019, the Canadian government established an AI Advisory Council to advise the government on how to build on the country's strength in the field of AI and to spur AI-powered economic growth. The council created two working groups: one on commercialisation and the second on public awareness. Public awareness is a key area for the Council that emphasised that policy design, including sectoral priorities, require the trust and support of the public to succeed.

ONE AI member Professor Marc-Antoine Dilhac (Canada) provided a framework for engaging in public consultations with citizens:

- Consultation, which consists of gathering existing opinions, most typically in a survey format. When done well, surveys can provide helpful feedback for policy makers to design and adjust policy actions, though particular attention should be paid to ensuring the diversity of respondents.
- Deliberation, i.e., bringing people together to meet and deliberate democratically. This involves rational discussion through an exchange of arguments and a collective decision. The goal of deliberation is to identify common orientations based on discussion, rather than to express existing opinions.
- Co-design, a process of conception and development, a collaborative process by which citizens elaborate on principles, norms, and standards.

Canada's AI Advisory Council created its public engagement and consultation processes using both consultation and deliberation. The national survey elicited an array of citizens' input on AI use in different sectors. The results will shape deliberative workshops that take place online due to the pandemic. The workshops aim to find ways to address ethical concerns raised by citizens via the survey. Among the goals of the deliberative process is to shape a new set of guidelines and recommendations for the development of AI.

Some ONE AI members highlighted the challenges of involving the public in consultation processes on AI policy design, which is often considered as technical and exclusive. The example of Chile was provided as a country whose government put the public consultation process at the centre of its AI policymaking, with new models to involve citizens in AI policy development. One model is to create an assembly by appointing several dozen citizens to discuss AI policy and gain expertise. Another is to conduct continuous consultations through online surveys. The AI Civic Forum is an initiative co-directed by The Future Society, AlgoraLab and Mila to engage the public through deliberative democracy (AICF, 2020^[3]).

Source: Presentation by Pr. Marc-Antoine Dilhac, 10 July 2020 (Expert group 3rd Meeting)

Chile

In 2019 the government of Chile started developing its national strategy. According to ONE AI member Jose Guridi (Chile), the consultation process that went from February 2020 to January 2021 faced two different crises: social riots and the COVID-19 pandemic. These crises allowed Chile to develop a more participatory process and create robust social dialogue to serve two purposes: building a national AI strategy and increasing AI awareness and education. Through a series of 69 regional workshops, 15 webinars with over 7000 attendants, and even a handbook, the government served as facilitator to raise awareness about AI. It developed a bottom-up participatory approach and inclusive social dialogue to solicit feedback from citizens to inform the design of national AI policy. During his presentation, Mr. Guridi highlighted the very wide range of participants drawn to AI events in Chile, which contribute to the AI policy design process but also to learning more about AI.

Since 2019, Chile has been developing its AI Policy



Note: For more data on public consultation processes for AI policy, visit: https://oecd.ai/dashboards/policy-instruments/Public_consultation_of_stakeholders

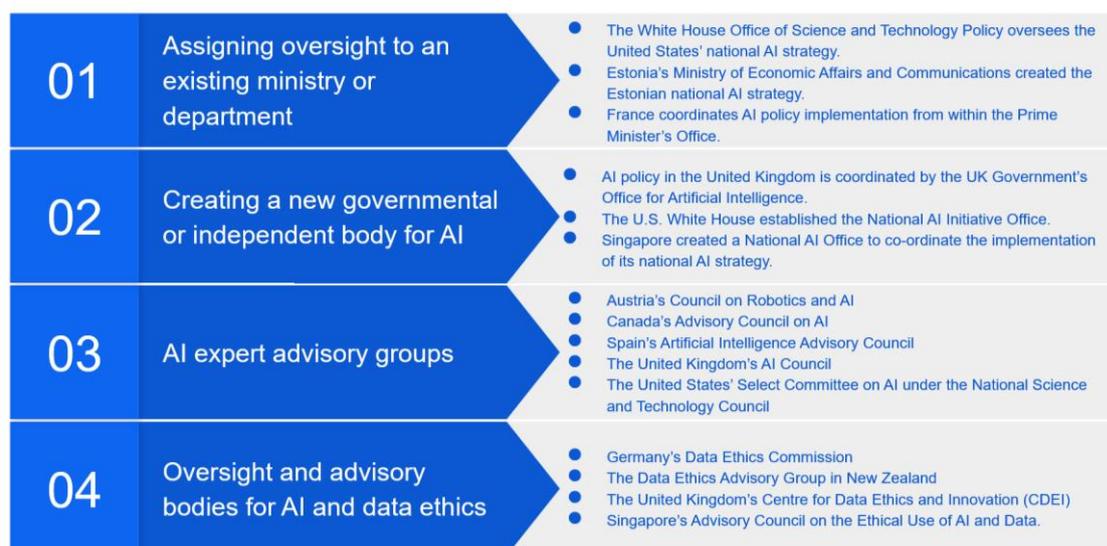
Source: Presentation by ONE AI members Carlos Ávila and José Guri, 15 February 2021 (Expert group 8th Meeting).

Effective implementation of national AI initiatives hinges on co-ordination

Countries are pursuing varying national governance approaches to coordinate the implementation of their national AI strategies and policies across government, offering regulatory and ethical oversight. The horizontal nature of AI policy often calls for the involvement of several institutions and actors. Examining national AI strategies at OECD.AI reveals several patterns.

To ensure policy coherence and the effective implementation of national AI policies, governments are using different models: i) assigning oversight of the development and implementation of a strategy to an existing ministry or agency; ii) creating a new governmental or co-ordination body for AI; iii) establishing AI expert advisory groups; iv) receiving input from oversight and advisory bodies for AI and data ethics bodies (Figure 7.).

Figure 7. Governance approaches to national AI policy



Note: This Figure offers a selection of national AI governance implementation examples. For more data on national AI governance, visit: https://oecd.ai/dashboards/policy-instruments/Creation_or_reform_of_governance_structure_or_public_body
Source: OECD.AI

Assigning oversight of the development and implementation of a strategy to existing ministries and agencies

Among existing ministries or agencies tasked with developing or implementing an AI strategy, those that tend to drive the creation of AI strategies most often are i) information technology and communications ministries; ii) economics or finance ministries; or iii) education, science (and technology) and innovation ministries. In Brazil, the national AI strategy efforts were spearheaded by the Ministry of Science, Technology, Innovations and Communication.⁵ Estonia's Ministry of Economic Affairs and Communications created its national AI strategy.⁶ In India the AI strategy is overseen by the Ministry of Planning, a ministry focused on fostering co-operation between Indian states.⁷ Israel's AI strategy was developed through its AI Strategy Governmental team, an inter-departmental effort with members from the Prime Minister's Office, Ministry of Defense, Israel Innovation Authority, National Cyber Directorate, and Council for Higher Education.⁸ Poland's AI strategy was developed by the Ministry of Digital Affairs, the Ministry of Development and Technology, the Ministry of Science and the Ministry of Public Funds. In Russia, the implementation of the AI national strategy is overseen by the Ministry of Economic Development.

Examples within the OECD.AI database show that the agency or government ministry responsible for implementing national AI strategy varies among countries. At least ten countries have assigned responsibility for AI policy coordination to more than one ministry. For example, Germany's AI strategy was a joint project between the Federal Ministries of Education and Research, Economic Affairs and Energy, and Labour and Social Affairs. Likewise, the Ministry of Industry and Technology and the Presidency's Digital Transformation Office are working together on developing Turkey's national AI strategy.

Creating a new governmental or co-ordination body for AI

Some countries created a co-ordination body to facilitate whole-of-government implementation of AI policies. For example, France co-ordinates AI policy from within the Prime Minister's Office, Colombia is developing an AI Office within the Presidency of the Republic. Egypt has a National Council for Artificial Intelligence headed by the Minister of Communications and Information Technology. Saudi Arabia's Data and Artificial Intelligence Authority co-ordinates its AI strategy with relevant agencies. Serbia established an inter-departmental group, the AI Council, to oversee the implementation of its AI strategy.⁹ Singapore created a National AI Office. The United Arab Emirates' Ministry for Artificial Intelligence. In 2019, the United Kingdom established the Office for AI. In 2020, the United States established the National AI Initiative Office (Box 3).

Box 3. Two key drivers for the effective implementation of AI policy: leader-level support and ensuring horizontal co-ordination

US National AI Initiative Office

In January 2021 the White House established the National AI Initiative Office to implement a national AI strategy, coordinating AI research and policymaking across government, industry and academia. The Office was established per the National AI Initiative Act of 2020 to serve as a hub for national AI research and policy. The Act also codified the American AI initiative that plans for increased AI research investment by the federal government, access to AI compute, and the establishment of AI technical standards, among others. The Act also expanded the White House-based Select Committee on AI and codified the establishment of the national AI research institutes, along with a national strategic R&D plan.

ONE AI member Lynne Parker (US) stressed that a key driver that has catalysed the implementation of the US' national AI policies is a high-level political endorsement from both the President of the United States who issued an Executive Order on AI in early 2019 and from Congress, which passed legislation – the National AI Initiative Act – that entered into force on 1 January 2021.

Lynne Parker also emphasised the importance of building strong collaboration across federal agencies. She stressed the challenge of coordinating across US federal agencies participating in AI R&D efforts and the key role of the new US National AI Initiative Office in coordinating these efforts, leveraging existing interagency coordination bodies. AI representatives from these agencies come together to learn more about each other's missions and challenges and identify commonalities and synergies. Horizontal co-ordination has proven valuable to develop general models for trustworthy AI that can also be tailored to particular use cases or mission priorities.

**National AI Initiative Office –
Central Hub for Coordinating Federal Activities, Outreach**

- Launched January 2021, per NAI Act
- Charged with overseeing and implementing the National AI Initiative
- Serves as central hub for Federal coordination and collaboration in AI research, development, and demonstration, as well as with private sector, academia, and other stakeholders involved in the initiative
- Conducts regular public outreach
- Promotes access to the technologies, innovations, best practices, and expertise derived from the National AI Initiative to agency mission and systems across the Federal Government



Source: Presentation by ONE AI member Lynne Parker (United States), 11 March 2021 (9th meeting).

AI expert advisory groups

Countries have also established AI expert advisory groups; multi-stakeholder groups comprising AI experts, tasked to identify and report on current and future opportunities, risks and challenges arising from the use of AI in society. These AI councils also provide recommendations to the government. These include Austria's Council on Robotics and AI; Canada's Advisory Council on AI; Spain's Artificial Intelligence Advisory Council; the United Kingdom's AI Council; Poland's Ad-Hoc Science AI Council and the United States' Select Committee on AI under the National Science and Technology Council and the National Security Commission on Artificial Intelligence. Colombia is also developing an International Council for AI

to oversee the implementation of its national AI strategy while also including input from international experts. Japan established the AI Strategy Implementation Council in 2018 as a dedicated body to coordinate the implementation of its AI Strategy.

Oversight and advisory bodies for AI and data ethics

Some countries have created or reformed oversight and advisory bodies for AI and AI-related areas. These include Germany's Data Ethics Commission, the Data Ethics Advisory Group in New Zealand, the United Kingdom's Centre for Data Ethics and Innovation (CDEI), and Singapore's Advisory Council on the Ethical Use of AI and Data. These bodies have introduced several reports and recommendations on the use of data and algorithmic systems.

In October 2019, the German Data Ethics Commission presented a report containing recommendations for action on the use of data and algorithmic systems (including AI systems) (Daten Ethik Kommission, 2019^[4]). In November 2020, the CDEI published its Review into Bias in Algorithmic Decision-Making (CDEI, 2020^[5]), which sets out recommendations to the UK government and sectoral regulators on how to tackle algorithmic bias and support organisations, whilst ensuring that the UK ecosystem is set-up to support ethical innovation.

An emerging trend is for national data protection authorities to issue guidance reports on challenges raised by AI systems that relate to data protection regulation (e.g., GDPR). One common concern is the collection of biometric data. In July 2020, the UK's Information Commissioner's Office (ICO) published a framework to audit AI systems and ensure data protection compliance (ICO, 2020^[6]). In February 2020, the Spanish Data Protection Agency published a guidance report on privacy compliance of the design and use of AI-based systems in light of GDPR (AEPD, 2020^[7]). In 2018 the Norwegian Data Protection Authority issued a report on Artificial Intelligence and Privacy (Datatilsynet, 2018^[8]). In December 2017, the French Data Protection Authority (CNIL) issued a report that identified six main ethical issues, derived several guiding principles, and concluded with practical policy recommendations (CNIL, 2017^[9]).

Box 4. National AI Governance approaches

Canada

In 2017, the Government of Canada announced EUR 84 million (CAD 125 million) for a Pan-Canadian Artificial Intelligence Strategy to retain and attract top academic talent, increase the number of post-graduate trainees and researchers in AI, promote collaboration between Canada's main centres of AI expertise, and position Canada as a world-leading destination for companies seeking to invest in AI and innovation. The government selected CIFAR (Canadian Institute for Advanced Research), an independent, not-for-profit organisation that supports the advancement of science through international and interdisciplinary collaboration and high-risk, high-impact research, as the organisation responsible for its implementation.

Other initiatives include the 'Innovation Supercluster Initiative' which is providing EUR 155 million (CAD 230 million) in funding to the Scale AI Supercluster to bring together retail, manufacturing, transportation, infrastructure and information and communications technology (ICT) sectors to build intelligent supply chains powered by AI.

China

The State Council of China published its national AI strategy in July 2017 (Next-Generation Artificial Intelligence Development Plan). The strategy set the target of AI development in China, including becoming a global AI innovation centre by 2030 and building up an AI industry of USD 150 billion (RMB 1 trillion). Following the strategy, the Chinese government launched pilot AI projects called "National Pilot Areas for AI Innovative Development" to test the application of emerging technologies, explore effective policy tools and measure the social impact of technologies. The government is developing its 14th Five-Year Plan (2021-2025) that prioritises innovation and China's long-term competitiveness in AI (Xia, 2021^[10]).

To cope with social challenges associated with the adoption of AI technologies, the government created an advisory committee for AI governance in March 2019: the National Specialised Advisory Committee for AI Governance. The Committee published AI governance principles (A New Generation of Artificial Intelligence Governance Principles) in June 2019. The AI governance principles are: i) Harmony and Human-friendly, ii) Fairness and Justice, iii) Inclusion and Sharing, iv) Respect for Privacy, v) Safety and Controllability, vi) Shared Responsibility, vii) Open and Collaboration, and viii) Agile Governance.

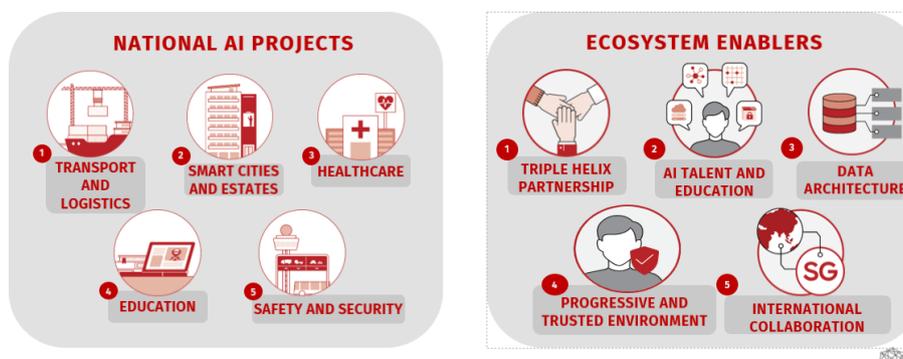
Singapore

By 2030, Singapore aims to become an AI leader by 2030, by focusing on specific sectors that will continue to drive further economic growth. ONE AI member Yeong Zee Kin (Singapore) presented the Singaporean national AI strategy.

Overview of the strategy

VISION

By 2030, Singapore will be a leader in developing and deploying scalable, impactful AI solutions, in key sectors of high value and relevance to our citizens and businesses.



Four of the most important actors in Singapore's governance structure of AI include the National AI Office, a National AI Steering Committee, the established Civil Service sector, and the Ministerial leadership.



In creating the National AI Office, Singapore emphasised the importance of bringing together public and private sector actors to carry out national priorities, as well as the importance of identifying key “enablers” (public-private partnerships, talent, data, citizen trust, and international cooperation) to create the right environment.

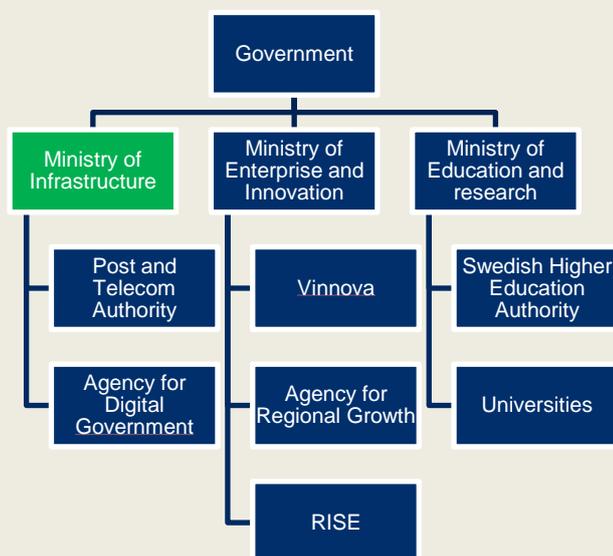
Source: Presentation by ONE AI member Yeong Zee Kin, 29 June 2020 (Expert group 2nd Meeting). For more information, see also the [Singaporean National AI Strategy](#).

Sweden

Sweden published a document outlining its national approach to AI in 2019. The purpose of this document was to identify an overall direction for AI-related work in Sweden and lay the foundation for future priorities. The document identified the direction and priorities for AI-related work in Sweden: i) education and training ii) research, iii) innovation and use, and iv) a framework and infrastructure. ONE AI member Irene Ek (Sweden) presented the AI-related governance structure in Sweden. Three Ministries – Ministry of Infrastructure; Ministry of Enterprise and Innovation; and Ministry of Education and Research – are responsible for AI policies and independent agencies under these Ministries implement these policies. For example:

- The Ministry of Infrastructure oversees a project called ‘Data as a strategic resource in SME’ and Agency for Regional Growth are implementing the project.
- The Ministry of Enterprise & Innovation set up a research grant and Vinnova (the Swedish innovation agency) is allocating the grant.

The independent agencies are implementing policies from different Ministries. ONE AI member Irene Ek (Sweden) stressed that both horizontal and vertical coordination across government bodies are key for the effective implementation of AI policy in Sweden.



Source: Presentation by ONE AI member Irene Ek, 24 September 2020 (Expert group 5th Meeting) Interim results from Ek, I (2020) *AI policy for competitiveness*.

United Kingdom

A number of recently created institutions are at the centre of the UK's AI strategy: the Office for Artificial Intelligence – the central AI policy team in Government, the AI Council – an independent expert advisory group drawn from industry, academia, and civil society; the Centre for Data Ethics and Innovation – a body separate from Government set up to advise Government and regulators on the use of data, including for AI. In addition, The Alan Turing Institute took on the role of 'national institute for AI' in 2017, and several other governmental bodies are tasked with driving adoption in the public sector (e.g., Government Digital Service, new Chief Digital and Data Office in Cabinet Office, Government Automation unit, Crown Commercial Service) or funding research (UK Research and Innovation).

Countries and inter-governmental organisations are exploring different regulatory frameworks to ensure trustworthy AI systems

Alongside promoting the widespread adoption of AI, national AI strategies call for responses to policy concerns raised by AI applications. These concerns relate to human rights, privacy, fairness, algorithmic bias, transparency and explainability, safety and accountability, among others. For example, safety concerns are associated with autonomous systems that control unmanned aircraft systems, driverless cars and robots. With regards to fairness, there are concerns about potential biases in AI systems that impact peoples' jobs, loans or health care. From a human rights perspective, many strategies highlight concerns over the impact on the right to privacy when it comes to the use of personal data in AI systems, and how to ensure the right to an effective remedy when there has been a human rights violation involving AI (Global Partners Digital, 2021^[11]).

Policy makers across the world have recognised the regulatory challenges associated with digital transformation, and have responded in a variety of ways, ranging from “wait and see” to “test and learn” to banning digitally enabled business models outright (OECD, 2018^[12]). Countries are exploring approaches to ensure trustworthy AI and mitigate risks associated with the development and deployment of AI systems. In addition to exploring the application and need to adapt current legislation for AI, emerging regulatory actions for AI trustworthiness include: i) providing soft law guidance; ii) considering hard law approaches, iii) introducing application-specific moratoriums or bans; iv) promoting controlled environments for regulatory experimentation and v) supporting international standardisation efforts and international law efforts.

Overall, countries' initiatives still retain predominately “soft” regulatory approaches for AI, including the development of ethical frameworks and guidelines, voluntary processes, technical standards, and codes of conduct. There is, however, a trend towards the development of legislative reforms and regulations for specific applications.

As highlighted by ONE AI member Lord Tim Clement-Jones, 2020 saw work at the international level in the Council of Europe, OECD and EU to operationalise high-level ethical principles such as the OECD AI Principles, with predominantly risk-based approaches to regulation (Clement-Jones, 2020^[13]): “*When it comes to AI technologies, we need to assess the risks such as the likely impact and probability of harm, the importance and sensitivity of use of data, the application within a particular sector, the risk of non-compliance and whether a human in the loop mitigates risk to any degree.*” To help policy makers navigate the complexity brought by the different policy concerns raised by different AI systems, the OECD Network of Experts Working Group on the Classification of AI systems is developing the OECD AI Systems Classification Framework (Box 5).

Box 5. OECD AI Systems Classification Framework

The OECD Classification Framework for AI systems seeks to provide a structure for assessing and classifying AI systems according to their potential impact on public policy in areas covered by the OECD AI Principles. It is developed by the OECD Network of Experts on AI (ONE AI).

AI systems are classified along four dimensions:

1. The context in which the system operates (e.g., sector of application, breadth of deployment).
2. The data and input used by the system (e.g., quality, the privacy of data).
3. The AI model that underpins the system (e.g., generative or symbolic models); and
4. The task and output that the system produces (e.g., level of autonomy, nature of the output).

Source: OECD (forthcoming), for more information visit: <https://oecd.ai/wonk/a-first-look-at-the-oecd-framework-for-the-classification-of-ai-systems-for-policymakers>

Soft law guidance

Many countries have introduced guidelines for trustworthy AI that are largely aligned with the OECD AI Principles and that provide standards for the ethical use of AI and its governance. Depending on the case, they are addressed to policy makers, businesses, research institutions and other AI actors. Examples include Australia's AI Ethics Framework; Belgium's online self-assessment tool to foster trustworthy AI specifically tailored to the public sector; Colombia's Ethics Framework for Artificial Intelligence, Egypt's Charter on Responsible AI (under development - planned to include assessment guidelines, technical guidelines and good practices); Hungary's AI Ethical Guidelines; Japan's AI R&D Guidelines and AI Utilisation Guidelines; and Scotland's AI explainability framework.

At the EU level, the European Commission's independent AI High-Level Expert Group (AI HLEG) introduced Ethical Guidelines on AI in December 2018. In July 2020, the AI HLEG presented a final Assessment List for Trustworthy Artificial Intelligence (European Commission, 2020^[14]).

Regulatory experimentation

Many countries are starting to consider experimental models or co-regulatory approaches. These approaches aim to allow experimentation to better understand the effects of AI systems and provide controlled environments to facilitate the scale-up of new business models (OECD, 2019^[15]; Planes-Satorra and Paunov, 2019^[16]). These take place in parallel to regulatory approaches that help create a policy environment that supports the transition from research to deployment of trustworthy AI systems. The concept of sandboxes was formally introduced in the United States. Subsequently, experimentation with sandboxes was conducted by the United Kingdom's Financial Conduct Authority. The objective of these sandboxes was to test new Fintech products and services before they officially enter the market. Since then, a number of sandboxes have emerged in a broad range of sectors.

Hard law approaches

Regulators are actively investigating and discussing regulations on AI-related issues. The OECD Parliamentary Group on Artificial Intelligence was formed in October 2019 to facilitate exchanges among legislators. The group, which held its first meeting in February 2020, also provides educational, technical and policy guidance to help inform national legislative processes.

As of January 2021, there are no mandatory governance instruments to regulate AI systems specifically. However, several governments and intergovernmental bodies have adopted or are considering binding legislation for specific areas of AI technologies. For example, the Danish Road Directorate has issued a binding guide on driverless cars. In June 2017, Germany allowed drivers to transfer control of vehicles to highly or fully automated driving systems for use on public roads. In the United States, the Federal Aviation Administration has been rolling out new regulations, rulemakings and pilot programmes. These aim to accelerate the integration of unmanned aircraft systems into the national airspace system. In 2020, the US Food and Drug Administration (FDA) considered regulating certain AI-powered medical diagnostic systems (FDA, 2020[8]). In February 2020, New York City introduced a regulation on the ‘sale of automated employment decision tools’.

Outright / effective ban

An outright (or effective) ban can be implemented by governments to maintain the existing market mechanisms or to protect citizens from the negative consequences of AI technologies. For example, Belgium has adopted resolutions to prohibit the use of lethal autonomous weapons by local armed forces.

Over the past years, biometric surveillance or facial recognition technology has emerged as a salient issue of public debate. Risks of improper algorithmic bias and data privacy concerns have resulted in various calls and actions to ban the use of facial recognition technology. In the United States, both federal and state governments indicated a willingness to enact regulations on the use of facial recognition technology by government agencies or law enforcement, as an innovative policy and regulatory tool for improving regulatory confidence over the various harms and benefits generated by emerging business models and technologies.

A selection of AI regulatory approaches

Finland

Finland’s Ministry of Justice and Ministry of Finance are currently examining national regulation on automated decision-making. A preliminary assessment of regulatory needs was published in July 2020. The main objectives of the process are i) to assess how automated decision-making within public administration meets the requirements from the Constitution of Finland and the data protection legislation of the European Union; and ii) to improve the regulatory environment and governance to encourage digitalisation and sustainable development, as well as a broad culture of experimentation.

Germany

In 2019, the German Data Ethics Commission assembled a regulatory risk pyramid for algorithmic systems, assessing the severity of harm and the likelihood of harm (Daten Ethik Kommission, 2019^[4]). This system was then adopted as the basis for the European Commission’s White Paper on Artificial Intelligence.

In November 2020, the German AI Inquiry Committee (*Enquete-Kommission Künstliche Intelligenz des Deutschen Bundestages*) presented its final report, which provides broad recommendations on how society can benefit from the opportunities inherent in AI technologies while acknowledging the risks they pose. The Committee’s work placed a focus on legal and ethical aspects of AI and its impact on the economy, public administration, cybersecurity, health, work, mobility, and the media. The Committee advocates for a “human-centric” approach to AI, a harmonious Europe-wide strategy, a focus on interdisciplinary dialogue in policymaking, setting technical standards, legal clarity on testing of products and research, and the adequacy of digital infrastructure.

New Zealand

In 2020, the New Zealand government launched a set of standards designed to act as a guideline for government agencies on how to use algorithms (the Algorithm Charter for Aotearoa New Zealand). The charter has been signed by 26 agencies in the country. The algorithm charter continues to evolve and will be reviewed after it has been in place for 12 months to ensure it achieved its intended purpose without stifling innovation or creating a compliance burden.

Portugal

The Portuguese AI strategy proposes to i) create an ethical committee for AI and automation to define and deploy guidelines for ethical-by-design AI; and ii) support the development of a legal and regulatory framework. This framework aims to determine issues related to liability in AI decision-making. Furthermore, the Portuguese government set up technological free zones. These zones focus on innovation and testing emerging technologies like artificial intelligence (AI), blockchain, big data, and 5G in real environments. The project is part of the Portuguese government's digital transition plan that is aimed at boosting social-economic progress and facilitating the country's transition to a sustainable economy.

Russia

In 2020, Russia adopted two laws in the area of digital innovation: i) the Federal Law on experimental legal regimes for "regulatory sandboxes" in the field of digital innovation and ii) the Federal Law on experimental regulation to facilitate development and implementation of AI technologies in Moscow.

Russia is developing AI regulation in the fields of autonomous vehicles and healthcare. In the area of autonomous vehicles, the Russian Government issued a regulation on highly automated vehicles on public roads in 2018 to allow the testing of autonomous vehicles. In 2020, Russia adopted the concept of road safety with autonomous vehicles on public roads and in 2021, the Russian government issued a set of measures for the testing of highly automated vehicles on public roads. In the area of healthcare, Russia established Rules for registering AI systems as medical software devices to simplify AI system registration procedures.

Singapore

In 2019, Singapore's Infocomm Media Development Authority (IMDA) launched the Model AI Governance Framework as a living document that puts AI ethics principles into implementable practices and measures. In early 2020, IMDA launched the second edition of the framework. It guides private sector organisations on how to address ethical and governance issues when deploying AI solutions. The second edition highlights that the framework is:

- **Algorithm-agnostic:** does not focus on specific methodologies related to AI or data analytics. It applies to the design, application and use of AI in general.
- **Technology-agnostic:** does not focus on specific systems, software, or technology, and will be applicable regardless of the development language and data storage method.
- **Sector-agnostic:** serves as a baseline set of considerations and measures that can be adopted by organisations operating in any sector. Specific sectors or organisations may choose to include additional considerations and measure or adapt the framework to meet their needs. IMDA encourages and will collaborate with public agencies adapting the Model Framework.
- **Scale- and business model-agnostic:** the framework does not focus on organisations of a particular scale or size. It can also be used by organisations engaging in business-to-business or business-to-consumer activities and operations, or in any other business model.

United States

In November 2020, the US Office of Management and Budget (OMB) issued guidance to federal agencies on when and how to regulate the private sector use of AI. The OMB's guidance on AI rulemaking includes a "regulatory impact assessment." The guidance focused on a risk-based, cost-benefit approach to AI regulation and prioritises non-regulatory approaches where possible. It requires that federal agencies develop compliance plans by 17 May 2021. Agencies will be obliged to document their regulatory authority over "high-priority AI applications," collections of "AI-related information" from regulated entities (and any restrictions on the collection or sharing of such information), the outcomes of stakeholder engagement that identify existing regulatory barriers to AI applications within that agency's purview, and any planned regulatory actions.

In December 2020, the US government signed a second Executive Order on AI, guiding the adoption of trustworthy AI by federal agencies in a manner that protects the privacy and civil rights. The Executive Order directs agencies to prepare inventories of AI use cases throughout their departments by July 2021.

United Kingdom

In July 2020, the Information Commissioner's Office ("ICO") published *Guidance on Artificial Intelligence and Data Protection*, to help organisations mitigate the risks of AI arising from a data protection perspective. The guidance sets out a framework and a methodology for auditing AI systems. The guidance includes best practices for compliance with the UK Data Protection Act 2018 and with data protection obligations under the EU's General Data Protection Regulation ("GDPR"). The guidance's "*proportionate and risk-based approach*" contains an auditing methodology with: i) tools and procedures for audits and investigations; ii) detailed guidance on AI and data protection, and iii) a toolkit providing practical support to organisations auditing the compliance of their own AI systems. The guidance addresses: i) accountability and governance in AI; ii) fair, lawful and transparent processing; iii) data minimisation and security; and iv) compliance with individual data subject rights.

The House of Lords' Liaison Committee published a report in December 2020 (UK House of Lords Liaison Committee, 2020^[17]) following up on a 2018 House of Lords (UK House of Lords, 2018^[18]). The House of Lords' 2020 Report found individual industry regulators and actors to be well placed to establish voluntary mechanisms for informing the public when AI is being used for significant or sensitive decisions for consumers and tasked the AI Council with developing and implementing such mechanisms. The report also flagged deficiencies in the existing legal framework for AI use in facial recognition applications, cautioning that a solely self-regulatory approach to ethical standards for AI would not be sufficient to ensure public trust. Moreover, the report recommended that by July 2021, the ICO – with input from the CDEI, the Office for AI and the Alan Turing Institute – develop a training course for regulators on public data use and AI. The report also recommended that CDEI developed international standards for ethical AI development by policy makers and businesses.

In January 2021, the AI Council, an independent expert and industry committee advising the UK Government on AI, published a roadmap recommending the deployment of a national AI strategy in the UK (UK AI Council, 2021^[19]). The roadmap stressed the UK should lead in developing appropriate standards on data governance and enact "clear and flexible regulation" building on guidance from regulators such as the ICO. The roadmap noted that "*the public should be reassured that the use of AI is safe, secure, fair, ethical and overseen by independent entities.*" In addition to the continuous development of industry standards and suitable regulations and frameworks for algorithmic accountability, it mentioned the need for further legislation, such as a public interest data bill to ensure transparency of automated decision-making, the right for people to seek meaningful information (for example, through algorithmic impact assessments) and the ability for regulators to enforce sanctions.

European Union (EU)

In February 2020, the European Commission (EC) published a white paper on AI (European Commission, 2020^[20]). The paper considers requiring a pre-market conformity assessment for “high-risk” AI applications, such as facial recognition, as a core element of a potential regulatory framework for AI. The paper also considers documentation requirements that enable authorities to ensure high-risk AI systems comply with fundamental rights. In addition, a voluntary “quality label” for AI applications deemed low-risk is mentioned. The white paper was followed by a public consultation in which over 1200 stakeholders provided feedback on the EC’s white paper, highlighting concerns about AI’s potential to breach fundamental rights and lead to discriminatory outcomes.

In July 2020, the EC published a preliminary impact assessment for AI legislation (European Commission, 2020^[8]), outlining that new legislation will focus on: *i*) protecting consumers from potential harm caused by AI, such as accidents caused by autonomous vehicles or other AI-driven robotics; *ii*) protecting fundamental rights, including those that threaten privacy and freedom of expression, such as facial recognition surveillance and similar monitoring systems; and *iii*) unlawful discrimination that may be caused by AI tools displaying bias against certain populations. The European Commission is expected to launch its revised AI legislative proposal in April 2021.

In December 2020, the EC introduced two legislative proposals to the Council and the European Parliament – the Digital Services Act and the Digital Markets Act – that would create new obligations and responsibilities for online platforms in terms of their access and processing of data, to ensure that recommendation algorithms are safe and transparent while promoting fair competition and fostering innovation. Liability regulation is also under review.

On 21 April 2021, the EC published its “AI legislative package” that comprises: *i*) a Proposal for a Regulation on a European approach for Artificial Intelligence (Box 6); *ii*) an updated Coordinated Plan with Member States, and *iii*) a Proposal for a Regulation on Machinery Products.

Box 6. European Commission’s legislative proposal on AI

In April 2021, the EC published a legislative proposal for a Coordinated European approach to address the human and ethical implications of AI. The draft legislation follows a horizontal and risk-based regulatory approach that differentiates between uses of AI that generate *i*) minimal risk; *ii*) low risk; *iii*) high risk; and *iv*) unacceptable risk, for which the EC proposes a strict ban. The EC legislative proposal requires that high-risk AI systems abide by a risk management system, be continuously maintained and documented throughout their lifetime and enable interpretability of their outcomes and human oversight. The proposal also encourages European countries to establish AI regulatory sandboxes to facilitate the development and testing of innovative AI systems under strict regulatory oversight (European Commission, 2021^[21]).

The European Parliament for its part established a Special Committee on AI in a Digital Age (AIDA) in June 2020, which published reports on ethical aspects of AI, robotics and related technologies (European Parliament, 2020^[7]) and recommendations on AI civil liability regimes (European Parliament, 2020^[8]). The European Parliament adopted Guidelines for military and non-military use of AI to ensure its robust, safe and secure use and respect of human dignity and human rights in EU defence-related activities: it says that humans must exert meaningful control over AI systems and be responsible and accountable for their use.

Council of Europe

The Council of Europe and its bodies have examined the impact of AI and published a series of recommendations. Examples include *i*) an ethical charter on the use of AI in judicial systems (Council of Europe, 2018^[22]), *ii*) guidelines on data protection and AI (Council of Europe, 2019^[23]) and facial recognition

in 2021 (Council of Europe, 2021^[24]); and iii) a feasibility study report to develop Council's instrument on AI and criminal law (Council of Europe, 2020^[25]). In March 2021, the Council's Committee of Ministers adopted a declaration on the risks of AI-enabled decision making in the field of the social safety net (Council of Europe, 2021^[26]).

The Council of Europe's Ad hoc Committee on Artificial Intelligence (CAHAI) adopted a Feasibility Study on a legal framework for AI in December 2020 (Council of Europe, 2020^[27]). The study examines the viability and potential elements of such a framework for the development and deployment of AI, based on the Council of Europe's standards on human rights, democracy and the rule of law.

The study proposes the creation of a new legal framework for AI consisting of both binding (such as a convention) and non-binding Council of Europe instruments and recommends a risk-based approach targeting specific AI application contexts. It identifies nine principles to respect human rights in the context of AI: human dignity; prevention of harm to human rights, democracy and the rule of law; non-discrimination, gender equality, fairness and diversity; the principle of transparency and explainability of AI systems; data protection and the right to privacy; accountability and responsibility; democracy; and rule of law. Concrete rights and obligations are associated with each of these principles. These principles are consistent with the OECD AI Principles.

Standards can help foster interoperable and trustworthy AI systems

Some countries are developing technical standard frameworks to support the implementation of the OECD AI principles. Countries such as Australia, Canada, China, Germany and the United States emphasise the need for common standards, particularly with regards to security issues. For example, Standards Australia launched Australia's AI Standards Roadmap in March 2020. The roadmap provides a framework for Australians to shape the development of standards for AI internationally. It explores standards that can promote and develop the opportunities of responsible AI, delivering business growth, improving services and protecting consumers (Standards Australia, 2020^[28]).

In August 2019, the US National Institute of Standards and Technology (NIST) published the report "*U.S. Leadership in AI: A Plan for Federal Engagement in Developing Technical Standards and Related Tools*" which emphasises the importance of AI technical standards for trustworthy AI (NIST, 2019^[29]). In August 2020, NIST published a paper entitled '*Four Principles of Explainable Artificial Intelligence*', comprising four fundamental properties for explainable AI systems (NIST, 2020^[30]):

- *Explanation*: AI systems should deliver accompanying evidence or reasons for all their outputs.
- *Meaningful*: AI systems should provide explanations that are meaningful or understandable to individual users.
- *Explanation Accuracy*: The explanation should correctly reflect the system's process for generating the output.
- *Knowledge Limits*: The system should only operate under conditions for which it was designed or when the system reaches sufficient confidence in its output.

In November 2020, Germany launched the *German Standardization Roadmap on Artificial Intelligence* (DKE, 2020^[31]). The Roadmap provides an overview of the status quo, requirements and challenges as well as the need for standardisation on seven key topics related to AI: basic principles, trustworthy AI, quality, conformity assessment and certification, IT security in AI systems, industrial automation, mobility and logistics and AI in medicine. The European political framework, European initiatives on AI and AI strategies of other countries were taken into account in developing the Roadmap.

Several cross-sector (horizontal) and sector-specific (vertical) AI standards are under development or becoming available, including those developed by organisations such as the International Organization for Standardization (ISO) and the Institute of Electrical and Electronics Engineers (IEEE). Countries, including

Denmark, Malta and Sweden, plan to establish or have already established AI certification programmes. The Danish government, alongside the Confederation of Danish Industry, the Danish Chamber of Commerce, SMEdenmark and the Danish Consumer Council, has created an independent labelling scheme: the Joint Cybersecurity and Data Ethics Seal (Larsen, 2020[14]). The seal is granted to companies that meet requirements for cybersecurity and responsible handling of AI-related data.

2. AI policy implementation

This section focusing on lessons learned to date through national implementation examples and identifies challenges and good practices for the implementation of the five recommendations to policy makers contained in the OECD AI Principles, namely: i) investing in AI R&D; ii) fostering a digital ecosystem for AI; iii) shaping an enabling policy environment for AI, and iv) building human capacity and preparing for labour market transformation. Section 6 of this report discusses the state of international co-operation for trustworthy AI.

Promoting investments in AI R&D

Investing in AI research and development (Principle 2.1)

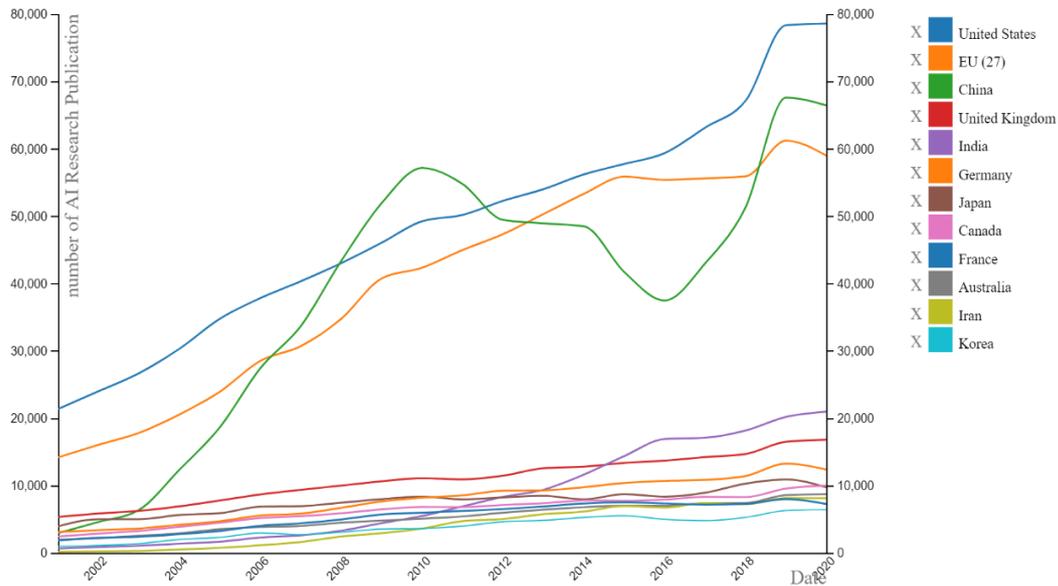
“Governments should consider long-term public investment, and encourage private investment in research and development, including inter-disciplinary efforts, to spur innovation in trustworthy AI that focus on challenging technical issues and on AI-related social, legal and ethical implications and policy issues.

Governments should also consider public investment and encourage private investment in open datasets that are representative and respect privacy and data protection to support an environment for AI research and development that is free of inappropriate bias and to improve interoperability and use of standards.”

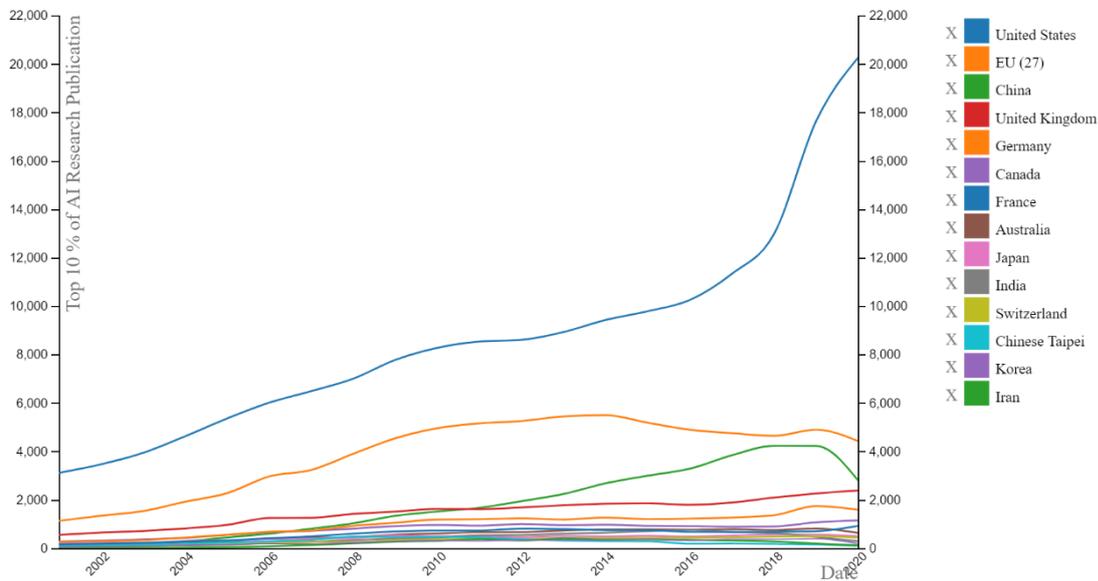
Enhancing AI R&D capabilities features in many national AI strategies, with AI considered to be a general-purpose technology that can impact many industries. It is an “invention of a method of invention” (Cockburn, 2018^[32]) and widely used by scientists and inventors to facilitate innovation, underscoring the importance of basic research and policies to consolidate research capability to catch up with the two leading countries: the United States and China (Figure 8).

Scientific research and AI

Over the past 20 years, AI publications continue to increase, led by the United States, China and EU-27. Figure 8 shows the absolute number of scientific publications on AI by country using data from Microsoft Academic Graph. China has been rapidly increasing its scientific publications since the early 2000s. India’s production of scientific publications has increased dramatically since 2010. When quality measures are factored in, publications from the United States account for a majority of the top-ranked papers (Figure 9).

Figure 8. AI publications by country, 2001-2020

Note: The number of publications is in absolute terms, each publication counts as one unit towards a country. To avoid double-counting, a publication written by multiple authors from different institutions is split equally among each author. See [methodological note](#) for more detail .
Source: OECD.AI (2021), visualisations powered by Josef Stefan Institute using data from Microsoft Academic Graph, version of 21/12/2020, accessed on 3/3/2021, www.oecd.ai

Figure 9. Top 10% AI publications by country, 2001-2020

Note: Microsoft Academic Graph assigns a rank to each publication to indicate its relevance by using a dynamic Eigen centrality measure that ranks a publication highly if that publication impacts highly ranked publications, is authored by highly ranked scholars from reputable institutions, or is published in a highly regarded venue and considers the competitiveness of the field. See more information at [methodological note](#).
Source: OECD.AI (2021), visualisations powered by Josef Stefan Institute using data from Microsoft Academic Graph, version of 21/12/2020, accessed on 3/3/2021, www.oecd.ai

AI calls for policy makers to reconsider the appropriate level of government involvement in AI research to address societal challenges, especially in promising areas underserved by market-driven investments. In addition, research institutions in all areas require capable AI systems to remain competitive, particularly in biomedical science and life science fields. The Stanford Institute for Human-Centered Artificial Intelligence 2021 AI Index report outlined recent AI trends and developments in 2020. Among their findings are significant increases in private AI R&D, especially in the field of biotech and drug design (Stanford University, 2021^[33]).

Public budgets on AI R&D vary across countries

Emerging trends on countries' AI public R&D investments include: i) supporting the establishment of national AI research institutes; ii) consolidating AI research networks and collaborative platforms; iii) prioritising AI investments in specific sectors; iv) pursuing AI mission-oriented innovation policies; and v) procuring AI systems for the public sector.

The allocation of public budgets on AI R&D varies in scale across countries. In many instances, the distribution of budgets per year for AI R&D and other aspects of the strategy is not explicitly mentioned. While there are no official or comparable estimates of public investment in non-defence AI R&D, several budget elements are provided below. Further, budget figures, however, do not include substantial AI R&D investments by national Defence bodies, as they are withheld from publication for national security reasons. The OECD has begun to assess government spending on AI-related R&D, mostly through proxy approaches, but to date, no comprehensive method exists by which to track and compare AI R&D funding across countries and agencies (OECD, forthcoming^[34]).

Public budgets on AI vary radically across countries (from over USD 2 billion in the US, around USD 1 billion in Japan, to around USD 500 million in Korea, Spain or the United Kingdom, to less than USD 1 million in Greece, Lithuania or Portugal) per year. In China, the State Council released the Guideline on Next Generation AI Development Plan in 2017. This aims to achieve: i) AI-driven economic growth in China by 2020; ii) breakthroughs in basic theories by 2025 and in building an intelligent society; and iii) for China to be a global AI innovation centre by 2030 and to build up an AI industry of USD 150 billion (RMB 1 trillion) (China, 2017^[35]). Data on Chinese public investment in AI R&D are not readily available. However, researchers at Georgetown's Centre for Security and Emerging Technology estimated that public AI R&D was in the order of a few billion US dollars in 2018, similar to the planned spending of the United States for FY2020. They also put forward that Chinese public AI R&D spending likely focuses on applied research and experimental development rather than basic research (Acharya and Arnold, 2019^[36]). Singapore committed over EUR 326 million (SGD 500 million) to further AI research innovation and enterprise.

The European Commission has committed EUR 1.5 billion to AI research over two years as part of its *Horizon 2020 programme*. The European Union expects the private sector and its member states at the national level to complement this investment, reaching at least EUR 20 billion invested by the end of 2020. This includes EUR 20 million to build the European Network of AI Excellence Centres (AI4EU), a European online platform that allows the exchange of AI tools and resources. Funding through Horizon Europe and the new *Digital Europe Programme* aims to bring a digital transformation in the EU in the period 2021-2027, with maximum benefits for businesses, public administrations and society. The policies of the *Digital Europe Programme* focus on five primary areas: high-performance computing (HPC); AI; cybersecurity and trust; advanced digital skills; interoperability and digital transformation. Support for AI R&D also includes grants to establish centres of excellence. The European Commission has planned an overall budget of EUR 7.5 billion for 2021-2027. At least EUR 2.1 billion is expected to be allocated exclusively to AI investment and facilitating the use of AI by businesses and public administrations; setting up a European Data Space and energy-efficient cloud infrastructure; and strengthening and supporting AI testing and experimentation in areas such as health and mobility in member states (European Commission, 2021^[37]).

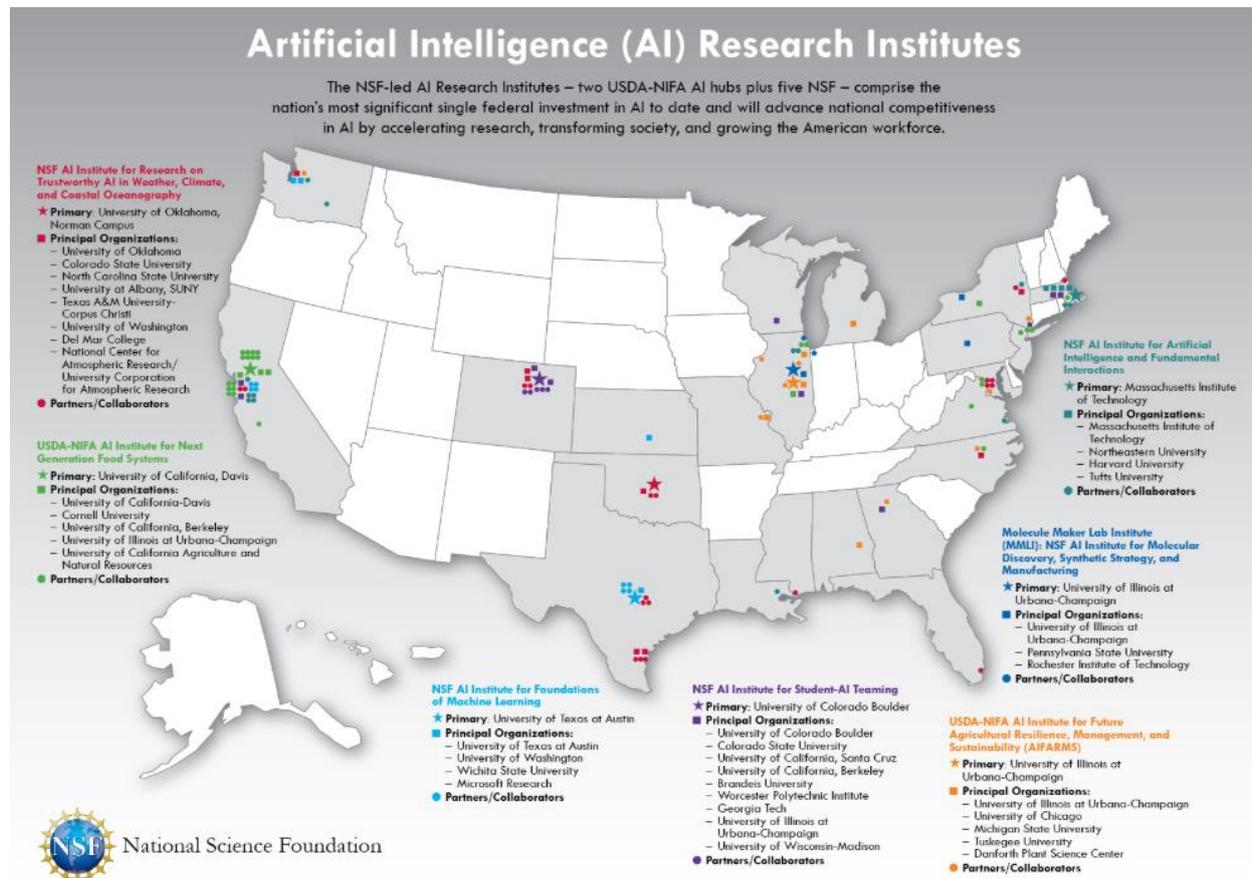
At the national level in Europe, Denmark allocated EUR 27 million (DKK 215 million) of its 2019 State Budget to the Innovation Fund Denmark to research technological possibilities offered by AI. The Finnish Centre for AI, a nationwide competence centre for AI with Academy of Finland flagship status, has been allocated EUR 250 million funding for the next eight years. In 2020, Germany increased its funding for AI from EUR 3 billion to EUR 5 billion until 2025 (BMBF, 2020^[38]). In late 2020, Spain adopted its National Artificial Intelligence Strategy and plans to invest EUR 600 million in AI over 2021-2023, and attract private funding of EUR 3.3 billion through public-private initiatives.

Establishing national AI research institutes

Some countries have established AI centres of excellence to strengthen AI research capabilities and to create interdisciplinary research communities. Some AI strategies call for the establishment of AI hubs, research centers that will help with R&D efforts as they relate to AI.

- Canada is funding AI research institutes in Montreal, Toronto, and Edmonton to bring academic talent to Canada. These hubs and institutes facilitate connections within the AI ecosystem and help catalyse partnerships and initiatives. Canada's federal and provincial governments have dedicated over USD 227 million (CAD 300 million) to AI research over 2017- 22, anchored in the three AI institutes along with the CIFAR Pan-Canadian AI Strategy.
- In the United States, the National Science Foundation (NSF) is investing in both foundational and translational AI research and is creating National AI Research Institutes in collaboration with the departments of Agriculture, Homeland Security, and Transportation (Figure 10). The objective is to trigger multisector and multidisciplinary research and workforce training. In 2021-2022, the NSF programme invites proposals from research institutions that focus on: i) Human-AI Interaction and Collaboration; ii) AI Institute for Advances in Optimisation; iii) AI and Advanced Cyberinfrastructure; iv) Advances in AI and Computer and Network Systems; v) AI Institute in Dynamic Systems; vi) AI-Augmented Learning; vii) AI to Advance Biology; viii) AI-Driven Innovation in Agriculture and the Food System. The 2020 National AI Initiative Act of 2020 budget authorises nearly USD 4.79 billion in funding for AI research at the National Science Foundation over the next five years, USD 1.15 billion at the DoE, and USD 390 million at NIST. Further, a report from the US National Security Commission on Artificial Intelligence (NSCAI) launched in March 2021, calls for the allocation of at least USD 8 billion towards AI R&D annually (NSCAI, 2021^[39]).

Figure 10. Launch of National AI Research Institutes

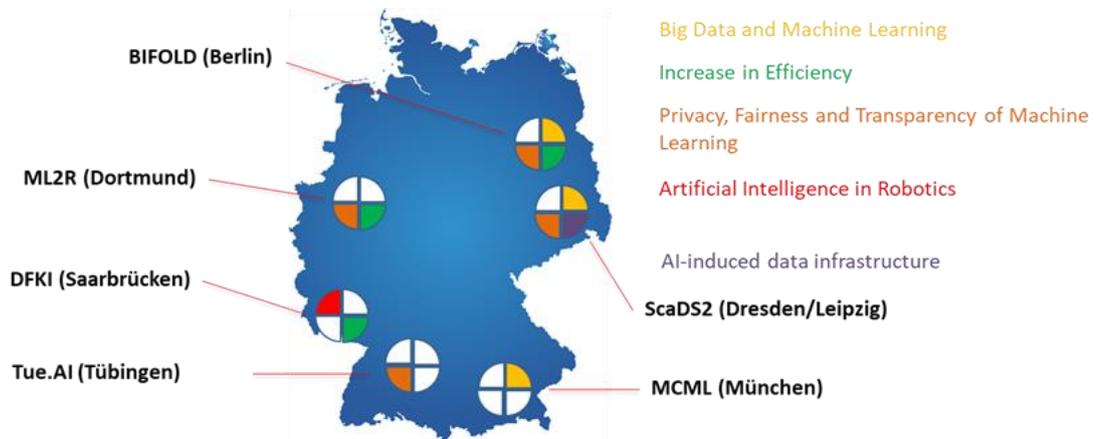


Source: Presentation by ONE AI member Lynne Parker (United States), 11 March 2021 (9th meeting).

- In Europe, France has established interdisciplinary institutes for AI (3IA institutes) to bring researchers together and to focus on academic excellence, interdisciplinary research and collaboration with industries. Each institute has been given areas of focus: MIAI in Grenoble focuses on health, environment and energy. 3IA Côte d'Azur in Nice focuses on health and the development of the territories. The PRAIRIE institute in Paris focuses on health, transport and the environment. The ANITI in Toulouse focuses on transport, the environment and health. It is reported that EUR 225 million will be spent on 3IA research projects in total.¹⁰

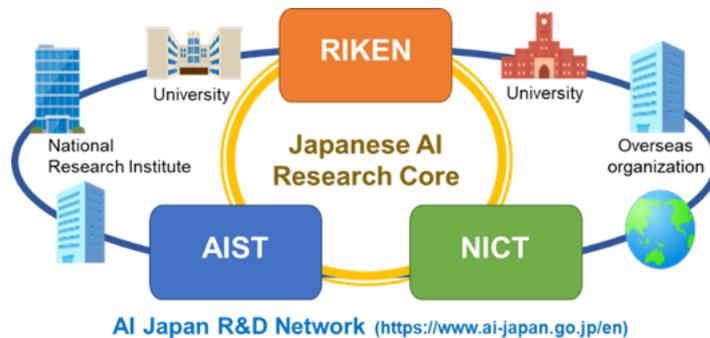
Consolidating AI research networks and centres of excellence

As part of Germany's AI strategy, the government developed a *Network of AI Research Competence Centres* to increase research capability by involving 26 existing institutions. These centres, located in Munich, Tübingen, Berlin, Dortmund, Saarbrücken, and Dresden, plan to develop an interconnected network (Figure 11) for which government funding will double by 2022. These centres are complemented by *application hubs* that support SMEs adopting AI technologies. ONE AI member Andreas Hartl (Germany) noted that this approach reflected the recommendation from stakeholders to leverage current research institutions rather than creating new AI-specific institution. He also highlighted an initiative entitled '*AI Coach*', in which competence centres provide seminars for SMEs. He noted that more than 50 coaches were active in 2019 (BMBF, 2020^[38]).

Figure 11. Germany's Network of AI Research Competence Centres

Source: Presentation by ONE AI member Andreas Hartl (Germany), 9 November 2020, (Experts' group 6th Meeting).

Japan has also established the “AI Japan R&D Network” in 2019 to facilitate exchange and collaboration among AI researchers from over 100 universities and institutes (Figure 12). Three national institutes – the National Institute of Advanced Industrial Science and Technology (AIST), the Institute of Physical and Chemical Research (RIKEN) and the National Institute of Information and Communications Technology (NICT) – play a key role in AI research. Other member organisations bring specific expertise to advance AI research in Japan.

Figure 12. AI Japan R&D Network

Source: Presentation by ONE AI member Yoichi Iida (Japan), 19 January 2021, (Expert group 7th Meeting).

In the United Kingdom, the AI Council recommended in its 2021 AI Roadmap to expand the role of the Alan Turing Institute to become a national network of hubs or centres of excellence. In turn, the centres of excellence would provide research, training, apprenticeships and upskilling (UK AI Council, 2021_[19]).

Prioritising AI investments in strategic sectors

A substantial number of national AI strategies and policies outline how countries plan to invest in AI to build or leverage their comparative advantages. They also encourage businesses to develop solutions that will boost growth and well-being. Countries tend to prioritise a handful of economic sectors, including mobility – logistics and transportation – and health (Table 2). In mobility, AI applications can help governments improve road safety, enhance public transportation efficiency, manage traffic and reduce carbon

emissions. In health care, AI can help governments harness the latest breakthroughs to help detect health conditions early or remotely. They can also help deliver preventative services, optimise clinical decision-making and discover new treatments and medications (OECD, 2020^[40]).

Table 2. Countries' AI policies focus on a handful of sectors, selected countries

Sector(s) targeted	Australia	Czech Republic	Denmark	France	Finland	Hungary	Japan	Korea	Latvia	Netherlands	Norway	Poland	United Kingdom	United States	China	India	Singapore ¹¹	Turkey	Malta	Saudi Arabia	United Arab Emirates	
Agriculture and food	✓		✓			✓	✓	✓	✓	✓		✓		✓	✓	✓		✓				
Cybersecurity							✓					✓					✓	✓				
Defence/security				✓				✓	✓					✓	✓		✓	✓			✓	
Education		✓					✓	✓						✓		✓	✓	✓	✓			
Energy			✓		✓	✓				✓	✓	✓	✓	✓	✓					✓	✓	✓
Environment	✓			✓						✓			✓	✓							✓	
Finance								✓	✓								✓					
Health care	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Manufacturing						✓	✓	✓					✓	✓			✓	✓		✓		
Mobility and transportation		✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Productivity					✓		✓					✓						✓				
Public administration				✓	✓	✓	✓	✓	✓		✓	✓					✓	✓	✓			
Seas and oceans								✓	✓		✓											
Smart cities/ Construction	✓								✓			✓				✓	✓	✓		✓	✓	
Aerospace/Space		✓						✓						✓								
Telecommunications and IT							✓	✓	✓					✓				✓	✓			

Note: The Pan-Canadian AI strategy and the German AI strategy do not have a significant focus on specific sectors.

Source: OECD AI Policy Observatory, powered by EC/OECD (2020) *STIP Compass* (database), <https://oecd.ai>, (accessed April 2020).

AI promises to make government services “smarter”: more agile, efficient and user-friendly. For instance, AI can help deliver personalised services to citizens. It can also enhance the efficiency and quality of administrative procedures by automating physical and digital tasks. In addition, it can improve decisions through better predictions based on patterns in large volumes of data (Ubaldi et al., 2019^[41]).

Pursuing AI mission-oriented innovation policies

Mission-oriented innovation policies are a new type of systemic intervention that a growing number of countries are implementing to tackle societal challenges (Larrue, 2021^[42]). Some seek to leverage AI to pursue grand challenges or “moon-shot” projects addressing high-impact societal challenges, such as climate change, ageing populations, health, inclusiveness, food, energy and environmental insecurity, and other objectives set out in the United Nations’ 2030 Agenda for Sustainable Development. For example, in January 2021, the UK’s AI Council recommended the government pursue “moon-shots (...) challenge-led, high-risk, scalable programmes, both advancing and leveraging AI (...) to tackle fundamental

challenges such as creating ‘explainable AI’, or important goals in any area where AI can contribute strongly, such as the UK Digital Twin program or developing smart materials for energy storage in the move towards net zero carbon emissions” (UK AI Council, 2021^[19]). In February 2021 the UK launched the Advanced Research and Invention Agency (ARIA), based on successful models in other countries notably the US Advanced Research Projects Agency (ARPA).

AI in the public sector

Building on their digital government approaches, many national AI strategies and policies explicitly encourage the adoption of AI in the public sector. For example, the EU Coordinated Plan on AI plans to “make public administrations in Europe frontrunners in the use of AI.” Denmark aims for the public sector to “use AI to offer world-class services for the benefit of citizens and society.” Finland’s *Aurora AI project* aims to use AI to provide personalised, one-stop-shop and human-centric AI-driven public services. Public entities can also use AI to strengthen law enforcement capabilities and to improve policy implementation. AI is also expected to free up public servants’ time and allow them to shift to higher-value work (Berryhill et al., 2019^[43]). At the same time, the use of AI in the public sector present challenges, as public administrations must ensure a high standard of transparency and accountability for their actions, especially those that directly impact individuals.

Despite these potential benefits, it has been argued that the role of the government as a user of AI technology is often overshadowed by the role of the government as a facilitator for AI development or as a regulator to minimise negative consequences of AI (Misuraca & van Noordt, 2020). AI in the public sector raises questions about both regulating its use and leveraging it to help in regulation and governance processes.

To stimulate the use of AI in the public sector, governments employ a variety of different policy actions that range from improving the quality and accessibility of internal datasets and providing training programmes for civil servants on AI, to funding AI projects and to promoting AI regulation (Noordt et al., 2020). For example, Estonia established an Open Data Portal to give everyone access to internal datasets and open data. The Maltese government has proposed to hold various awareness campaigns for civil servants to help them understand the potential of AI, allowing frontline staff to discover potential use cases for AI in their work. In Turkey, an open data portal was established to share data produced by citizens, researchers, public institutions and organisations, and state affiliates.

Stimulating the uptake of AI to provide better public services requires training: for example, Canada is developing foundational AI training which will be available to all federal public servants through the Canada School of Public Service’s Digital Academy. The Danish government also plans to establish an internal academy that provides AI training to its staff specialist and generalist training programmes.

Many national AI strategies highlight ecosystems to use AI in the public sector (GovTech) and harness local data ecosystems and talents. For example:

- Colombia has prioritised the support to public entities in the adoption of GovTech solutions.
- Estonia published in February 2020 #KrattAI, an interoperable network of AI applications, which will enable citizens to use public services with virtual assistants through voice-based interaction. #KrattAI is a network of both public and private sector AI solutions, which, from the user’s point of view, act as a single channel for public services and information.
- Hungary’s AI strategy has a general goal of introducing data wallets and personalised data services to give citizens full control over their data, so they can decide who has access to their data, and what they are can do with the data, including the opportunity of directly profiting from such usage.
- The United Arab Emirates launched an AI Lab led by Smart Dubai in 2017. The lab is testing use cases across all types of city services – from police and security to land development, education and the environment.

- The United States established an AI Center of Excellence to enable Federal Agencies to determine best practices for incorporating AI into their organisations (Parker, 2020^[44]).

To track how algorithms are deployed in cities, both Amsterdam and Helsinki have launched AI registers. The registers currently contain only a limited selection of applications. Helsinki's is comprised of four chatbots and an intelligent management system for the city library's collection, while Amsterdam's includes an automated parking control system that analyses reports on issues in public space with an AI system calculating the probability of a vacation rental being illegal.

Procuring AI for the public sector

Administrations are, however, struggling with procuring and using innovative solutions from the private sector as traditional public procurement processes may not be fit for the iterative process of developing AI solutions. Some national government policies plan to revise existing procurement processes and implement new, challenge-based procurement models to encourage trustworthy AI in the public sector. For example, Canada presented the *Directive on Automated Decision-Making Systems* published by the Treasury Board Secretariat and the *Pre-qualified AI Vendor Procurement Program* to ensure the accountability of AI tools used within the government.¹² In 2020, the UK introduced the *Guidelines on Public Procurement* (Box 7). This recent development from the UK Government adds to the growing set of guidance on the use of AI for the public sector. Other examples of such guidance include *Guide to using AI for the Public Sector* (2019); *Data Ethics Framework* (updated in 2020); *Code of conduct for data-driven health and care technology* (2018), and *A Buyer's Checklist for AI in Health and Care* (2020); and ICO's *AI Auditing Framework* (2020). The ICO's work has a much broader application than just the public sector, as it is aimed at any organisation seeking to adopt AI solutions.

Box 7. Policies to ensure the procurement of trustworthy AI in the Public Sector

Canada

Canada's Treasury Board Secretariat (TBS) developed a whitepaper entitled 'Responsible AI in the Government of Canada' in 2018. This paper, produced with stakeholders through online and in-person consultations, highlighted the need for oversight regarding the government's use of AI systems. The TBS developed the *Directive on Automated Decision-Making* as a first policy approach for AI. The cornerstone of the Directive is an *Algorithmic Impact Assessment* to calculate the risks of an AI system. In a parallel effort to support the Directive, TBS worked with Public Services and Procurement Canada to establish a *Pre-qualified AI Vendor Procurement Program* to streamline the procurement of AI solutions and services in the government. Over 90 companies are currently pre-qualified to provide AI services and solutions to the government under this programme.

ONE AI member Ashley Casovan (AI Global) provided her views on the challenges she sees for the government of Canada in implementing the Pre-qualified AI Vendor Procurement Program. This new AI public procurement programme was used to help government departments and agencies build awareness of the solutions offered by AI. It also provided small and medium AI companies with an opportunity to provide their services to the government. In practice, the initiative did not yet gain traction. Ms Casovan underlined that if a new AI procurement programme is not mandatory, it is unlikely to be used by governmental agencies. She also stressed that a complex procurement process hindered adoption and that the new AI public programme should be aligned with and complement existing procurement practices to facilitate its use. She suggested the need for further discussion on how AI procurement differs from other technology procurement and why it requires ethical oversight as well as clear guidance on the types of AI systems that should or not be subject to the procurement mechanism. For example, exceptions could be made for certain systems that cannot harm humans. She also suggested that it is critical to formulate the primary objective(s) of the procurement policy clearly, which should be to help departments and agencies obtain the solutions and services they need.

Canada's AI procurement programme is rich in lessons learned and demonstrates the importance of embedding new AI policies into existing governance structures.

Source: Presentation by Ashley Casovan, 29 June 2020 (Expert group 2nd Meeting). More information at: <https://www.canada.ca/en/government/system/digital-government/digital-government-innovations/responsible-use-ai.html>

United Kingdom

In June 2020, the UK Government in collaboration with the World Economic Forum (WEF) published the *Guidelines for Artificial Intelligence (AI) procurement* that provide the central government and other public sector bodies with guiding principles for purchasing AI technology. They also guide challenges that may occur during the procurement process. In connection with this project, the Office for AI and the WEF also created the *AI Procurement in a Box* toolkit, which acts as a guide for public sector AI procurement.

The Guidelines set out the following top 10 considerations:

1. Include procurement within a strategy for AI adoption.
2. Make decisions in a diverse multidisciplinary team to mitigate AI bias.
3. Conduct a data assessment before starting the procurement process.
4. Assess the benefits and risks of AI deployment, including defining the public benefit goal.
5. Engage effectively with AI suppliers from the outset.
6. Establish the right route to market and focus on the challenge rather than a specific solution.
7. Develop a plan for governance and information assurance.
8. Avoid 'black box' algorithms and vendor lock-in.
9. Focus on the need to address technical and ethical limitations of AI deployment during the evaluation.
10. Consider the lifecycle management of the AI system.

Source: <https://www.gov.uk/government/publications/guidelines-for-ai-procurement>

Digital infrastructure for AI

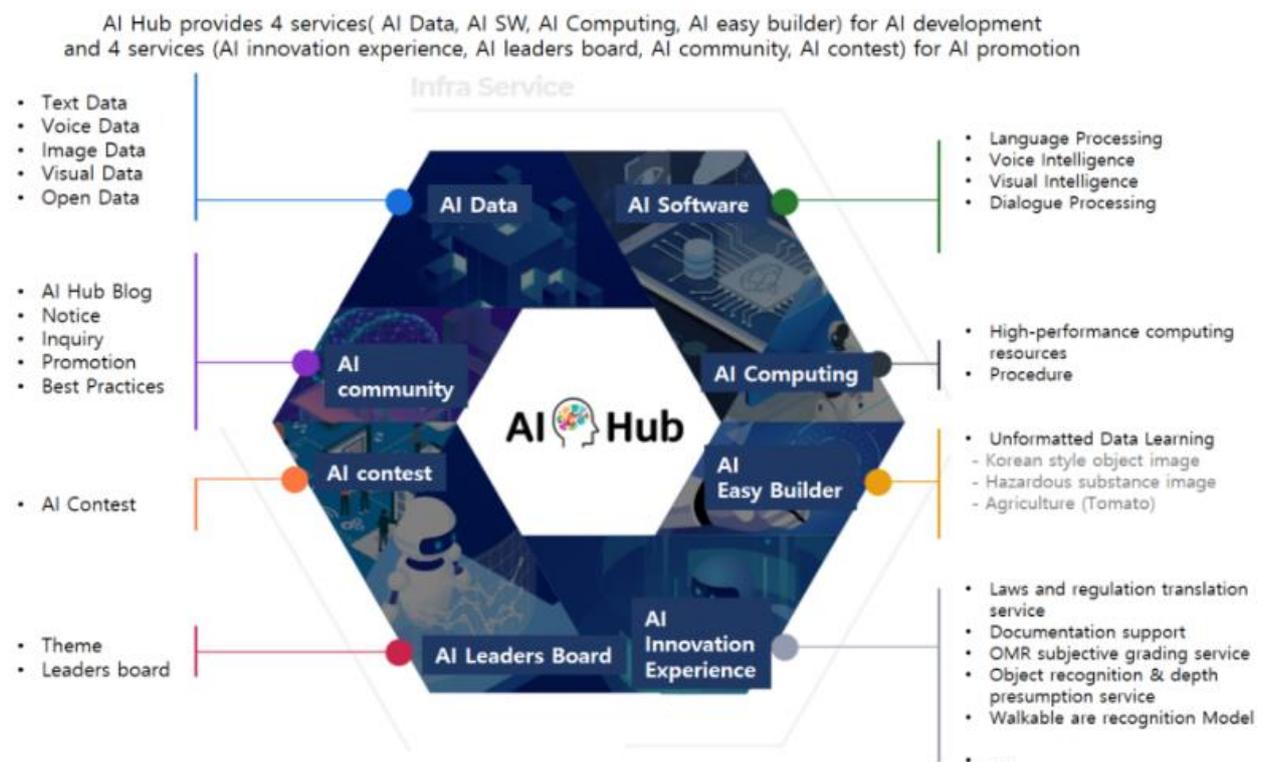
Fostering a digital ecosystem for AI (OECD AI Principle 2.2)

“Governments should foster the development of, and access to, a digital ecosystem for trustworthy AI. Such an ecosystem includes in particular digital technologies and infrastructure, and mechanisms for sharing AI knowledge, as appropriate. In this regard, governments should consider promoting mechanisms, such as data trusts, to support the safe, fair, legal and ethical sharing of data”.

Countries increasingly link data access and sharing policies with AI policies

Many countries focus on providing access to public sector data, including open government data, geo-data (e.g., maps) and transportation data. They also emphasise data sharing within the public sector. Countries are building on their open data access policies and strategies to promote data access and sharing for AI. For example, Denmark plans to provide open access to weather, climate and marine data from the Danish Meteorological Institute, in addition to cop-operating with Europe’s space data. In Korea, the Ministry of Science and ICT established the *AI Open Innovation Hub* to provide supports for AI development and promotion (Figure 13).

Figure 13. AI Hub in Korea



Source: <https://www.aihub.or.kr/>

Several national AI policies plan to develop centralised, accessible repositories of open public data. The OECD 2019 Digital Government Index (OECD, 2019^[45]) assesses the maturity level of digital government strategies in OECD countries and partner economies based on the Survey of Digital Government. The Index found that all respondents have a portal for open government data and that most (82%) have an action plan on open government data. In addition, 88% of respondents require openness by default.

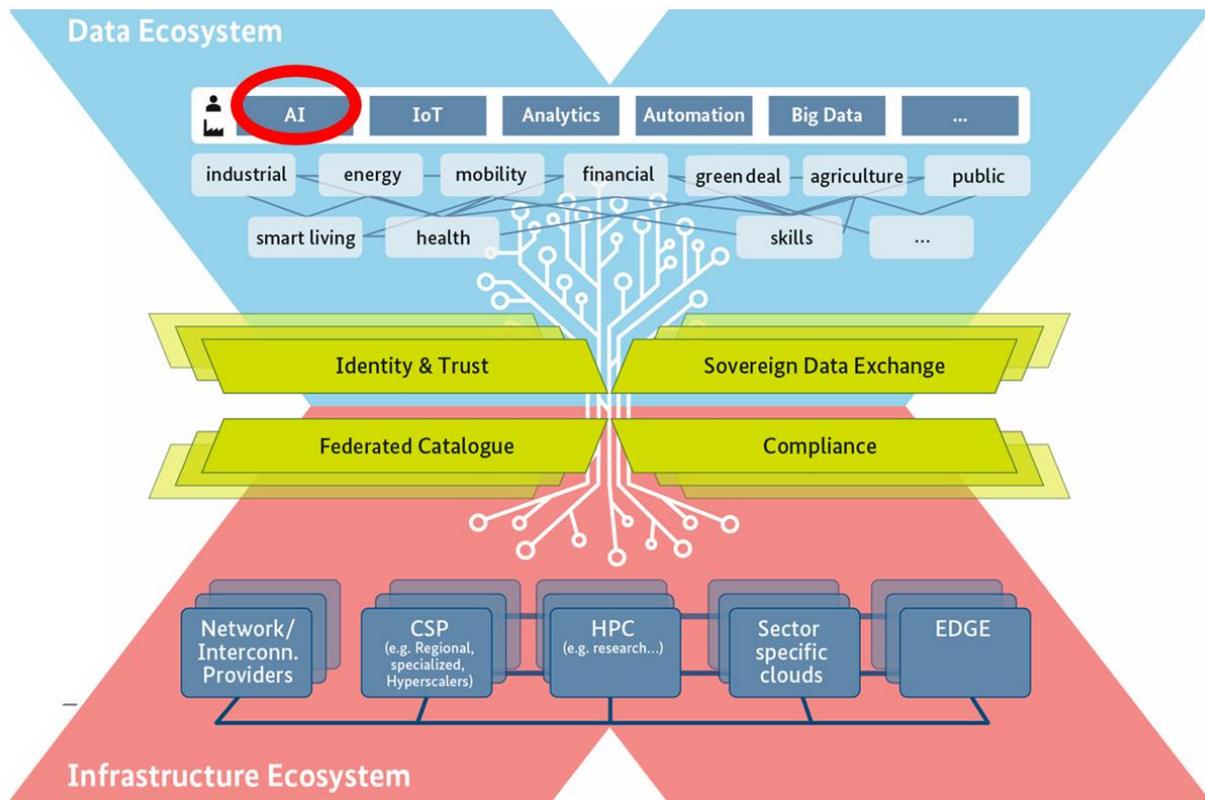
In Norway, the Brønnøysund Register Centre and the Norwegian Digitalisation Agency have established a national directory of data held by different public agencies, their relationships, what they mean and whether data can be shared and on what terms. Portugal also plans to create a centralised repository for administrative data.

The U.K. is making available high-quality public data in an open, reusable and accessible format for machine learning. The UK's Geospatial Commission aims to improve access to geospatial data, including for AI uses. In 2018, the U.K.'s Office for AI, with the Open Data Institute and Innovate the UK, launched three pilot projects to explore data trust frameworks for safe, secure and equitable data transfers. In its AI Roadmap, the AI Council recommended new policies and regulations beyond the National Data Strategy, including a 'Public Interest Data Bill' and other standards and regulations aiming to position the UK as a world leader in accessing and using 'safe, secure and good quality data' (UK AI Council, 2021^[19]).

Organisations focused on data have also been created or are being considered. The Spanish AI strategy, for example, recommends the creation of a National Data Institute. Chile established the *Data Observatory* through a public-private partnership in 2019 to provide open access to astronomical and environmental data for the global scientific community, private industry, and the public. Hungary established the National Data Agency (NAVÜ) to enable efficient use of public data and provide analyses of public data. NAVÜ's tasks will include: i) operating a national public data portal, ii) setting up and managing a national public data cadastre, iii) processing and analysing anonymised databases, and iv) offering data analysis services to the government, markets and citizens.

Countries and regional institutions are encouraging both public and private sector data sharing. The European Union will be creating a number of *European Data Spaces*, which will facilitate the sharing of public and private sector data in a trusted environment (Figure 15). ONE AI member Andreas Hartl (Germany) noted that GAIA-X partners are not just from European countries; the initiative also involves partners from the United States and Japan.

Figure 14. GAIA-X



Source: Presentation by ONE AI member Andreas Hartl (Germany), 9 November 2020, (Expert group 6th Meeting).

Through its *Digital New Deal*, Korea is establishing a big data platform entitled *Data Dam* to collect and process both public and private data (Figure 15.). More than 2000 organisations were engaged in the development of this platform to integrate existing big data platforms help promote the digital transformation of key industries in Korea.

Figure 15. Korea's Data Dam



Source: Presentation by ONE AI member Deuk Jung Kim (Korea), 19 January 2021, (Expert group 7th Meeting).

In February 2020, the European Commission launched the *EU Data Strategy*, alongside its *White Paper on AI*, as the first pillar of the EC's new digital strategy (European Commission, 2020^[46]). The European Commission's Data Strategy envisions a common *European Data Space*, *i.e.*, a single market for data that can be used irrespective of its physical location in the EU, in compliance with applicable laws. It calls for a mechanism for free and safe cross-border data flows, subject to restrictions for public security, public order and other legitimate EU public policy objectives.

In November 2020, the EC published its draft *Data Governance Act*. The first action of the *EU Data Strategy* promotes access to and sharing of data by encouraging public data sharing and allowing citizens to donate their data to *European Data Spaces* (European Commission, 2020^[47]).

The OECD Committee on Digital Economy Policy (CDEP), through its Working Party on Data Governance and Privacy, and together with the Committee for Scientific and Technological Policy and Public Governance Committee, is currently developing a *Recommendation on Enhancing Access to and Sharing of Data* (Box 8) (OECD, 2019^[48]).

Box 8. OECD project on enhancing access to and sharing of data (EASD)

The OECD has extensively analysed how enhancing access to data can maximise the social and economic value of data. The November 2019 report "*Enhancing Access to and Sharing of Data: Reconciling Risks and Benefits for Data Re-use across Societies*" identifies best practices to balance different interests to reap the benefits of data access and sharing, while managing and reducing risk to a socially acceptable level.

Towards general principles on EASD

The OECD is working towards general principles for enhancing access to and sharing of data across the economy in a coherent manner and consolidate guidance and best practices on issues such as data openness, transparency, stakeholder engagement, intellectual property rights (IPR), and pricing. These legal instruments include:

- OECD (2006, updated in 2021) Recommendation of the Council concerning Access to Research Data from Public Funding
- OECD (2008) Recommendation of the Council for Enhanced Access and More Effective Use of Public Sector Information
- OECD (2014) Recommendation of the Council on Digital Government Strategies
- OECD (2016) Recommendation of the Council on Health Data Governance

Note: More information on legal instruments available at <https://legalinstruments.oecd.org/>.

Source: <https://www.oecd.org/sti/ieconomy/enhanced-data-access.htm>

Uptake also requires access to AI technologies and computing capacity

Developing and using AI requires access to AI technologies and infrastructure. This requires affordable high-speed broadband networks and services, computing power and data storage, as well as supporting data-generating technology such as Internet of Things (IoT) infrastructure. Improving connectivity will enable innovative business models in many sectors such as manufacturing, healthcare, security, transportation, education, and the development of smart cities.

Many countries have begun to deploy a 5G network to ensure high-quality connectivity that will also support AI development and use. The United Kingdom's AI strategy mentions a public investment of USD 1.24 billion (GBP 1 billion) to boost digital infrastructure, including USD 219 million (GPB 176 million) for 5G and USD 249 million (GBP 200 million) for full-fibre networks. ONE AI member Deuk Jung Kim (Korea) noted that integrating 5G and AI into industries and government services are priorities of the *Korean New Deal*, a policy package launched in 2020 to facilitate structural changes and stimulate the country's recovery from the pandemic.

Many technical/software tools to develop AI systems exist as open-source resources, which facilitates their adoption and allows for crowdsourcing solutions to software bugs on platforms such as Github. Some researchers and companies share curated training datasets and training tools publicly to help diffuse AI technology. In Estonia, the *Open-source AI components* initiative makes AI components available for reuse by interested parties. The initiative allows both public and private sectors to reuse and further develop AI solutions free of charge. Under the initiative, open-source tools for speech recognition, speech synthesis, text keyword extraction, and chatbot solutions are available to accelerate AI uptake.

Algorithms and data play strong roles in the development and performance of AI systems. However, as AI projects move from concept to commercial application, they often need specialised and expensive cloud computing and graphic-processing unit resources. Several countries allocate high-performance and cloud

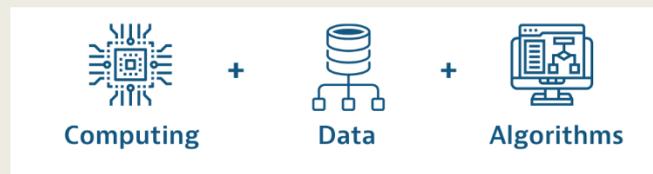
computing resources to AI-related applications and R&D (US, 2019^[49]). Some are setting up supercomputers designed for AI use and devoted to research and/or providing financial support to develop the national high-performance computing infrastructure. The ONE AI task force on AI compute (forthcoming) will develop a framework for understanding, measuring and benchmarking domestic AI computing supply by country and region (Box 9).

- The *European High-Performance Computing Joint Undertaking (EuroHPC)* is a EUR 1 billion undertaking by the European Union and several individual European countries. It aims to develop peta and pre-exa-scale supercomputing capacities and data infrastructure to support European scientific and industrial research and innovation.
- In Japan, the RIKEN Center for Computational Science and Fujitsu launched a top-ranked Supercomputer named *Fugaku* in 2020. The National Institute of Advanced Industrial Science and Technology (AIST) developed and operates an open AI computing infrastructure named *AI Bridging Cloud Infrastructure* to accelerate collaborative AI R&D between industry, academia and the government.
- The Korean government launched the *AI Semiconductor Industry Development Strategy* with USD 1 billion cross-ministerial R&D project in 2020. The Korean government is also focusing on providing a high-performance computing environment for companies, universities and research institutions to enhance the adoption and use of AI technologies.
- The US Department of Energy is building the Frontier supercomputer, expected to debut in 2021 as the world's most powerful high-performance computer for AI and the NSF also invests significantly in next-generation supercomputers for AI R&D such as *Frontera*. The National Aeronautics and Space Administration also has a high-end computing programme and is augmenting its Pleiades supercomputer with new nodes specifically designed for machine learning AI workloads (US, 2019^[49]). The US National AI Initiative Act of 2020 plans to make world-class computational resources and datasets available to researchers across the country on the forthcoming US *National AI Research Resource Cloud* (NITRD, 2020^[50]).
- In October 2020, the United Kingdom announced the upcoming launch of the UK's most powerful supercomputer, *NVIDIA's Cambridge-1* that will be used by healthcare researchers to tackle pressing medical challenges.

Box 9. ONE AI task force on AI compute

Alongside data and algorithms, AI computing capacity (“AI compute”) has emerged over recent years as a key enabler for AI and AI-enabled economic growth and competitiveness. While data and machine learning algorithms are receiving significant attention in policy circles at the OECD and beyond, the computational infrastructure that makes AI possible has been comparatively overlooked. Since understanding domestic AI compute capacity is increasingly critical to formulating effective AI policies and informing national AI investments, the CDEP and its ONE AI expert group are focusing on this area in 2021.

AI Enablers



The OECD AI Principles recommends that policy makers: “foster the development of, and access to [...] digital technologies and infrastructure” and also instruct the OECD Committee on Digital Economy Policy (CDEP): “to continue its important work on AI building on this Recommendation [...] to further develop the measurement framework for evidence-based AI policies.”

The creation of a ONE AI task force on AI compute in early 2021 will help the OECD create a framework for understanding, measuring and benchmarking domestic AI computing supply by country and region. The task force will coordinate the broad engagement of key AI compute players and a data-gathering exercise that ideally would be sustainable over time. This task force will also need to be mindful that the AI compute landscape is unusually dynamic with technology shifts frequently.

An interactive visualisation on the OECD.AI Policy Observatory is expected to feature the work of the task force.

The targeted focus of the ONE AI task force on AI compute will complement the activities of the three ONE AI working groups, notably the working group on national AI policies.

Countries are investing in language technologies

Language technologies (LTs) cover many AI disciplines, including natural language processing (NLP), information extraction, speech recognition, computational linguistics and machine translation. A number of countries prioritised LTs in their AI strategies as key to enabling interactive dialogue systems and personal virtual assistants for personalised public services (OECD, forthcoming^[51]). Automated translation services could mitigate language barriers in international e-commerce, particularly for SMEs (OECD, forthcoming^[16]). Some countries are consolidating datasets to create resources to train LT systems (Berryhill et al., 2019^[43]).

- As part of its *Digital Agenda*, Spain announced a dedicated national plan (*National Plan for the Advancement of Language Technologies*)¹³ to foster LT development aiming to i) develop language infrastructure (e.g., language processors) between Spanish and other official languages in Spain (Catalan, Basque and Galician); ii) enhance the visibility of the Spanish LT sector and harness the high potential in the Ibero-American market; iii) apply LTs in specific public services with high social impact.
- Denmark is focusing on LT to support ‘*AI in Danish*’ and in June 2020, launched a platform displaying metadata of existing linguistic resources¹⁴ to facilitate the development of LTs in Danish (sprogteknologi.dk).

- Hungary plans to invest in Hungarian language R&D to enable multi-lingual customer service deployment in the public and private sector.
- Norway is also prioritising the development of LT systems that support communications in Norwegian, Sami and smaller dialects.
- Japan has promoted the use of a multilingual translation system in various sectors, such as public services, medical care, transportation and tourism. The system was developed by the National Institute of Information and Communications Technology (NICT). In 2020, the Japanese government announced the ‘*Global Communication Plan 2025*’, which sets development targets for LTs by 2025, including liaison interpretation systems and LT applications to help foreign visitors.¹⁵ ONE AI member Yoichi Iida (Japan) presented an LT application for natural disaster response being leveraged by NICT to aggregate Twitter posts and display real time information on recovery of utilities, delivery of disaster relief supplies etc.
- In Israel, the AI R&D Framework and Activities of the Innovation Authority is supporting the development of Hebrew-language NLP tools.
- In Turkey, under the *Turkish Natural Language Processing Project*, the Ministry of Industry and Technology plans to i) develop user-friendly and high-performance libraries and datasets for processing Turkish texts and ii) establish a distribution infrastructure for data and tools.

Shaping an enabling environment for AI

Shaping an enabling policy environment for AI (OECD AI Principle 2.3)

“Governments should promote a policy environment that supports an agile transition from the research and development stage to the deployment and operation stage for trustworthy AI systems. To this effect, they should consider using experimentation to provide a controlled environment in which AI systems can be tested, and scaled up, as appropriate.

Governments should review and adapt, as appropriate, their policy and regulatory frameworks and assessment mechanisms as they apply to AI systems to encourage innovation and competition for trustworthy AI.”

Countries seek to support an agile transition from R&D to commercialisation or deployment of AI in four ways by i) providing controlled environments for experimentation and testing of AI systems; ii) improving access of companies – including SMEs and start-ups – to funding; iii) connecting emerging companies with business opportunities through networking and collaborative platforms, and iv) providing tailored advisory to support businesses’ scale-up. A number of firms and service offerings such as DataRobot, Amazon Web Services (AWS), Github, Kaggle, Google Tensorflow, and related services are also helping to reduce barriers to AI adoption by small firms.¹⁶

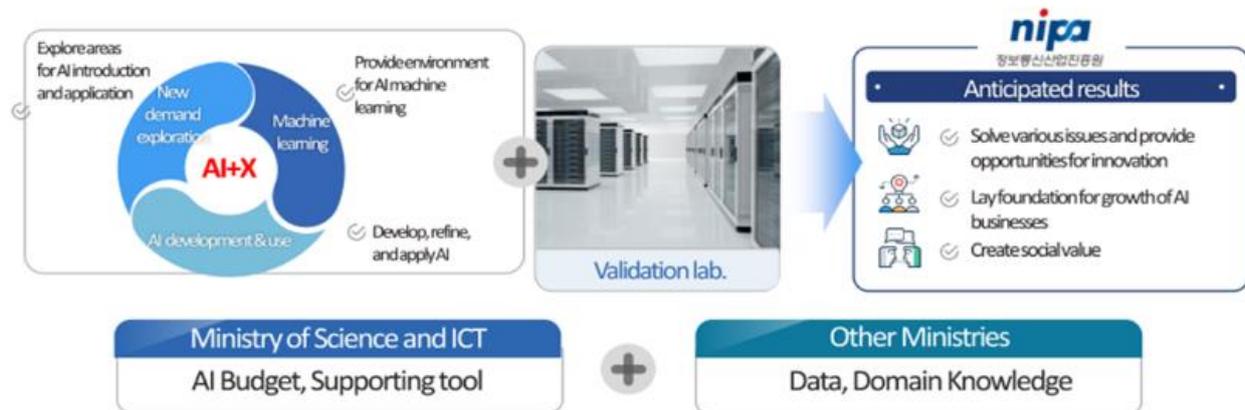
Controlled environments for AI experimentation

Controlled environments for AI experimentation and testing facilitate the timely identification of potential technical flaws and governance challenges.¹⁷ They can reveal potential public concerns through testing under quasi real-world conditions (European Commission, 2020_[20]) and provide an impact assessment of AI technology on various aspects of people’s lives, such as jobs, education and the environment.¹⁸ Such environments include innovation centres, policy labs and regulatory sandboxes. The latter is a form of limited regulatory testing for innovative applications not intended to enable permanent regulatory waivers or exemptions. Experiments can operate in “start-up mode” whereby they are deployed, evaluated and modified, and then scaled up or down, or abandoned quickly. Co-creation governance models engaging

both governments and private stakeholders already play a key role in many national AI strategies, such as those of Germany, New Zealand, Korea, the United Kingdom and the United States.

- Colombia designed regulatory sandboxes and “beaches” (allowing for less oversight and more flexibility for experimentation) for AI planned to be implemented in 2021 (DAPRE, 2020^[52]). In November 2020, the Presidency of the Republic and the Data Protection Authority launched public consultations on a regulatory sandbox on the ‘AI and Privacy by Design Principles’ (SIC, 2020^[53]).
- Germany’s AI strategy plans the establishment of AI living labs and testbeds, such as the living lab on the “A9 *autobahn*”. These allow the testing of technologies in real-life settings (Germany, 2018^[54]). ONE AI member Andreas Hartl (Germany) noted that experimentation can help companies adopt AI and allow the government to identify needed regulatory reforms. Germany is facilitating experimentation by i) creating a network of regulatory sandboxes with over 520 participants, ii) providing a *Handbook for regulatory sandboxes* (BMW, 2019^[55]), and iii) organising a competition for regulatory sandboxes and highlighting innovative practices.
- The Korean Ministry of Science and ICT, Ministry of Trade, Industry and Energy, Ministry of SMEs and Startups established a regulatory sandbox in 2019 that grants a time-limited regulatory waiver to businesses to test innovative products, services and business models. The sandbox also informs government regulations based on real-life data. The Korean Ministry of Science and ICT launched the 7 *AI+X projects* in collaboration with other ministries that use validation Labs to solve problems in the military, security, customs, energy, defence, and industry (Figure 16).

Figure 16. AI+X Project in Korea



Source: Presentation by ONE AI member Deuk Jung Kim (Korea), 19 January 2021, (Expert group 7th Meeting).

- In Russia, the Federal Law on experimental legal regimes seeks to establish regulatory sandboxes to facilitate digital innovation. Additional regulations include a Federal law on experimental regulation to facilitate the development and implementation of AI technologies in Moscow and regulation for testing highly automated vehicles on public roads.
- The United Arab Emirates announced in 2019 a collaboration between the regulatory lab (RegLab of the UAE government) and the Dubai ‘10X’ regulatory sandbox (of the Dubai Future Foundation) to provide a safe experimental environment for future technologies including AI and inform legislation (UAE Regulations Lab, 2020^[56]).
- The United Kingdom’s Financial Conduct Authority established the world’s first regulatory sandbox in 2015. The sandbox seeks to provide financial firms with a) the ability to test products and services in a controlled environment; b) reduced time-to-market at potentially lower costs; c) support in identifying appropriate consumer protection safeguards to build into new products and

services; and d) better access to finance (FCA, 2021^[57]). This model has been replicated in more than 50 countries (BIS, 2020^[58]). In 2020, the FCA partnered with The Alan Turing Institute to better understand the practical challenges of AI transparency and explainability in the financial sector.

- The European Commission is considering the development of large-scale AI testing and experimentation facilities, which will be available to all actors across Europe to help avoid duplication of efforts. These testing facilities may include regulatory sandboxes in selected areas (European Commission, 2020^[59]). The updated Coordinated Plan also encourages European countries to establish AI regulatory sandboxes to facilitate the development and testing of innovative AI systems under strict regulatory oversight (European Commission, 2021^[21]).

Financial incentives and access to funding for companies

To spur investment in AI projects, some countries have created financial incentives. Since January 2018, the United Kingdom provided an *AI R&D Expenditure Credit* (12% tax credit) to stimulate AI uptake, including within the public sector. In its *AI Roadmap*, the UK's AI Council recommended improving funding for high-growth AI start-ups to enable businesses to receive foreign investment while remaining in the UK and focusing notably on series B+ funding (UK AI Council, 2021^[19]). Malta has also reformed the *Seed Investments Scheme* with more favourable tax credit conditions for innovative AI firms.

Networking and collaborative platforms

Countries also develop innovative AI research ecosystems by establishing networking and collaborative platforms, such as AI hubs, AI labs and AI accelerator programmes. These facilitate cooperation between industry, academia and public research institutes.

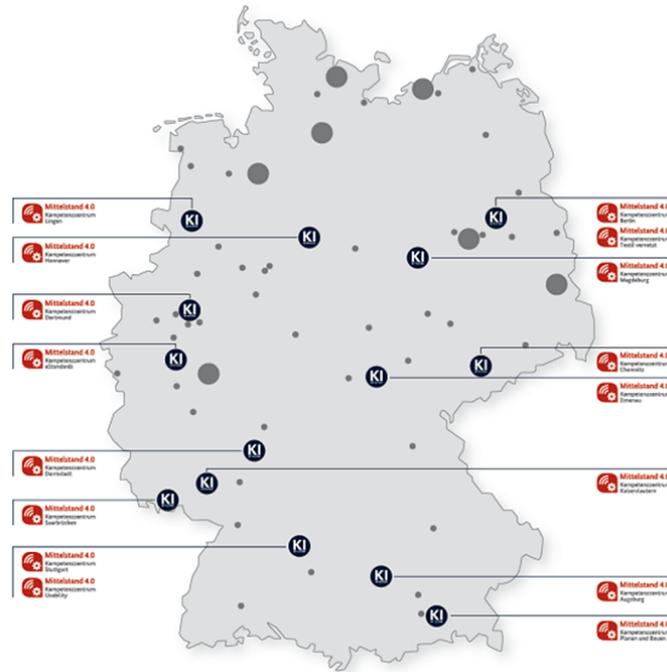
- Canada's *Innovation Superclusters Initiative* invites industry-led consortia to invest in regional innovation ecosystems and supports partnerships between large firms, SMEs and industry-relevant research institutions.
- Denmark's national AI strategy plans a digital hub for public-private partnerships.
- The European network of *Digital Innovation Hubs* (DIHs) is a network of one-stop shops to support SMEs' digitalisation. DIHs provide test beds for technologies, advice on financing options, and networking and training opportunities. The EU provides funding and encourages cooperation between DIHs from different regions. The *Digital Europe Programme* plans to expand existing DIHs to include AI and other technologies (OECD, forthcoming^[51]).

Tailored advisory to support businesses' scale-up

Countries are introducing a wide range of policy measures and initiatives to spur innovation and AI adoption by SMEs (OECD, forthcoming^[51]).

- Germany's AI Strategy promotes the transfer of findings from AI research to the economy and the use of AI across SMEs (the "Mittelstand"). To remove market barriers and encourage trust and confidence in emerging technologies, the Federal Government has expanded its information and advisory services for SMEs and improved the environment for start-ups through regional AI clusters that foster science-industry collaboration and AI trainers in Mittelstand (SME) 4.0 Excellence Centres. ONE AI member Andreas Hartl highlighted the Hubs for Tomorrow initiative, which aims to build capacity across SMEs and empower SME employees to shape the digital transformation at the industry level (Figure 17). The German Labour Ministry has created regional hubs to support the adoption of trustworthy AI in the workplace: the hubs provide training for employees and tailored services for SMEs.

Figure 17. Germany's Hubs for Tomorrow



Source: Presentation by ONE AI member Andreas Hartl (Germany), 9 November 2020, (Expert group 6th Meeting).

- In the European Union, five new public-private research partnerships are planned for launch in 2021 to increase Europe's technological sovereignty and build European values and ethics into products including AI, robotics, machine learning and autonomous vehicles. The European Commission's AI4EU project is an AI-on-demand platform to help EU's SMEs adopt AI.
- The Belgian Start AI program and Tremplin AI program.
- Canada has invested EUR 608 million (CAD 950 million) in five regional *Innovation Superclusters*, one of which focuses on accelerating the application of AI for supply chains (*SCALE.AI*).
- The Czech Republic is developing specific support grants and investment programmes for SMEs, start-ups and spinoffs with innovative services and business models.
- Finland's *AI Accelerator*, initiated by the Ministry of Economy and Employment with Technology Industries of Finland, spurs AI use in SMEs. Finland's AI Business programme encourages new AI business ecosystems and investments in Finland.
- In Hungary, the AI Innovation Centre was established to serve as a hub for SME's and start-ups to support the implementation of AI and data-based solutions. A self-service online platform was created to display technologies and local case studies to foster collaboration and awareness.
- The Maltese YouStartIT accelerator.
- Portugal has established Digital Innovation Hubs on production technologies, manufacturing, and agriculture, as well as collaborative laboratories (*CoLabs*) (Portugal, 2019^[60]).
- Korea's *AI Open Innovation Hub* provides SMEs and start-ups with data, algorithms and high-performance computing resources aiming to spur innovation with AI.
- In the United Arab Emirates, *Dubai Future Accelerators* facilitates collaboration between government entities, private sector organisations and start-ups, scale-ups and innovative SMEs to co-create solutions to global challenges. The United Arab Emirates' *Dubai AI lab* – a partnership

between various parts of government, IBM and other partners – provides essential tools and go-to-market support to implement AI services and applications in different areas.

ONE AI members shared insights on the challenges and opportunities faced by policies promoting an agile transition from research to commercialisation of AI (Box 10).

Box 10. Insights on the challenges and opportunities faced by policies promoting an agile transition from research to commercialisation of AI¹⁹

United Kingdom: Digital Catapult and Innovate UK

ONE AI members discussed the barriers that small businesses face to access AI computing capacity and what the UK government is doing to help, including a EUR 187 million (GBP 170 million) investment and ML garage established by the Digital Catapult. The UK has a network of catapults helping to promote the adoption of technologies. The digital catapult leads on AI-related efforts and offers access to compute credits to businesses and links to cloud computing resources, which are vital for businesses that could benefit from AI but lack the technical infrastructure. The Digital Catapult works with 30 start-ups per year and uses a competitive process. To monitor the efficacy of R&D projects, the project relies on a wider framework in place with partners at UK Research and Innovation. Innovate UK focuses on commercialisation in some of its programmes like Knowledge Transfer Networks, which can show “wins” but uses indirect measures of impact and influence such as citations. The UK is focusing on building the ecosystem this decade and will focus on AI applications next decade. The UK government committed to doubling AI R&D spending by 2023-2024.

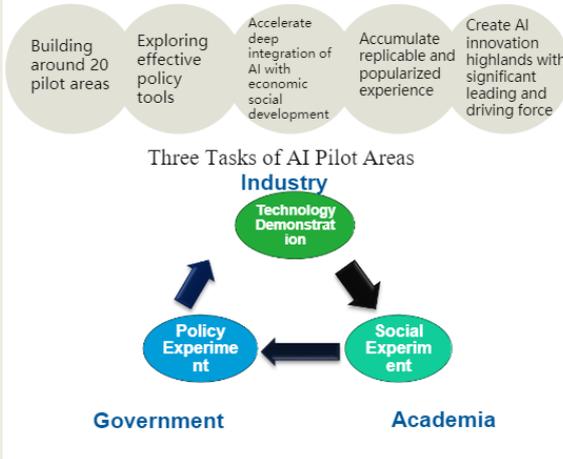
Two key challenges that faced the UK Office for AI when implementing its policies were highlighted:

- The lack of regular market data: There are gaps in market data on AI compared to established markets, in part because the wide deployment of AI is recent and discussions about what should be measured are still underway. This is notable in the communications industry, where the UK’s communications regulator has a statutory duty to provide regular market intelligence. This is helpful for both public policy and business strategy. While work is ongoing to provide data and metrics by organisations including the OECD, the Stanford Human-Centred AI Institute via its AI Index, and others, data on the diversity of the AI workforce and data showing AI adoption across sectors (e.g., how fast a sector is moving, comparative analyses across sectors) are needed.
- The need to prioritise AI goals: Governments need the right processes and criteria to prioritise the outcomes they want to secure, especially when considering the level of necessary collaboration across departments and the technical community.

China: Pilot zones and Open innovation platforms

The Chinese government launched pilot AI projects called the “National Pilot Areas for AI Innovative Development” to test the application of emerging technologies, explore effective policy tools and measure the social impact of technologies. The objectives and tasks of the pilot areas are provided by the “Guidance on the Construction of National Pilot Area for the Innovative Development of New Generation AI” published in August 2019. 11 pilot areas are already launched and the government plans to create 20 pilot areas in total by the end of 2023.

“Guidance on the construction of national pilot area for the innovative development of new-generation AI”, 2019.08



An open innovation platform was created in China where large companies collaborate with SMEs and small research institutions to build mutual beneficial innovation ecosystems. This would mitigate the disadvantage in smaller AI actors that cannot afford strong computing resources, the collection and accumulation of data and the required multi-disciplinary talent.

Artificial Intelligence Open Innovation Platforms

阿里巴巴 City Mangement	科大讯飞 Voice recognition and interaction	HUAWEI Basic hardware and software	TAL 好未来 Smart education	依图 YITU Visual computing	MEGVII 旷视 Image perception	360 Network security	
百度 Autonomous Vehicle	腾讯 Medical image diagnosis	商汤 Vision intelligence	中国平安 Inclusive finance	海康威视 Video perception	小米 Smart home	明略科技 Smart marketing	京东 Smart supply chain

Singapore: Triple Helix Partnership between the Research Community, Industry and Government

The goal of Singapore's Triple Helix Partnership is to enable the rapid commercialisation of fundamental AI research and deployment of AI solutions through multi-stakeholder collaboration. This initiative aims to deepen investments in AI-related R&D across the research ecosystem; drive partnerships between the research community and industry (over 15 AI public-private partnerships and joint labs established to date, e.g., KPMG-A*STAR, Singtel-NTU); accelerate AI adoption in companies; and establish AI innovation testbeds (e.g., AISG's 100E Programme supports companies in deploying AI in a co-investment model).

The Working Group on Innovation and Commercialization of the Global Partnership on AI (GPAI)

The working group is exploring practical tools and methods to foster innovation and accelerate the commercialisation of trustworthy AI, with a special focus on SMEs. The working group plans several deliverables that will analyse: i) emerging business models

made possible by AI, ii) how to stimulate innovation and to reduce the time to market, iii) the role of policy to establish trust in commercialised AI systems throughout the entire life cycle of an AI system, and iv) intellectual property issues.

Sources: Presentation by ONE AI member Edward Teather, 10 July 2020 (Expert group 3rd Meeting). Presentation by ONE AI Guest Speaker Li Xiuquan, 24 August 2020 (Expert group 4th meeting). Presentation by ONE AI member Yeong Zee Kin, 29 June 2020 (Expert group 2nd Meeting); Presentation by ONE AI Guest Speaker Françoise Soulié, 24 September 2020 (Expert group 5th meeting).

AI skills, jobs and labour market transformation

Building human capacity & preparing for labour market transformation (OECD AI Principle 2.4)

“Governments should work closely with stakeholders to prepare for the transformation of the world of work and of society. They should empower people to effectively use and interact with AI systems across the breadth of applications, including by equipping them with the necessary skills.

Governments should take steps, including through social dialogue, to ensure a fair transition for workers as AI is deployed, such as through training programmes along the working life, support for those affected by displacement, and access to new opportunities in the labour market.

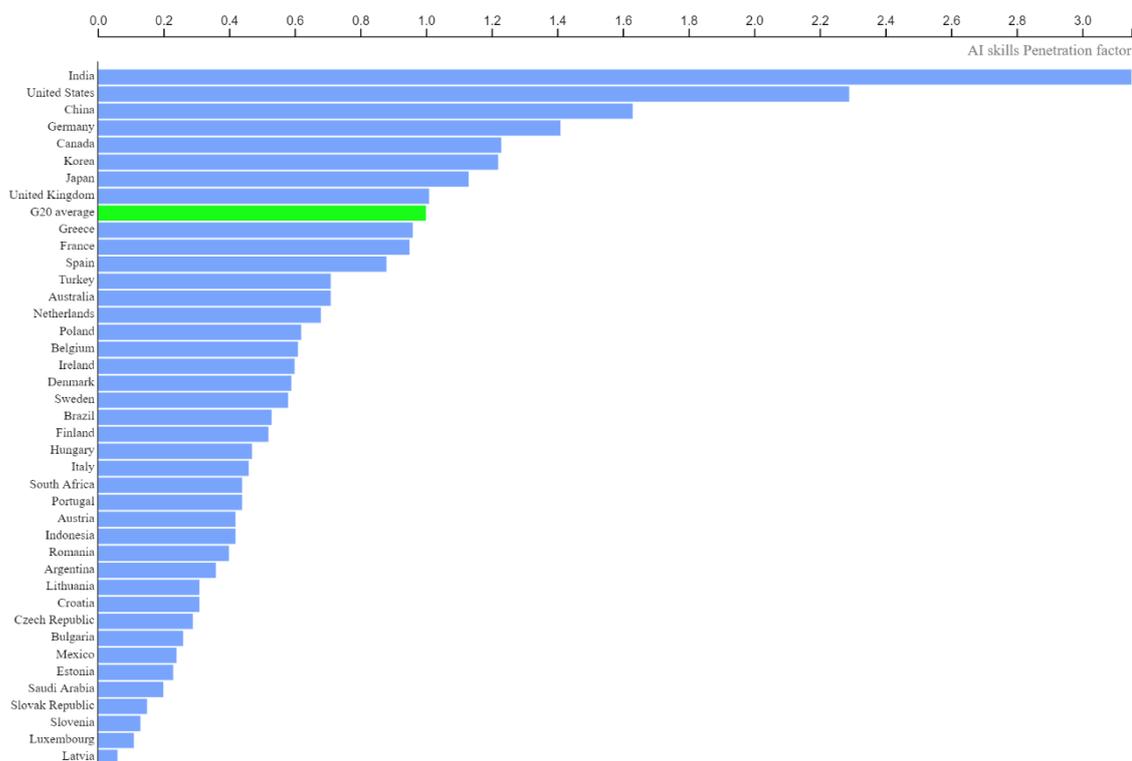
Governments should also work closely with stakeholders to promote the responsible use of AI at work, to enhance the safety of workers and the quality of jobs, to foster entrepreneurship and productivity, and aim to ensure that the benefits from AI are broadly and fairly shared.”

Automation is not a new phenomenon, but AI is expected to accelerate the change in the profile of tasks that can be automated. Many countries are conducting research to understand the impacts of AI in a range of workplace settings. For example, the United States’ NSF awarded grants under *The Future of Work at the Human-Technology Frontier*, a “big idea” programme. The funded projects aim at understanding the impacts of AI in different workplace settings.

To empower people with the skills for AI and to prepare them for the labour market transformation, countries are deploying a myriad of policy initiatives, including: i) establishing formal education programmes on Science Technology Engineering and Mathematics (STEM), AI and AI-related fields; ii) devising vocational training and lifelong learning AI and AI-related programmes; iii) providing financial and non-financial support to retrain and attract AI talent; iv) fostering academic partnerships between public and private AI research institutions; and v) monitoring the impact of AI on the labour market for policy intervention. The first four categories are more developed in the current landscape, while measures addressing broader labour market trends and challenges remain at a very early stage of development.

Establishing formal education programmes on STEM, AI and AI-related fields

Countries have identified AI talent as the bedrock of technological advancement in AI, and education and skills are a priority for all national AI strategies. One focus is on increasing the penetration of AI skills at the national level (Figure 18). This can be accomplished through formal education and training programmes on AI, including education in science, technology, engineering, and math (STEM); training in IT and AI tools and methods; and domain-specific education (Vincent-Lancrin and van der Vlies, 2020^[61]).

Figure 18. Cross-country AI skills penetration

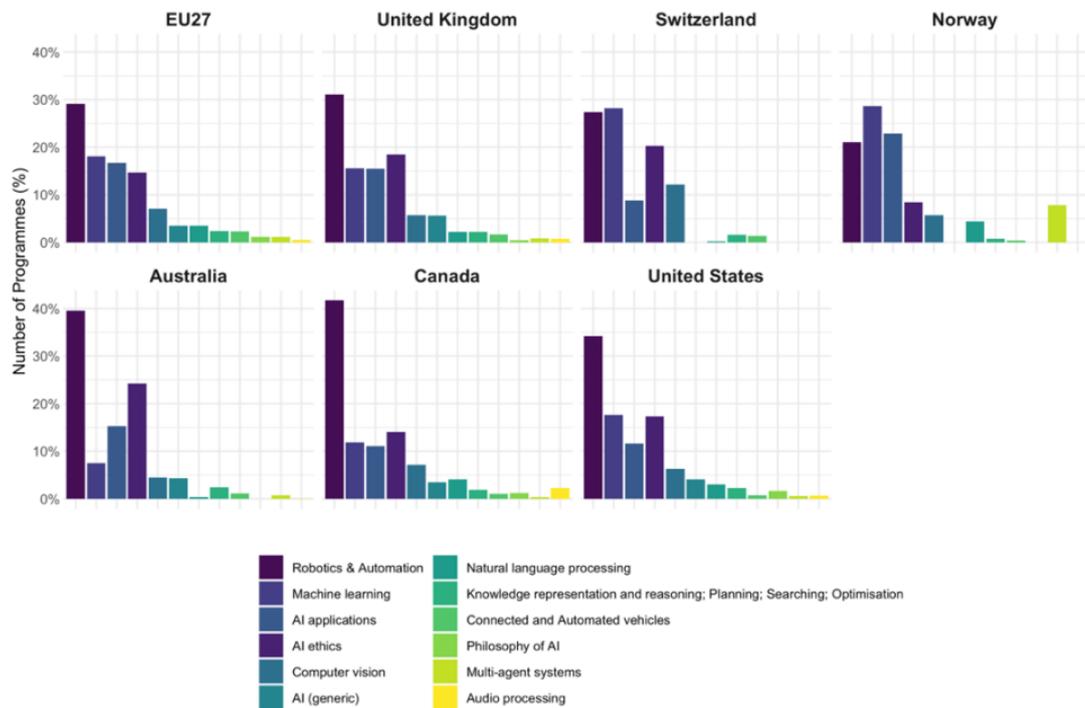
Note: Average from 2015 to 2020 for a selection of countries with 100 000 LinkedIn members or more. The value represents the ratio between a country's AI skill penetrations and the benchmark, controlling for occupations. See [methodological note](#) for more information.

Source: OECD.AI (2021), visualisations powered by Josef Stephan Institute using data from LinkedIn, accessed on 11/5/2021, www.oecd.ai

A recent EC-JRC study maps the education offer in AI and other advanced digital technologies (AI, High-performance computing, Cybersecurity and Data Science), at bachelor and master levels in the EU27 and 6 additional countries.²⁰ The study quantifies the programmes taught in English and analyses their characteristics. The AI domains covered most by university programmes are Robotics and Automation, Machine learning, AI applications, and AI ethics. They are part of ICT and engineering studies (Figure 19).

Figure 19. Academic offer of advanced digital skills in 2019-20 (EC-JRC)

AI programmes by geographic area and content taught (%). All geographic areas, 2019-20



Note: The percentages are based on the number of programmes in the corresponding geographic areas.

Source: Righi, R., López-Cobo, M., Alaveras, G., Samoili, S., Cardona, M., Vázquez-Prada Baillet, M., Ziembra, L.W., and De Prato, G., Academic offer of advanced digital skills in 2019-20. International comparison. Focus on AI, High-Performance Computing, Cybersecurity and Data Science, EUR 30351 EN, Publications Office of the European Union, Luxembourg, 2020, ISBN 978-92-76-21541-9, doi:10.2760/225355, JRC121680. <https://publications.jrc.ec.europa.eu/repository/handle/JRC121680>

In the United States, STEM education is a key priority in the AI strategy. It devotes at least USD 200 million grant per year to promote high-quality computer science and STEM education, including the training for teachers. Finland plans to create new AI Bachelor's and master's programmes, as well as promote incentives and training mechanisms for teachers to use AI in their courses and teaching methods.

Through the *National Digital Languages Plan*, Chile plans to promote computational thinking and programming in its educational system to build problem-solving and innovation skills. ONE AI member Carlos Avila (Chile) highlighted that scholarships for doctoral studies abroad were launched through the pilot initiative *Technological Revolution and AI*. Chile's *Talent Development Plan* stipulates that the government will evaluate the effectiveness of this initiative.

In June 2020, the UK's Department for Digital, Culture, Media and Sport and the Office for AI announced a EUR 15 million (GBP 13 million) budget for the Office for Students to provide degree conversion courses on data science and AI, including EUR 11.5 million (GBP 10 million) for up to 1 000 scholarships for people from diverse backgrounds. Universities and industry partners will provide an additional EUR 12.7 million (GBP 11 million) for this programme. At least 2 500 graduate places will be created through the programme, with the first courses starting in autumn 2020. This programme builds on a pilot project of conversion courses in data science. In its *AI Roadmap*, the UK's AI Council recommended developing a specialist curriculum on AI and improving teachers' knowledge of AI. At the postgraduate level, the Council recommended increasing financial support for master's and PhD programmes. The Council also recommended tracking and benchmarking the level of diversity and inclusion in AI programmes (UK AI Council, 2021^[19]).

The Korean government added AI subjects to the curricula of elementary, middle and high schools. At universities, AI departments were created and expanded at 45 universities with a capacity for 4,761

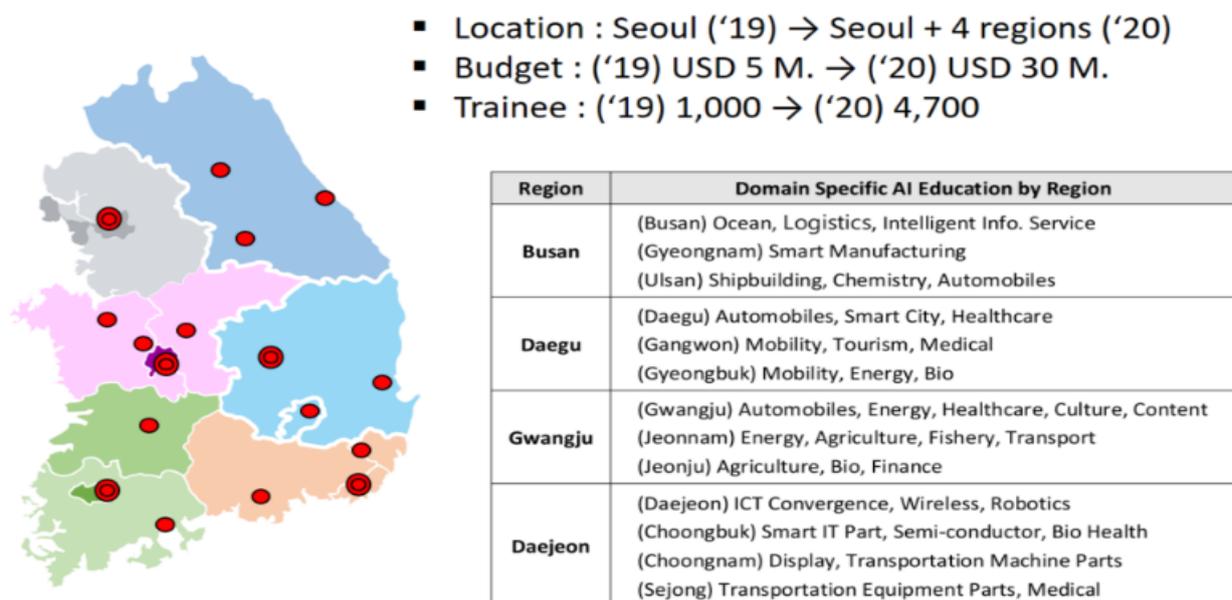
students. AI graduate schools are offering masters and doctoral courses to foster talented professionals (5 graduate schools in 2019 and 8 in 2020).

Devising vocational training and lifelong learning AI and AI-related programmes to increase AI literacy

Vocational training and lifelong learning programmes would help the workers and citizens keep up with technological and societal changes over the long term. This, in turn, ensures that the public can make use of IT-enabled resources and that the domestic workforce is available and qualified for the jobs of the future. Finland's Elements of AI programme is a ten-hour Massive Open Online Course that seeks to ensure that all citizens have a basic understanding of AI. Finland's AI strategy sets the goal to educate the entire nation with basic AI – including people who are employed and the elderly – to build “civic competence”. While Finland initially targeted the training of 1% of its population, the course attracted more than 100 000 participants, representing more than 2% of the population. This course is now provided in several official languages in the EU and will soon be in all of them. Another course on the *Ethics of AI* was launched in Finland in November 2020.

In Korea, the Ministry of Science and ICT established the *ICT Innovation Squares* in Seoul and 13 regions. These Squares offers working-level AI education programs in conjunction with regional industries. 600 professionals from 6 industry domains participated in this programme in 2020, and industry domains were expanded to 12 areas in 2021 (Figure 20).

Figure 20. ICT Innovation Centres in Korea



Source: Presentation by ONE AI member Deuk Jung Kim (Korea), 19 January 2021, (Expert group 7th Meeting).

Financial and non-financial to retain and attract AI talent

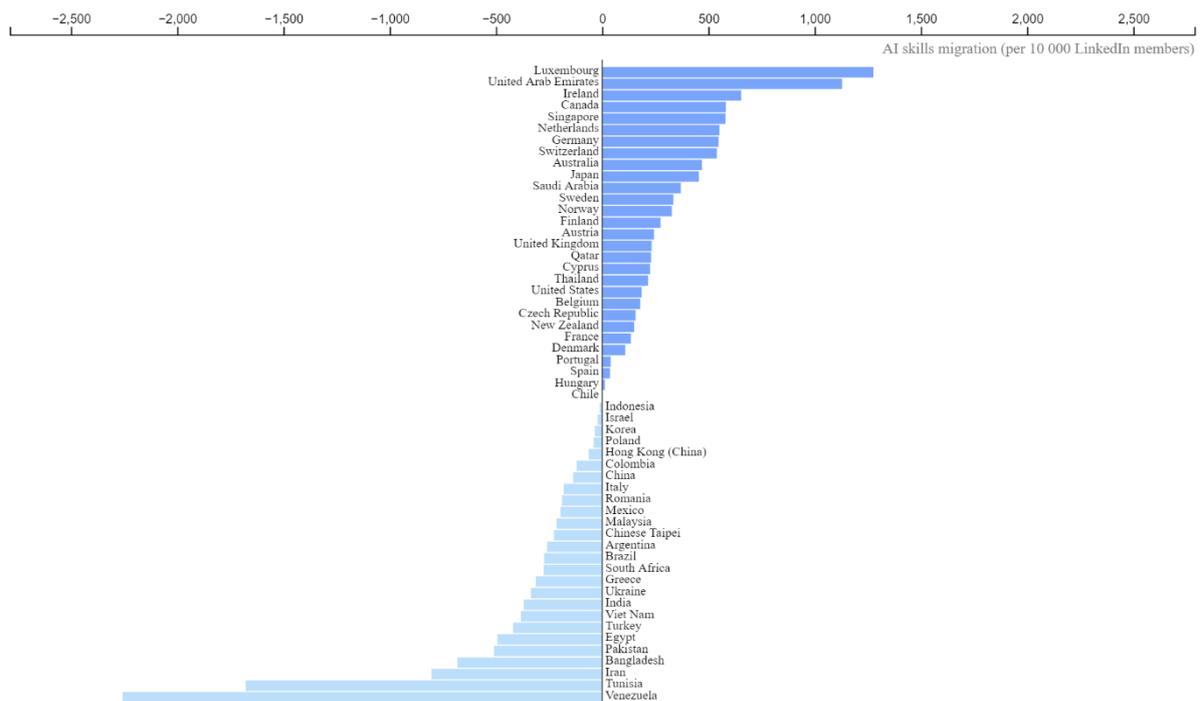
Many countries are offering fellowships, postgraduate loans, and scholarships to increase domestic AI research capability and expertise and retain AI talent. Australia has dedicated USD 0.89 million (AUD 1.4 million) to AI and Machine Learning PhD scholarships.

- Canada seeks to retain and attract AI talent with the Canada CIFAR AI Chairs Programme. The programme provides dedicated funding for five years to world-class AI researchers.

- Chile plans to launch a PhD scholarships pilot programme in 2020 to promote targeted studies on AI.
- Singapore seeks to attract AI talent at the postgraduate level, e.g. the Singapore Digital Scholarship (postgraduate) offered by the Infocomm Media Development Authority.
- The United Kingdom established *Turing Fellowships* to attract and retain top AI researchers. ONE AI member Ed Teather (United Kingdom) presented the plans to increase domestic AI talents by a fellowship programme to open 2 500 seats for non-STEM to acquire data science skills.
- The United States, the National Science Foundation’s new National AI Research Institutes programme will also contribute to workforce development, particularly for AI researchers (Parker, 2020^[44]).

There are concerns about the shortage of skilled AI workers and the migration of researchers and engineers to other countries (Figure 21). Many national AI strategies also include incentives to attract foreign skills and top talent in AI. Belgium plans to attract world-class data and AI talent by introducing migration quotas to facilitate selective immigration and visa policies for top foreign talent. For example, the United Kingdom plans to ease visa restrictions for PhD researchers from abroad and increase the amount of Exceptional Talent (Tier 1) visas (up to 2 000 per year) to attract science, technology, AI specialists.

Figure 21. Between-country AI skills migration



Note: Linearly average from 2015 to 2019 for a selection of countries with 100 000 LinkedIn members or more. Migration flows are normalized according to LinkedIn membership in the country of interest. Data downloads provide a snapshot in time. Caution is advised when comparing different versions of the data, as the AI-related concepts identified by the machine learning algorithm may evolve in time. Please see methodological note for more information. The information in this document with reference to “Cyprus” relates to the southern part of the Island. There is no single authority representing both Turkish and Greek Cypriot people on the Island. Turkey recognises the Turkish Republic of Northern Cyprus (TRNC). Until a lasting and equitable solution is found within the context of the United Nations, Turkey shall preserve its position concerning the “Cyprus issue..” See [methodological note](#) for more information.

Source: OECD.AI (2021), visualisations powered by Josef Stefan Institute using data from LinkedIn, accessed on 4/3/2021, www.oecd.ai

Fostering partnerships between public and private AI research institutions

National AI strategies support the development of AI education. To that end, they promote collaboration among government, business, educational and non-profit communities to develop educational programmes, tools, and technologies. Korea's *Smart Training Education Platform* allows people to take training programmes that combine theory and field experience. Through its *Plattform Lernende Systeme* (Learning Systems Platform), Germany's Federal Ministry of Education and Research brings together expertise from science, industry, and society. It is a forum for exchange and co-operation on technological, economic, and societal challenges regarding the research and application of AI.

Countries are also partnering with the private sector to reskill and upskill the workforce for AI. For example, in Chile, public-private discussions focus on incorporating AI in the curriculum of Professional Institutes. Amazon Web Services provides AWS Credits for research and education through programs in Latin America, including AWS Educate, AWS Academy, and AWS Training and Certification supporting data scientists (AWS, 2019^[62]).

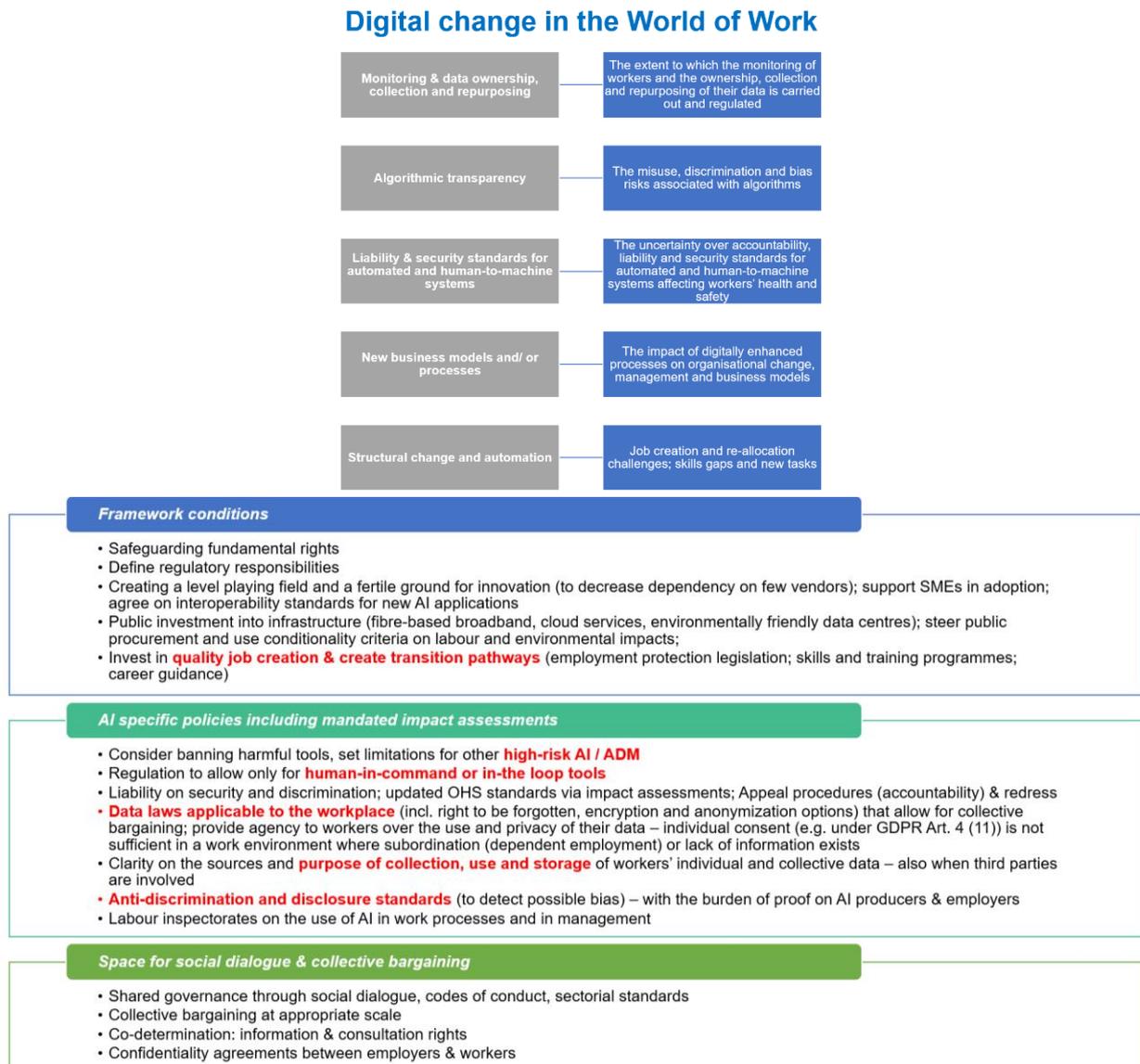
Some large AI actors are supporting students taking AI-related graduate courses around the world. For example, ONE AI member Jennifer Bernal (Deepmind) presented Deepmind's Scholars programme, which provides financial support to students from underrepresented groups seeking graduate courses (master's programmes and PhDs). The programme, launched in Brazil, Bulgaria, Canada, Colombia, France, Greece, Poland, Romania, Turkey, South Africa, the United Kingdom, and the United States, also offers support from a Deepmind mentor. Similarly, Facebook is collaborating with University College London to create new AI doctoral research programmes in the UK and open-source their findings.

Monitoring the impact of AI in the labour market

AI is likely to reshape the work environment of many people, by changing the content and design of their jobs, the way workers interact with each other, with their managers and with machines, and how work effort and efficiency are monitored. Human-machine collaboration can help workers with tedious or physically demanding tasks while allowing them to leverage their uniquely human abilities (OECD, 2018^[63]). AI can provide cheaper, faster, and more scalable solutions in human resource management, helping managers to manage, and enhancing training. However, the same AI applications create risks. Lack of transparency and explainability around algorithmic predictions and decisions can make employees feel insecure, either psychologically or physically. By enabling extensive monitoring of workers' performance, AI can increase work pressure and generate stress about productivity and about how managers may interpret data (Lane and Saint-Martin, 2021^[64]).

Governments are adapting existing policies and developing new strategies to prepare citizens, educators, and businesses for the jobs of the future and minimise AI's negative impacts. This is in line with the AI principle to enable fair transitions in labour markets. Many national AI policies emphasise retraining for those displaced by AI, and AI education and training for workers coming into the labour force. ONE AI member Anna Byhovskaya (Trade Union Advisory Committee to the OECD) emphasised the need for policy makers to address the effects of different AI tools and algorithmic management systems in the workforce and bias and discrimination challenges with algorithmic human resource management (including in recruitment), in addition to engaging in social dialogue around these issues and around skills development (Figure 22). Social dialogue initiatives include the '*Digitization partnership for Denmark's digital future*', which discusses labour market transitions and training needs.

Figure 22. Digital change in the World of Work



Source: Presentation by ONE AI member Anna Byhovskaya (TUAC at OECD), 15 February 2021 (8th meeting).

National institutions are closely monitoring the impact of AI on the labour market. Examples include:

- France created a Centre of Excellence for AI to help recruit AI talent and to serve as an advisor and lab for public policy design.
- With the establishment of its AI Observatory, Germany's Labour Ministry plans to systematically monitor and analyse the implications of smart and autonomous systems in the world of work.
- The Czech Republic will monitor the impact of technological changes on the labour market.
- Poland also plans to create an AI Observatory for the Labour Market.

At the same time, AI can help governments and others match labour supply and demand. For example, Korea's AI service – *The Work* – helped 2 666 job seekers find relevant offers that led to a job in the second quarter of 2019. Korea has since put in place a pilot service using a chatbot named *Goyong-yi* ("employment") to provide 24/7 automated customer support.

The OECD launched the Programme on AI in Work, Innovation, Productivity and Skills (AI-WIPS) in 2020, supported by the German Ministry of Labour (Box 11). AI-WIPS analyses the impact of AI on the labour market, skills and social policy while providing opportunities for international dialogue and policy assessments.

Box 11. OECD Programme on AI in Work, Innovation, Productivity and Skills

The OECD.AI Policy Observatory houses a dedicated Programme on AI in Work, Innovation, Productivity and Skills. The programme aims to help ensure that adoption of AI in the world of work is effective, beneficial to all, people-centred and accepted by the population at large. It is supported by the German Federal Ministry of Labour and Social Affairs (BMAS) and complements the work of the German AI Observatory in the Ministry's Policy Lab Digital, Work & Society. The Programme aims at producing in-depth analyses, measurement, opportunities for international dialogue and concrete policy assessments on how AI impacts labour markets and societies. Through collaboration with international policy, research, and business communities, as well as labour union representatives and civil society, the OECD will identify necessary employment, skills, and social policy reforms.

The first international conference of AI-WIPS was held virtually in February 2021 (<https://www.oecd.ai/work-innovation-productivity-skills/events>).

Note: more information available at <https://oecd.ai/wips> and <https://denkfabrik-bmas.de/>

3. AI policy intelligence to monitor implementation

A few countries have launched policy intelligence activities and issued annual reports to evaluate the implementation of their national AI strategies. Canada, Germany, Singapore, United Kingdom, United States, and the European Commission had published reports that monitored and evaluated the implementation of their AI strategies. Countries highlight milestones and accomplishments in these reports. These types of monitoring and evaluation publications can be expected to expand across countries as national AI strategies move into later stages of implementation.

Several national or regional institutions have established AI observatories to oversee the implementation of national AI strategies and policies. For example, the German Labour Ministry launched the KI-Observatorium in March 2020 to help implement parts of Germany's AI strategy and encourage the responsible, people-centred, and participatory use of AI in the world of work and society. Other observatories include: the Czech Republic's AI Observatory and Forum (AIO&F); Quebec's International Observatory on the Social Impacts of Artificial and Digital Intelligence in Canada; France's Observatory on the Economic and Social Impact of AI; the Italian Observatory on AI; and Chile is considering an Observatory on AI and established a Labour Observatory to analyse the internal ecosystem, gather new evidence, and incorporate this evidence base into policy.

Some countries report more detailed assessments, including information such as budgets, funding, and specific targets. Some countries are also developing different indicators to measure progress across different AI policy domains:

- Canada's CIFAR also produced an annual report summarising the organisation's key activities including its Evaluation Strategy Framework. A performance measurement matrix is used by CIFAR to monitor qualitative data by categorising each activity into desired outputs, short-intermediate-long term outcomes, and the ultimate desired impact.²¹ In October 2020, CIFAR released the Pan-Canadian AI Strategy Impact Assessment Report (CIFAR, 2020_[65]). This report highlights the strategy's impact on the following domains and Canadian regions:
- *Commercialisation and adoption of AI*: 50% growth in foreign direct investment in ICTs from 2017 to 2019.
- *Research & development*: 109 leading researchers recruited and retained in Canada through the Canada CIFAR AI Chairs program. In 2019, Canadians Yoshua Bengio and Geoffrey Hinton (along with their colleague Yann LeCun), won the ACM A.M. Turing Award, widely considered the "Nobel Prize of Computing".
- *Talent and job creation*: The strategy helped create a Canadian ecosystem that attracts and retains highly skilled talent.
- *Education*: enrolment in math, computer and information science postsecondary programmes grew by 26% since 2015/16, compared to 3% growth for all topics.

- *Social*: Canadian research institutes CIFAR, Amii, Mila and the Vector Institute prioritise AI for Good across societal causes including health, education, and the environment through a portfolio of programs.
- *Responsible AI*: Canada and France founded the Global Partnership on AI (GPAI) focusing on responsible AI.
- *Regional Impact Evaluation*: The establishment of three AI institutes, Amii, Mila, and the Vector Institute, created a collaborative network across Canada, enabling regions to deepen their respective specialised strengths while building cross-regional synergies.
- Colombia is developing policy intelligence tools to monitor the implementation of i) national AI policies, ii) emerging good practices to implement the OECD AI recommendations to governments, and iii) AI projects in the public sector:
- SisCONPES is a tool that monitors the implementation of every action line in the AI national strategy. It reports advances and challenges in implementation to entities leading the implementation of the strategy, notably the Presidency of the Republic.
- A follow-up plan to monitor the implementation of the OECD AI Principles and identify good practices matches specific actions implemented by the Colombian government to the OECD recommendations to governments.
- The GovCo Dashboard monitors the implementation of AI projects in the public sector. The dashboard includes a description of each project and highlights the mechanisms through which AI is used and the progress of each project.

These policy intelligence tools are also used by the Presidency and the AI Office to evaluate resource allocation and evaluate policy implementation.

- In 2019, Germany published an interim report detailing the work accomplished in the first year of its AI strategy. Beginning with a statistical summary, the report outlines German accomplishments regarding AI publications, patent applications, percentage increases in new AI start-ups, as well as expanded academic, undergraduate, and graduate positions. The report highlights the need for consolidating the governance framework. The report mentioned the call for a regulatory framework over algorithmic systems raised by the Data Ethics Committee. The governance framework also establishes guidelines for funding aimed at developing user-friendly AI applications to improve user protection and quality of life. The government has also drafted a roadmap regarding AI standards and has stressed the need for stronger standardisation in the AI landscape.

In December 2020, Germany published an updated report on the German AI strategy. With this update, the federal government is responding to current developments and high-priority topics such as the COVID-19 pandemic, environmental and climate protection; and complementing the strategy with further measures (BMBF, 2020^[38]).

- The UK's Centre for Data Ethics and Innovation (CDEI) launched an "AI Barometer" that identifies public distrust of AI as a key barrier that needs addressing (CDEI, 2020^[66]).²² The AI Council launched an AI Roadmap in late 2020 providing recommendations to the government (UK AI Council, 2021^[19]). In 2019, the UK Office for AI released its first-year report on the 2018 AI Sector Deal that highlights:²³
- *Business environment* – the establishment of the Office for AI, the AI Council, and the Centre for Data Ethics and Innovation;
- *People* – funding more doctoral training, launching AI Turing Fellowships, opening AI Masters programs, and creating conversion courses to bring non-STEM students into AI;
- *Infrastructure* – piloting data trusts;
- *Place* – funding centers of excellence for AI applications in healthcare; and
- *Ideas* – collaborating with the private sector to expand R&D.

- The White House’s Office of Science and Technology Policy’s annual report identifies each of the 6 key policies and practices of the American AI Initiative to assess important milestones and accomplishments. For example, the report discusses the White House Office of Management and Budget’s creation of the Federal Data Strategy to help federal agencies harness data and AI for their work. The publication takes stock of the US government’s efforts to expand access to AI resources and promote the right environment for innovation and research through regulatory guidelines and technical standards. Impacts to the American workforce is also a priority area for monitoring efforts in the American AI strategy.²⁴
- The EU’s 2018 Coordinated Action Plan on the development of AI announced the creation of AI Watch, the “European Commission Knowledge Service to Monitor the Development, Uptake and Impact of Artificial Intelligence Policy for Europe” (Box 12).²⁵ In April 2021, as part of its AI legislative package) the European Commission updated its Coordinated Plan with EU Member States.

Box 12. European Commission – Joint Research Centre (AI Watch)

AI Watch is an initiative developed by the European Commission - Joint Research Centre and DG CONNECT of the European Commission. It monitors AI-related development and provides analyses to support the implementation of the European AI initiatives. JRC is also developing a methodology to identify risks and opportunities, drivers, and barriers of the use AI in public service provision. In February 2020, JRC launched a report on national AI strategies of EU member countries, the objective of which is “to present and gather information on all EU Member States’ national AI strategies in a structured and comprehensive way” (see table below). It aims to help Member States compare their strategy and identify areas for strengthening synergies and collaboration. The EU’s effort to monitor implementation develops a harmonised policy framework by assessing each Member State’s strategy through specific policy areas: human capital, research, networking, infrastructure, and regulation. The purpose of this framework is to enable comparisons by policy makers in each country.²⁶

Overview of national AI strategies in the EU Member States and Norway

Country	Status	Date	Country	Status	Date
 Austria	In progress		 Italy	In progress	
 Belgium	In progress		 Latvia	Published	Febr. 2020
 Bulgaria	Published	Dec. 2020	 Lithuania	Published	March 2019
 Croatia	In progress		 Luxembourg	Published	May 2019
 Cyprus	Published Updated	Jan. 2020 June 2020	 Malta	Published	Oct. 2019
 Czech Republic	Published	May 2019	 Netherlands	Published	Oct. 2019
 Denmark	Published	March 2019	 Norway ^{AC}	Published	Jan. 2020
 Estonia	Published	July 2019	 Poland	Published	Dec 2020
 Finland	Published Updated	Dec. 2017 Nov. 2020	 Portugal	Published	June 2019
 France	Published	March 2018	 Romania	In progress	
 Germany	Published Updated	Nov. 2018 Dec. 2020	 Slovakia	Published	July 2019
 Greece	In progress		 Slovenia	In progress	
 Hungary	Published	Sept. 2020	 Spain	Published	Dec. 2020
 Ireland	In progress		 Sweden	Published	May 2018

Source: JRC – European Commission

Note: Last update of the table on 15 March 2021. The information in the table is based on input from national contact points or public sources. It presents release dates of national AI strategies in their native language. Countries in bold have published or updated their national AI strategy since the release of the previous AI Watch report in February 2020*. In addition to EU Member States, this table also includes Norway as Associated Country highlighted with the superscript AC. Switzerland does not intend to release a national AI strategy. See: <https://ec.europa.eu/jrc/en/publication/ai-watch-national-strategies-artificial-intelligence-european-perspective-2019>

AI Watch activities that map the AI landscape aim to identify main European and non-European stakeholders and the competitive position of Europe in major AI subdomains, e.g., machine learning methods, computer vision and connected automated vehicles.²⁷ AI Watch also investigates both R&D and industry activities. AI Watch provides a Landscape dashboard that allows exploration of data at country level.²⁸



OVERVIEW

Focus on country level data to have a comparative worldwide landscape overview. The number of agents detected in each country is used as an indicator of involvement of a country in AI-related economic processes.



THEMATIC AREAS OF SPECIALISATION

Identification of technological subdomains and countries' key thematic areas of specialisation, analyzing the textual content of worldwide R&D and industrial activities.



INDUSTRY

Firms detected to be involved in AI. Location of firms, core business and patenting activity, age and main sector of economic activity.



RESEARCH AND DEVELOPMENT

This section provides a selection of indicators on attractiveness and excellence in research.

Source: (Samoili et al. 2020) <https://ec.europa.eu/jrc/en/publication/tes-analysis-ai-worldwide-ecosystem-2009-2018>, and https://web.jrc.ec.europa.eu/dashboard/AI_WATCH_LANDSCAPE

4. International and multi-stakeholder co-operation on AI

International co-operation for trustworthy AI (OECD AI Principle 2.5)

“Governments, including developing countries and with stakeholders, should actively cooperate to advance these principles and to progress on responsible stewardship of trustworthy AI.

Governments should work together in the OECD and other global and regional fora to foster the sharing of AI knowledge, as appropriate. They should encourage international, cross-sectoral, and open multi-stakeholder initiatives to garner long-term expertise on AI.

Governments should promote the development of multi-stakeholder, consensus-driven global technical standards for interoperable and trustworthy AI.

Governments should also encourage the development, and their own use, of internationally comparable metrics to measure AI research, development and deployment, and gather the evidence base to assess progress in the implementation of these principles.”

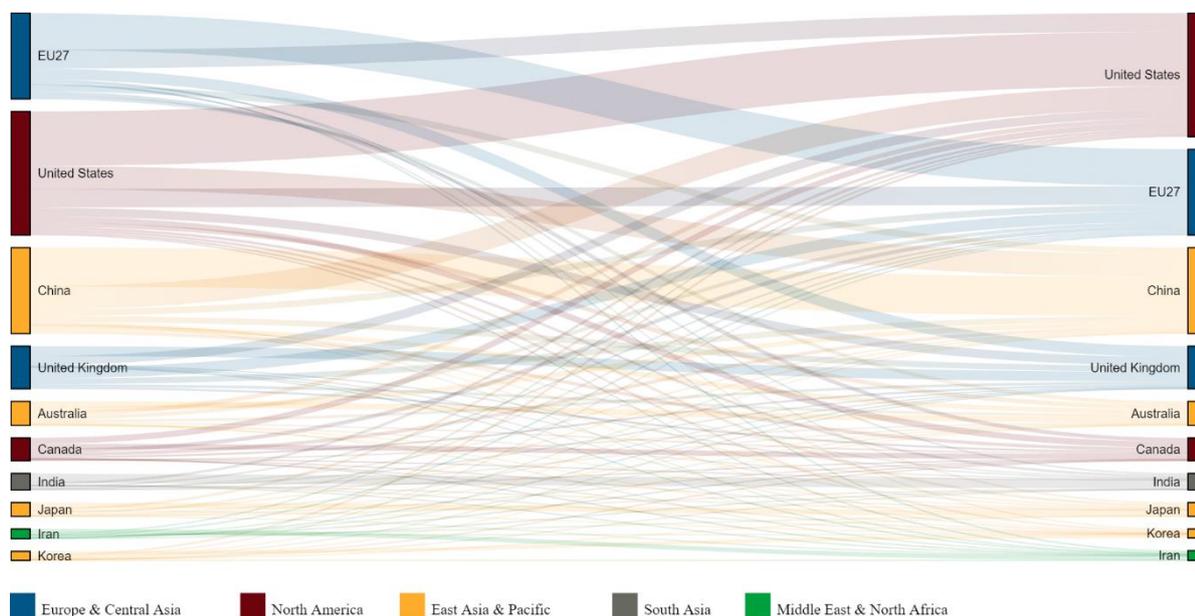
International AI research collaboration

Countries are promoting cross-border research collaboration on AI (Figure 23). For example, the French National Research Agency, the German Research Foundation and the Japanese Science and Technology Agency have agreed on trilateral collaboration in AI research over three years. Some projects started in 2020. The United Kingdom and the United States signed a “Declaration on Cooperation in AI R&D” that envisages i) using bilateral science and technology cooperation and multilateral cooperation frameworks; ii) recommending priorities for future cooperation, particularly in R&D areas; iii) coordinating the planning and programming of relevant activities in areas that have been identified; and (iv) promoting R&D in AI, focusing on challenging technical issues in 2020.²⁹ Canada and Germany are working together to advance AI industrialisation by organising joint R&D projects on the application of AI technologies in manufacturing, as applied to manufacturing, supply chain and other fields (Canada, 2020_[67]).

Many EU countries are also participating in European AI research projects and networks such as BVDA/EURobotics, the Confederation of Laboratories for AI Research in Europe (CLAIRE) and the

European Laboratory for Learning and Intelligent Systems (ELLIS). AI is also a priority in Horizon Europe, the EU's next framework programme for research and innovation.

Figure 23. Domestic and international AI research collaboration



Note: The thickness of a connection represents the number of joint AI publications between two countries since 1980. “Domestic collaboration” shows co-authorship involving different institutions within the same country. See [methodological note](#) for more information. EU27 = the European Union minus the United Kingdom.

Source: OECD.AI (2021), visualisations powered by Josef Stefan Institute using data from Microsoft Academic Graph, version of 21/12/2020, accessed on 4/3/2021, www.oecd.ai

International and multi-stakeholder co-operation on trustworthy AI

Countries are increasingly engaged in international co-operation to promote the beneficial use of AI and address its challenges. Many inter-governmental organisations with complementary mandates and membership are engaged in AI initiatives and projects. Several of these activities are listed in what follows. The OECD and other intergovernmental organisations are also engaged in the development of a neutral platform entitled “*GlobalPolicy.ai*” to share information on the AI initiatives and projects undertaken by these organisations.

Regional co-operation is also taking place. In 2018, several Nordic and Baltic countries agreed to collaborate on AI policies, including skills development, access to data and standard-setting exercises.³⁰ The Arab AI Working Group, formed in 2019 by the Arab League members, aims to i) develop a joint framework for capacity building in the Arab region; ii) raise awareness of the opportunities and challenges of AI; iii) train youth to compete in AI jobs; and iv) establish a common Arab Strategy, including a regulatory framework for AI. The African Union set up a working group on AI to create a joint capacity-building framework across the continent under Egypt's presidency in 2020. This will help address skills gaps and prepare African youth for future jobs; identify and initiate AI projects across Africa to serve the Sustainable Development Goals (SDGs), and establish a common AI strategy for Africa.

Some countries are leveraging trade agreements to enhance co-operation on AI. For example, in 2020, Chile, New Zealand and Singapore signed the Digital Economy Partnership Agreement (DEPA) which aims to promote the safe and responsible use of AI technologies.³¹ Australia and Singapore, building on

their pre-existing trade agreement, also signed the Singapore-Australia Digital Economy Agreement (SADEA) in the same year, where Parties agreed to advance their co-operation on AI.³²

CAF - Development Bank of Latin America

The CAF has conducted work on AI and a data policy development project, to provide technical cooperation to Latin-American countries working on the design and implementation of AI policies. An example of this cooperation work with the Colombian Government to develop the first draft of Colombia's ethical AI framework, a model for implementing AI regulatory sandboxes and a data governance model. CAF has been leading the design and implementation of Colombia's AI Office. CAF has recently also begun collaborating with the Government of Peru on Peru's AI Strategy.

Council of Europe

The Council of Europe and its bodies have been examining the impact of AI and have published several recommendations. In September 2019, the Committee of Ministers of the Council of Europe set up the Ad Hoc Committee on Artificial Intelligence (CAHAI). This committee was examining the feasibility of developing a legal framework for the development, design, and application of AI, based on the Council's standards on human rights, democracy, and rule of law. In April 2020, the same Committee of Ministers issued a set of guidelines calling on governments to take a precautionary approach to the development and use of algorithmic systems. It further called for the adoption of legislation, policies and practices that fully respect human rights. In June 2020, the CAHAI established three working groups.

CAHAI's Policy Development Group developed a feasibility study for a legal framework on AI applications - which was adopted by the CAHAI in December 2020 - and proposals for engaging with and consulting relevant external stakeholders. The Consultations and Outreach Group is taking stock of the results of the online consultation and preparing a stakeholder analysis and mapping. The Legal Frameworks Group started in January 2021 to work on proposals for provisions for a legal framework, with specific regulatory proposals for the development, design, and application of AI in areas identified as risky by member states and other stakeholders.

European Commission

The multi-stakeholder High-Level Expert Group on Artificial Intelligence (AI HLEG) was convened by the European Commission to support the implementation of the European Strategy on AI and completed its four outputs in July 2020³³: Ethics Guidelines for Trustworthy Artificial Intelligence in April 2019, Policy and Investment Recommendations for Trustworthy Artificial Intelligence in June 2019, an updated Assessment List for Trustworthy Artificial Intelligence (ALTAI) in July 2020, and Sectoral Considerations on the Policy and Investment Recommendations in July 2020.³⁴ The European AI Alliance is a multi-stakeholder forum for engaging in a broad and open discussion of all aspects of AI development and policy, and its impact on the economy and society.³⁵ In April 2021, the EC published the "AI legislative package" that comprises: i) a Proposal for a Regulation on a European approach for Artificial Intelligence (Box 6); ii) an updated Coordinated Plan with Member States, and iii) a Proposal for a Regulation on Machinery Products.

G20

Under the Japanese Presidency in 2019, the G20 agreed to commit to a human-centred approach to AI and adopted the G20 AI Principles, which were drawn from the OECD AI Principles. Under the Saudi presidency in 2020, the G20 agreed to advance the G20 AI Principles in each country. The OECD contributed to the 2020 Declaration of G20 Digital Economy Ministers by providing a report on examples of policies to advance the AI Principles (OECD, 2020[68]); and (G20, 2020[69]). The G20 is continuing

discussions on AI under the Italian Presidency in 2021, with a focus on trustworthy and inclusive AI for MSMEs.

GPAI

The Global Partnership on AI (GPAI) is an international and multi-stakeholder initiative, conceived by Canada and France during their respective 2018 and 2019 G7 presidencies, to undertake cutting-edge research and pilot projects on AI priorities to advance the responsible development and use of AI. The Partnership was launched in June 2020 with 15 founding members: Australia, Canada, France, Germany, India, Italy, Japan, Mexico, New Zealand, Korea, Singapore, Slovenia, the United Kingdom, the United States, and the European Union. In December 2020, Brazil, the Netherlands, Poland, and Spain joined GPAI.

GPAI is led by a ministerial-level Council and a Steering Committee, and is supported by a dedicated Secretariat hosted by the OECD, as well as two Centres of Expertise: one in Montreal (the International Centre of Expertise in Montreal for the Advancement of Artificial Intelligence (ICEMAI)) and one in Paris (at the French National Institute for Research in Digital Science and Technology (INRIA)).

GPAI brings together leading AI experts from industry, government, civil society, and academia to collaborate across four current working groups on the themes of: i) responsible AI (including a subgroup on AI and pandemic response), ii) data governance, iii) the future of work, and iv) innovation and commercialisation. The Montreal Centre of Expertise supports the first two working groups, while the Paris Centre of Expertise supports the latter two working groups.

As the 2020-2021 GPAI Chair, Canada hosted the inaugural GPAI Summit in December 2020, which included the first meetings of GPAI's governance bodies (the Council and Steering Committee). The summit also featured the GPAI Multistakeholder Experts Group Plenary, which brought together over 200 leading AI experts to discuss the activities of GPAI's working groups to date. France will be hosting the 2021 GPAI Summit as the 2021-2022 GPAI Chair. More information on GPAI is available at <https://gpai.ai/>.

IDB (Inter-American Development Bank)

The Inter-American Development Bank (IDB) is engaged in the 'fAIr LAC' initiative to promote the responsible and ethical use of AI and improve the public services e.g., education, health, and social protection, in Latin American and Caribbean (LAC) countries. Working with the public and private sectors, civil society, and academia, IDB implements experiments and pilot projects of AI systems in LAC countries. The initiative includes the creation of a regional observatory to map and track AI projects and AI use cases.³⁶ As part of the work that fAIr LAC is doing with the HUBs, they recently begun collaborating with the Government of Costa Rica in designing its roadmap for national AI strategy and its ethical framework and creating a space for knowledge exchange between different countries seeking to advance in its own strategies.

ITU (International Telecommunication Union)

Beginning in 2017, the ITU operated "AI for Good", an annual Summit along with an action-oriented, global and inclusive platform on AI (in partnership with the XPRIZE Foundation, other UN agencies, the Swiss Government and ACM). The goal of this platform is to identify practical applications of AI and scale those solutions for global impact, to accelerate progress towards the UN Sustainable Development Goals. The 2019 Summit gave rise to 'AI Commons', a framework for collaboration for AI development and application. ITU published reports summarising the work undertaken by other UN agencies to address AI related challenges. In May 2021, ITU published a report to help policy makers overcome the barriers and embrace the huge development opportunities offered by AI and big data technologies (ITU, 2021^[70]).

OECD

OECD member countries adopted a set of AI principles in May 2019, the first set of intergovernmental principles and recommendations to governments for trustworthy AI. Early 2020, the OECD launched OECD.AI, a platform to share and shape AI policies that provides data and multidisciplinary analysis on artificial intelligence. Also in early 2020, the OECD's Committee on Digital Economy Policy tasked the OECD.AI Network of Experts (ONE AI) with proposing practical guidance for implementing the OECD AI principles for trustworthy AI through the activities of three working groups. The OECD.AI expert group on the classification of AI systems is developing a user-friendly framework to classify and help policy makers navigate AI systems and understand the different policy considerations associated with different types of AI systems. The OECD.AI expert group on implementing trustworthy AI is identifying practical guidance and shared procedural approaches to help AI actors and decision-makers implement effective, efficient and fair policies for trustworthy AI. The OECD.AI expert group on national AI policies developed this report to identify practical guidance and good practices for implementing the five recommendations to policy makers contained in the OECD AI Principles.

UNESCO

UNESCO has organised events to exchange knowledge about AI, focusing on the dimensions of ethics, policy and capacity building. In March 2020, UNESCO appointed 24 leading experts to an Ad Hoc Expert Group (AHEG) on the ethics of AI. UNESCO's November 2019 General Conference tasked the AHEG with elaborating a recommendation on the ethics of artificial intelligence, which will be considered for adoption in November 2021.

United Nations (UN)

The United Nations' Secretary-General presented his "Roadmap for Digital Cooperation" in June 2020 to address issues related to AI and other digital technologies as well as encourage global cooperation. The Roadmap builds on the recommendations made by the High-level Panel on Digital Cooperation in June 2019. Among the roundtable groups of experts created to discuss the implementation of the Roadmap, 'Roundtable 3C' is working to identify and share knowledge and best practices in key areas of AI development, governance, and use. In April 2021, the UN published the "Resource Guide on AI Strategies" to lay out existing resources on AI ethics, policies and strategies on national, regional and international level.

World Bank

The "Harnessing AI for Development" initiative at the World Bank aims to understand the role of governments in fostering AI development and adoption in developing countries. The work highlights how governments are designing policy and regulatory frameworks around AI to support their unique development needs and make progress towards tackling each of the UN Sustainable Development Goals (SDGs).

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Annexes

Annex A provides a detailed version of the AI work across the OECD

Annex B provides the list of members of the OECD.AI Network of Experts working group on national AI policies

Annex A. AI work across the OECD

A selection of AI work strands taking place across the OECD

Policy recommendations of OECD AI Principles	A selection of OECD bodies working on AI in specific policy areas
i) investing in AI R&D	<ul style="list-style-type: none"> • Survey on AI in business by the Committee for Science and Technological Policy (STI/CSTP) • Work on measuring public research in AI by the CSTP Working Party of National Experts on Science and Technology Indicators (STI/CSTP/NESTI)
ii) fostering a digital ecosystem for AI – data, infrastructure, technologies, knowledge	<ul style="list-style-type: none"> • Digital infrastructure: Working party on Communication Infrastructures and Services Policy (STI/CDEP/CISP) of the Committee on Digital Economy Policy (STI/CDEP) and Global Science Forum (STI/CSTP/GSF) • Data governance and Privacy: Working Party on Data Governance and Privacy in the Digital Economy (STI/CDEP/WPDGP) • Data governance for growth and well-being: Horizontal project (Going Digital phase 3, STI/CDEP with Statistics and Data Directorate (SDD) and Trade and Agriculture Directorate (TAD)) • Work on public data by the Public Governance Committee (GOV/PGC) and work on other specific types of data (e.g., scientific, space, health, IoT, financial data etc.)
iii) shaping an enabling policy environment for AI, including regulation and experimentation ⁵	<ul style="list-style-type: none"> • Work on enabling SMEs to leverage AI by the Committee on Industry, Innovation and Entrepreneurship (CIIE) and its Working Party on SMEs and Entrepreneurship (CFE/WPSMEE) • Policy experimentation work by the Public Governance Directorate (GOV) and the Committee on Digital Economy Policy (STI/CDEP) • Work on AI policy implications: The Competition Committee (DAF/COMP); trade policy by the Trade Committee (TAD/TC); tax policy by the Committee on Fiscal Affairs (CFA) • Sectors prioritised by national AI policies include: <ul style="list-style-type: none"> ○ Work on AI in the public sector by the Public Governance Committee (GOV/PGC) and the Observatory of Public Sector Innovation (GOV/OPSI) ○ Work on AI in health by the Health Committee (ELS/HC) ○ Work on AI for the environment by the Environment Policy Committee (ENV/EPOC) and for the energy by International Energy Agency (IEA) ○ Work on AI for smart cities by the Working Party on Urban Policy (CFE/RDPC/WPURB) ○ Work on AI for transportation by the International Transport Forum (ITF)

iv) building human capacity and preparing for labour market transformation (Education and skills)	<ul style="list-style-type: none">• AI education policy implications by the OECD's Programme for International Student Assessment (EDU/PISA and EDU)• Skills/Jobs: Employment, Labour and Social Affairs Directorate (ELS) and the Productivity, Innovation and Entrepreneurship Division at Science, Technology and Innovation Directorate (STI/PIE)
v) international co-operation for trustworthy AI	<ul style="list-style-type: none">• Digital Economy Policy Committee (CDEP)• Work conducted by the Development Assistance Committee (DAC)

Annex B. OECD.AI Network of experts working group on national AI policies membership

Name	Title	Organisation	Delegation / Group
András Hlács (Co-Chair)	Counsellor	Permanent Delegation of Hungary to OECD	Hungary
Michael Sellitto (Co-Chair)	Deputy Director	Stanford Institute for Human-Centered Artificial Intelligence (Stanford)	Civil Society and Academia
Nathanaël Ackerman	Lead, AI & Innovation Expert	AI4Belgium	Belgium
Elissa Strome	Executive Director of the Pan-Canadian Artificial Intelligence Strategy	Canadian Institute for Advanced Research (CIFAR)	Canada
Samuel Marleau Ouellet	Director, External and Trade Policy Branch	Innovation, Science and Economic Development Canada	Canada
Ali Tejpar	Senior Analyst, Artificial Intelligence Hub, External and Trade Policy Branch	Innovation, Science and Economic Development Canada	Canada
Spencer Smitheman	Acting Manager, International, Artificial Intelligence Hub	Innovation, Science and Economic Development Canada	Canada
Allison O'Beirne	Manager, International, Artificial Intelligence Hub	Innovation, Science and Economic Development Canada	Canada
Carlos Avila	Future Team	Ministry of Science, Technology, Knowledge and Innovation	Chile
José Antonio Guridi	Chief of the future and Social Adoption of Technology Unit	Ministry of Economy, Development, and Tourism	Chile
Armando Guio-Espanol	CAF Consultant	Presidency of the Republic of Colombia	Colombia
Alžběta Krausová	Researcher	Department of Private Law and head of the Center of Innovations and Cyberlaw Research at the Institute of State and Law of the Czech Academy of Sciences	Czech Republic
Marek Havrda	AI Policy and Social Impact Director	GoodAI	Czech Republic
Satu Vasamo-Koskinen	Senior Specialist, Innovations and Enterprise Financing	Ministry of Economic Affairs and Employment of Finland	Finland
Bertrand Braunschweig	Coordination du Plan National de Recherche en Intelligence Artificielle	Institut national de recherche en sciences et technologies du numérique (INRIA)	France
Renaud Vedel	Coordonnateur de la stratégie nationale en IA	Ministère de l'intérieur	France
Andreas Hartl	Head of the Artificial Intelligence Division	Federal Ministry for Economic Affairs and Energy	Germany
Ferenc Kasa	Datamarket Projectleader	AI Coalition of Hungary	Hungary
László BOA	General Manager	AI Coalition of Hungary	Hungary
Lilja Dögg Jónsdóttir	Specialist	Department of Coordination, Prime Minister's Office	Iceland
Ray Walshe	Standards Leader in AI, BigData, Cloud	Dublin City University (DCU)	Ireland
Terry Landers	Chief Standards Officer for	Microsoft	Ireland

	Europe, Middle East and Africa		
Aviv Zeevi Balasiano	VP of the Technology Infrastructure Division	Israel Innovation Authority	Israel
Luigia Spadaro	Head of the Secretariat of the Undersecretary Mirella Liuzzi	Ministry of the Economic Development	Italy
Yoichi Iida	Chair of the CDEP and Going Digital II Steering Group	Ministry of Internal Affairs and Communications	Japan
Osamu Sudoh	Graduate School of Interdisciplinary Information Studies(GSII)	University of Tokyo	Japan
Yuki Hirano	Deputy Director, Multilateral Economic Affairs Office, Global Strategy Bureau	Ministry of Internal Affairs and Communications	Japan
Takahiro Matsunaga	Assistant Director, Multilateral Economic Affairs Office, Global Strategy Bureau	Ministry of Internal Affairs and Communications	Japan
Deuk Jung Kim	Vice President at the Artificial Intelligence Department	National IT Industry Promotion Agency (NIPA)	Korea
Janis Ratkevics	Senior Consultant at Information Society Development Department	Ministry of Environmental Protection and Regional Development	Latvia
Katrina Kosa-Ammari	Counsellor at Foreign Economic Relations Promotion Division	Ministry of Foreign Affairs	Latvia
Vjačeslavs Dombrovskis	Member of the Parliament	Parliament of Latvia	Latvia
Kate MacDonald	Fellow of the WEF's C4IR in San Francisco	New Zealand's Department of Internal Affairs	New Zealand
Colin Gavaghan	Director	New Zealand Law Foundation-sponsored Centre for Law and Policy in Emerging Technologies	New Zealand
Christine Hafskjold	Specialist director	Norway's Department of ICT policy and public sector reform	Norway
Robert Kroplewski	Plenipotentiary for the Information Society in Poland, lawyer and convergence strategy policy advisor	Minister of Digital Affairs for the Information Society in Poland	Poland
Nuno Rodrigues*	Member of the Board of Directors	Science and Technology Foundation Portugal	Portugal
Andrey Neznamov	Executive Director	Sberbank	Russia
Dmitry Belyaev	Head of the Innovation Infrastructure Division	Ministry of Economic Development	Russia
Yeong Zee Kin	Assistant Chief Executive	Infocomm Media Development Authority of Singapore	Singapore
Gregor Strojín	State Secretary	Ministry of Justice	Slovenia
Marko Grobelnik	AI Researcher & Digital Champion	AI Lab of Slovenia's Jozef Stefan Institute	Slovenia
Irene Ek	Senior Digitalisation Policy Analyst	Swedish Agency for Growth Policy Analysis	Sweden
Ashley Casovan	CEO	AI Global	Technical
Sumaya Al Hajeri	Head of Policies and Data at the UAE AI Office	UAE AI Office	United Arab Emirates
Edward Teather	Senior Policy Adviser	Office for Artificial Intelligence	United Kingdom
Lord Tim Clement-Jones	Lord	U.K. House of Lords	United Kingdom
Erwin Gianchandani	Deputy Assistant Director, Computer and Information Science and Engineering	National Science Foundation	United States
Lynne Parker	Deputy United States Chief Technology Officer	The White House	United States
Nicholas Reese	Policy expert	Department of Homeland Security	United States
Raj Madhavan	Policy Fellow and Program	Department of State	United States

	Analyst		
Giuditta de Prato	Researcher	European Commission DG Joint Research Centre (JRC)	European Commission
Yannick Meneceur	Programme Specialist, Digital Innovation and Transformation	Council of Europe	IGO
Cristina Pombo	Principal Advisor and Head of the Digital and Data Cluster, Social Sector	Inter-American Development Bank	IGO
Cedric Wachholz	Head of UNESCO's ICT in Education, Science and Culture section	UNESCO	IGO
Prateek Sibal	AI Policy Researcher, Knowledge Societies Division, Communication and Information Sector	UNESCO	IGO
Sasha Rubel	Programme Specialist, Communication and Information Sector	UNESCO	IGO
Aki Ilari Enkenberg	Senior Digital Development Specialist	World Bank	IGO
Zaki B Khoury	Senior Technology & Strategy Advisor	World Bank	IGO
Nicole Primmer	Senior Policy Director	BIAC	Business
Jennifer Bernal	Lead on Global Policy	Deepmind	Business
Martina Le Gall Maláková	Managing Director	ELECTRIK	Business
Marc-Etienne Ouimette	Head, public policy & government relations	Element AI	Business
Daniel Faggella	Head of Research, CEO	Emerj AI Research	Business
Norberto Andrade	Privacy and Public Policy Manager	Facebook	Business
Lynette Webb	Senior Manager for AI Policy Strategy	Google	Business
Benoit Bergeret	CEO	Indust AI	Business
Caroline Louveaux	Chief Privacy Officer	Mastercard	Business
Alice Munyua	Director, Africa Innovation and public policy program	Mozilla Africa	Business
Marina Geymonat	Leader, AI Center of Excellence	Telecom Italia	Business
Emmanuel Bloch	Director of Strategic Information	Thales	Business
Jacquelynn Ruff	Expert on International Law and Policy	Wiley Rein LLP	Business
Clara Neppel	Senior Director	IEEE European Business Operations	Technical
Jacques Ludik	Founder & President	Machine Intelligence Institute of Africa (MIIA)	Technical
Ashley Casovan	CEO	AI Global	Civil society and Academia
Marjorie Buchser	Head of Innovation Partnerships and Digital Society Initiative	Chatham House	Civil society and Academia
Suso Baleato	Secretary	CSISAC	Civil Society and Academia
Aishik Ghosh	PhD in Artificial Intelligence for Particle Physics in Atlas	European Organisation for Nuclear Research (CERN)	Civil Society and Academia
Ryan Budish	Executive Director, Berkman Klein Center for Internet & Society	Harvard University	Civil Society and Academia
Nathalie Smuha	Researcher - Law and Ethics of AI	KU Leuven Faculty of Law & Leuven.AI Institute	Civil Society and Academia
Cyrus Hodes	Chair of the AI Initiative	The Future Society	Civil Society and Academia
Nicolas Mialhe	Founder and President	The Future Society	Civil Society and Academia

Marc-Antoine Dilhac*	Professor of Philosophy	Université de Montréal	Civil Society and Academia
Anna Byhovskaya	Senior Policy Advisor	Trade Union Advisory Committee (TUAC) to the OECD	Trade Union
Valerio de Stefano	BOF-ZAP Research Professor of Labour Law	University of Leuven	Trade Union
Etienne Corriveau-Hébert	Head of partnerships division	Ministère des Relations internationales et de la Francophonie	Other
Karine Perset	Secretariat	OECD	
Laura Galindo	Secretariat	OECD	
Luis Aranda	Secretariat	OECD	
Nobuhisa Nishigata	Secretariat	OECD	

Notes

¹ Available online: <https://oecd.ai/dashboards/policy-initiatives/2019-data-policyInitiatives-24994>, "Malta's National AI Strategy."

² [Presentation](#) by Yeong Zee Kin, 29 June 2020 (Expert group 2nd Meeting).

³ Available online: <https://oecd.ai/dashboards/policy-initiatives/2019-data-policyInitiatives-26202>, "Priorities Areas and Upcoming Technology Roadmap in AI"; and <https://oecd.ai/dashboards/policy-initiatives/2019-data-policyInitiatives-26190>, "Focus Group on AI - Assembly of Turkish Scientists Abroad".

⁴ See above "AI expert advisory groups" section.

⁵ Available online: <https://oecd.ai/dashboards/policy-initiatives/2019-data-policyInitiatives-24273>, "Brazilian Strategy for Digital Transformation".

⁶ Available online: <https://oecd.ai/dashboards/policy-initiatives/2019-data-policyInitiatives-24257>, "Estonia's National Artificial Intelligence Strategy".

⁷ Available online: <https://oecd.ai/dashboards/policy-initiatives/2019-data-policyInitiatives-24951>, "India's National Strategy on Artificial Intelligence".

⁸ Available online: <https://oecd.ai/dashboards/policy-initiatives/2019-data-policyInitiatives-5295>, "AI R&D Framework and Activities of the Israeli Innovation Authority".

⁹ Available online: <https://oecd.ai/dashboards/policy-initiatives/2019-data-policyInitiatives-26466>, "Strategy for the Development of Artificial Intelligence in the Republic of Serbia for the Period 2020-2025".

¹⁰ Available online: <https://www.inria.fr/en/news/news-from-inria/four-3ia-projects-selected>

¹¹ In his presentation, Mr. Yeong introduced Singapore's priority national AI projects: i) intelligent freight planning; ii) municipal services; iii) chronic disease prediction and management; iv) personalised education through adaptive learning and assessment; and v) border clearance operations. See Presentation by Yeong Zee Kin, 29 June 2020 (Expert group 2nd Meeting).

¹² Presentation by Ashley Casovan, 29 June 2020 (Expert group 2nd Meeting).

¹³ Available online: <https://oecd.ai/dashboards/policy-initiatives/2019-data-policyInitiatives-16665>, "National Plan for the Advancement of Language Technologies".

¹⁴ Available online: <https://oecd.ai/dashboards/policy-initiatives/2019-data-policyInitiatives-26748>, "Digital Platform sprogteknologi.dk".

¹⁵ Available online: https://www.soumu.go.jp/main_sosiki/joho_tsusin/eng/pressrelease/2020/3/31_1.html

¹⁶ Available online: <https://insights.techreview.com/ai-and-inequality/>

¹⁷ See [DSTI/CDEP/GD\(2019\)7/FINAL](#), "The role of sandboxes in promoting flexibility and innovation in the digital age".

¹⁸ OECD's Better Life Index <http://www.oecdbetterlifeindex.org/>

¹⁹ Presentation by Edward Teather, 10 July 2020 (Expert group 3rd Meeting)

²⁰ The United Kingdom, Norway, and Switzerland in Europe, Canada and United States in America, and Australia.

²¹ Available online: <https://www.cifar.ca/cifarnews/2019/04/08/annual-report-of-the-cifar-pan-canadian-ai-strategy>

- ²² Available online: <https://www.gov.uk/government/publications/cdei-ai-barometer>
- ²³ Available online: <https://www.gov.uk/government/publications/artificial-intelligence-sector-deal/ai-sector-deal-one-year-on>
- ²⁴ Available online: <https://www.whitehouse.gov/wp-content/uploads/2020/02/American-AI-Initiative-One-Year-Annual-Report.pdf>
- ²⁵ Available online: https://ec.europa.eu/knowledge4policy/ai-watch/about_en
- ²⁶ Available online: <https://ec.europa.eu/jrc/en/publication/ai-watch-national-strategies-artificial-intelligence-european-perspective-2019>
- ²⁷ Presentation by Emilia Gómez, 24 August 2020 (Expert group 4th Meeting) and report by Samoilii et al. 020 <https://ec.europa.eu/jrc/en/publication/tes-analysis-ai-worldwide-ecosystem-2009-2018>
- ²⁸ Available online: https://web.jrc.ec.europa.eu/dashboard/AI_WATCH_LANDSCAPE/index.html
- ²⁹ Available online: <https://oecd.ai/dashboards/policy-initiatives/2019-data-policyInitiatives-26717>
- ³⁰ Available online: https://www.regeringen.se/49a602/globalassets/regeringen/dokument/naringsdepartementet/20180514_nmr_deklaration-slutlig-webb.pdf
- ³¹ Available online: <https://www.mti.gov.sg/-/media/MTI/Microsites/DEAs/Digital-Economy-Partnership-Agreement/Text-of-the-DEPA.pdf>
- ³² Available online: <https://www.mti.gov.sg/-/media/MTI/Microsites/DEAs/Singapore-Australia-Digital-Economy-Agreement/MOUs/MOU-on-Cooperation-on-Artificial-Intelligence.pdf>
- ³³ Available online: <https://ec.europa.eu/digital-single-market/en/high-level-expert-group-artificial-intelligence>
- ³⁴ The approach in the “self-assessment list” of AI systems published by the EC according to the seven key requirements is also based on risk assessment depending on the degree of criticality in using AI systems and the solutions they offer, the dependence on their correctness and possible harmful consequences. The latest version from July 2020 of the Assessment List for *Trustworthy Artificial Intelligence (ALTAI)*, developed by the High-Level Expert Group on AI, also offers an online self-assessment platform to raise awareness and knowledge of implementing organisations and companies (especially small and medium-sized businesses) on the risks and methods of prevention.
- ³⁵ Available online: <https://futurium.ec.europa.eu/en/european-ai-alliance>
- ³⁶ Available online: <https://fairlac.iadb.org/es/observatorio>