



# JRC TECHNICAL REPORT

## AI Watch

### National strategies on Artificial Intelligence A European perspective in 2019



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## Foreword

This report is published in the context of AI Watch, the European Commission knowledge service to monitor the development, uptake and impact of Artificial Intelligence (AI) for Europe, launched in December 2018.

AI has become an area of strategic importance with potential to be a key driver of economic development. AI also has a wide range of potential social implications. As part of its Digital Single Market Strategy, the European Commission put forward in April 2018 a European strategy on AI in its Communication "Artificial Intelligence for Europe" COM(2018)237. The aims of the European AI strategy announced in the communication are:

- To boost the EU's technological and industrial capacity and AI uptake across the economy, both by the private and public sectors;
- To prepare for socio-economic changes brought about by AI;
- To ensure an appropriate ethical and legal framework.

Subsequently, in December 2018, the European Commission and the Member States published a "Coordinated Plan on Artificial Intelligence", COM(2018)795, on the development of AI in the EU. The Coordinated Plan mentions the role of AI Watch to monitor its implementation.

AI Watch monitors European Union's industrial, technological and research capacity in AI; AI-related policy initiatives in the Member States; uptake and technical developments of AI; and AI impact. AI Watch has a European focus within the global landscape. In the context of AI Watch, the Commission works in coordination with Member States. AI Watch results and analyses are published on the [AI Watch Portal](#).

From AI Watch in-depth analyses, we will be able to understand better European Union's areas of strength and areas where investment is needed. AI Watch will provide an independent assessment of the impacts and benefits of AI on growth, jobs, education, and society.

AI Watch is developed by the Joint Research Centre (JRC) of the European Commission in collaboration with the Directorate-General for Communications Networks, Content and Technology (DG CONNECT).

The European Commission notably collaborates with the OECD on collecting and analysing National strategies on Artificial Intelligence in the EU Member States. Both the OECD and the European Commission have exchanged contents for publication on their respective platforms, being the [OECD AI Policy Observatory](#) and [AI Watch](#).

The objective of this report is to present and gather information on all EU Member States' national AI strategies in a structured and comprehensive way. It aims to help Member States to compare their strategy and to identify areas for strengthening synergies and collaboration.

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## Executive summary

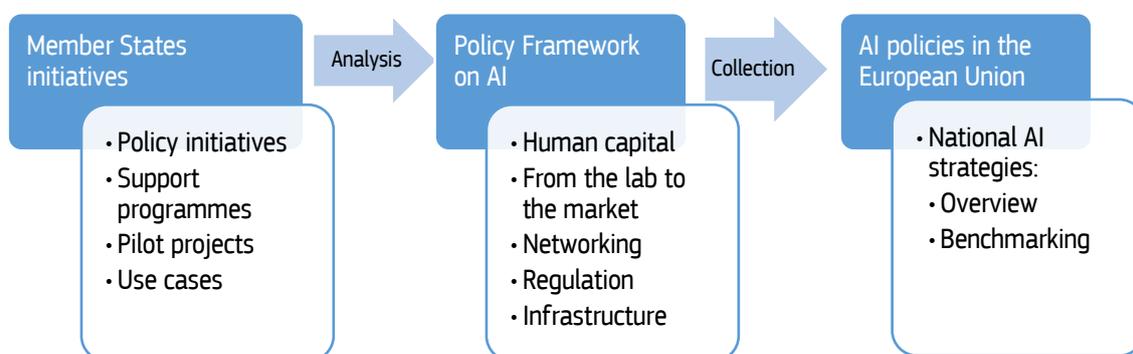
Similarly to electricity or the internet, artificial intelligence (AI) is a general-purpose technology for which it is difficult to imagine an industry or economic sector that will not be affected by it. The possibilities that AI is offering are immense and the revolutionizing process of AI is still ahead of us. AI will not only create a wide range of new opportunities but it will also require to overcome many challenges. In this respect, it is important to focus on strengthening the necessary conditions for a smooth uptake and adoption of AI across society and to develop a solid and vibrant AI ecosystem. This calls for policy actions and joint coordination across European countries and the European Commission in addressing these challenges and making the most of the opportunities offered by AI.

In December 2018, the European Commission presented a [Coordinated Plan on Artificial Intelligence](#). The Coordinated Plan aims at ensuring complementarity and synergies between national and EU level actions to maximise the impact and spread the benefits of AI across Europe. It also provides a strategic framework for national AI strategies. One of the key priorities of the Coordinated Plan is to encourage Member States to develop their national AI strategies by the end of 2019 outlining investments levels and implementation measures.

On 19 February 2020, the European Commission published a [White Paper](#) aiming to foster a European ecosystem of excellence and trust in AI. The white paper proposes measures that will streamline research, foster collaboration between Member States and increase investment into AI development and deployment. In addition, it presents policy options for a future EU regulatory framework that would determine the types of legal requirements that would apply to relevant actors, with a particular focus on high-risk applications.

The objective of this report is to present and **gather information on all EU Member States' national AI strategies** in a structured and comprehensive way. It aims to help Member States to compare their strategy and to identify areas for strengthening synergies and collaboration. Published national AI strategies are analysed to identify the most relevant policy areas and to develop a common **AI Policy Framework** that can be used for the presentation of policy initiatives. Figure 1 presents the methodology to collect national AI strategies and initiatives from EU Member States.

**Figure 1.** Methodology to collect EU Member States National AI Strategies and initiatives



Source: JRC – European Commission

The policy initiatives identified in the AI national strategies relate to the following **policy areas**: human capital, from the lab to the market, networking, infrastructure and regulation. Initiatives categorised as **human capital** target all policies to foster the educational development of people in using and developing artificial intelligence solutions. It includes aspects of formal education and training (e.g. reforms of educational systems towards inclusion of AI courses and programs), vocational and continuing learning (e.g. training of existing workforce to obtain AI-related skills and competences), and labour market intelligence and needs (e.g. identifying forthcoming skill needs due to changes in technology developments). **From the lab to the market** encompasses policy initiatives to encourage research and innovation in AI towards business growth in the private sector and increased efficiency of public services. This section also includes policy instruments to facilitate testing and experimenting newly developed AI pilots and services. **Networking** presents all policy initiatives related to AI collaborations across private and/or public sectors and directed to

increasing the (inter)national attractiveness of the country (e.g. policies aiming at attracting foreign AI talented individuals and firms to the focal country). This category also includes policies related to the dissemination and uptake of AI such as promotion campaigns and mapping of AI players and applications. **Regulation** highlights policies for the development of ethical guidelines, legislative reforms and (international) standardisation. Finally, **infrastructure** covers initiatives to encourage data collection and responsible usage of it, and to foster the digital and telecommunication infrastructure.

While several EU Member States are well-advanced and have already signalled their commitment to AI by publishing their national AI strategies, others are still in the process of developing one. Table 1 provides an overview of the progress of Member States in developing their national AI strategies:

- 16 Member States have published AI strategies;
- 5 Member States have final draft versions at hand;
- 1 Member state has an action plans that serve as initial step to develop a national strategy;
- 6 Member States have started consultations with intergovernmental working groups and are in progress of developing a national strategy.

**Table 1.** Overview of national AI strategies

Country	Status	Date	Country	Status	Date
 Austria	Final draft	June 2019	 Italy	Final draft	July 2019
 Belgium	In progress		 Latvia	Published	Febr. 2020
 Bulgaria	In progress		 Lithuania	Published	April 2019
 Croatia	Final draft	Nov. 2019	 Luxembourg	Published	May 2019
 Cyprus	Published	Jan. 2020	 Malta	Published	Oct. 2019
 Czech Republic	Published	May 2019	 Netherlands	Published	Oct. 2019
 Denmark	Published	March 2019	 Poland	Final draft	Aug. 2019
 Estonia	Published	July 2019	 Portugal	Published	June 2019
 Finland	Published	Oct. 2017	 Romania	In progress	
 France	Published	March 2018	 Slovakia	Published	Oct. 2019
 Germany	Published	Nov. 2018	 Slovenia	In progress	
 Greece	In progress		 Spain	Final draft	Nov. 2019
 Hungary	Action plan	Nov. 2019	 Sweden	Published	May 2019
 Ireland	In progress		 United Kingdom	Published	April 2018

Source: JRC – European Commission

Note: Last update of the table on 25<sup>th</sup> of February 2020. The information in the table is based on input from national contact points or public sources. The United Kingdom is mentioned as an EU Member State, as this report presents the state of affairs in 2019.

This report presents country fiches for all Member States with detailed information about policy measures that have been identified in their national AI strategies. It takes inspiration from prior attempts to overview national AI strategies, such as OECD's initiatives on [Going Digital](#) and the [Observatory of Public Sector Innovations](#), a comprehensive policy review from [FutureGrasp](#) and Tim Dutton's website on [Medium](#). It complements prior attempts and aims to provide an in-depth and fine-grained analysis of the policy initiatives by structuring them along their policy areas. It has been enriched with policy initiatives of an interactive database of AI policies jointly launched by the OECD and the EC in February 2020. The interactive database can be accessed on [OECD's AI Policy Observatory](#).

This exercise will be updated annually and published in forthcoming reports in 2021 and 2022. While this first report aims to assemble a synthetic overview of what is happening in Europe in terms of AI policies, subsequent reports will provide more in-depth analyses based on benchmarking indicators.

## 1 Introduction

Similarly to electricity or the internet, artificial intelligence (AI) is a general-purpose technology for which it is difficult to imagine an industry or economic sector that will not be affected by it. Artificial Intelligence (AI) has already demonstrated its broad spectrum in nearly every industry. In recent years, there are clear signs of an accelerating speed of AI diffusion and development across society. Hence, the importance of AI is only expected to increase in the future.

The possibilities that AI is offering are immense and the revolutionizing process of AI is still ahead of us. AI will not only create a wide range of new opportunities but it will also require to overcome many challenges. In this respect, it is important to focus on strengthening the necessary conditions for a smooth uptake and adoption of AI across society and to develop a solid and vibrant AI ecosystem. This calls for policy actions and joint coordination across European countries and the European Commission in addressing these challenges and making the most of the opportunities offered by AI.

In December 2018, the European Commission (EC) presented a [Coordinated Plan on Artificial Intelligence](#). The Coordinated Plan aims at ensuring complementarity and synergies between national and EU level actions to maximise impact and spread the benefits of AI across Europe. It also provides a strategic framework for national AI strategies. One of the key priorities of the Coordinated Plan is to encourage Member States to develop their national AI strategies by the end of 2019 outlining investments levels and implementation measures.

The objective of this report is to present and gather information on all EU Member States' national AI strategies in a structured and comprehensive way. It aims to help Member States to compare their strategy and to identify areas for strengthening synergies and collaboration. Published national AI strategies are analysed to identify the most relevant policy areas and to develop a common AI Policy Framework that can be used for the presentation of policy initiatives. In this sense, this report follows a similar approach as used in the AI strategies, by presenting policy initiatives from a holistic perspective. To highlight the numerous economic and policy outlook from which the transformative nature of AI can be explored, this report presents policy initiatives across various policy areas, including human capital (i.e. educational development), from the lab to the market (i.e. Research & Development, innovation, business and public sector development), networking (i.e. collaboration and dissemination), regulation (i.e. ethical guidelines, legislation and standardisation) and infrastructure (i.e. data and telecommunication infrastructure).

This report takes inspiration from prior attempts to overview national AI strategies, such as OECD's initiatives on [Going Digital](#) and the [Observatory of Public Sector Innovations](#), a comprehensive policy review from [FutureGrasp](#) and Tim Dutton's website on [Medium](#). It complements prior attempts and aims to provide an in-depth and fine-grained analysis of the policy initiatives by structuring them along various policy areas. It has been enriched with policy initiatives of an interactive database of AI policies jointly launched by the OECD and the EC in February 2020. The interactive database can be accessed on [OECD's AI Policy Observatory](#).

This report will be part of a series of reports that will be published in 2020 and 2021. While this first report aims to assemble a synthetic overview of what is happening in Europe in terms of AI policies, subsequent reports will provide annual updates and will provide more in-depth analyses based on benchmarking indicators. In addition, it will monitor to what extent Member States have incorporated recommended strategic actions and policy measures of the EU Coordination Plan in their national strategies.

The remainder of this report is structured in the following way. Section 2 presents an overview of national AI strategies in the European Union. It highlights the progress made by Member States in developing their strategies, it mentions the publication dates or the expected time frame needed to finalise draft strategies in progress. Section 3 presents the methodology used in this report to gather and structure information on EU Member States' AI policies. It follows a holistic approach, aiming at classifying policy initiatives along various policy areas. Subsequent sections present country fiches for all Member States with detailed information about policy measures that have been identified in their national AI strategies. Finally, the last section provides concluding remarks.<sup>1</sup>

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<sup>1</sup> Disclaimer: The views expressed in this report are purely those of the writer and may not in any circumstance be regarded as stating an official position of the European Commission. This report provides information on the status of national AI strategies until the 25th of February 2020. Updates of this report will be published in the first quarter of 2021 and 2022. For updated information on a regular basis, please refer to the country pages on the [AI Watch portal](#).

## 2 Overview of national AI strategies

The [Coordinated Plan on Artificial Intelligence](#) published by the European Commission in December 2018, encouraged Member States to release their national strategies on AI by mid-2019. While several EU Member States are well-advanced and have already signalled their commitment to AI by publishing their national AI strategies, others are still in the process of developing one. Table 2 provides an overview of the progress of Member States in developing their national AI strategies:

- 16 Member States have published AI strategies;
- 5 Member States have final draft versions at hand;
- 1 Member state has an action plan that serves as an initial step to develop a national strategy;
- 6 Member States have started consultations with intergovernmental working groups and are in progress of developing a national strategy.

From the 28 Member States of the European Union, 16 have published their AI strategy. Finland, France, the United Kingdom and Germany released their AI strategy prior to the communication of the Coordinated Plan. Cyprus, Denmark, Latvia, Lithuania, Portugal, Luxembourg, Czech Republic, Sweden, Estonia, Malta, the Netherlands and Slovakia have published their AI strategies in 2019. Poland has a final draft version ready and has recently launched public consultations in order to obtain the view and engagement of public bodies and relevant stakeholders. Other Member States such as Austria, Croatia, Italy and Spain announced to have final draft versions at hand at the high-level working groups, but that the official publication date is not yet known or postponed for political reasons.

The remaining 6 Member States are still in the process of developing their national AI strategy. The High-level working group of Hungary released an action plan and roadmap with concrete policy recommendations forming initial steps towards the development of a national AI strategy. Belgium, Bulgaria, Ireland, Greece, Romania and Slovenia have set up intergovernmental working groups and have started preparation of national AI strategies. Full strategies for these Member States are expected to be published in 2020.

**Table 2.** Overview of national AI strategies

Country	Status	Date	Country	Status	Date
 Austria	Final draft	June 2019	 Italy	Final draft	July 2019
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### 3 Methodology

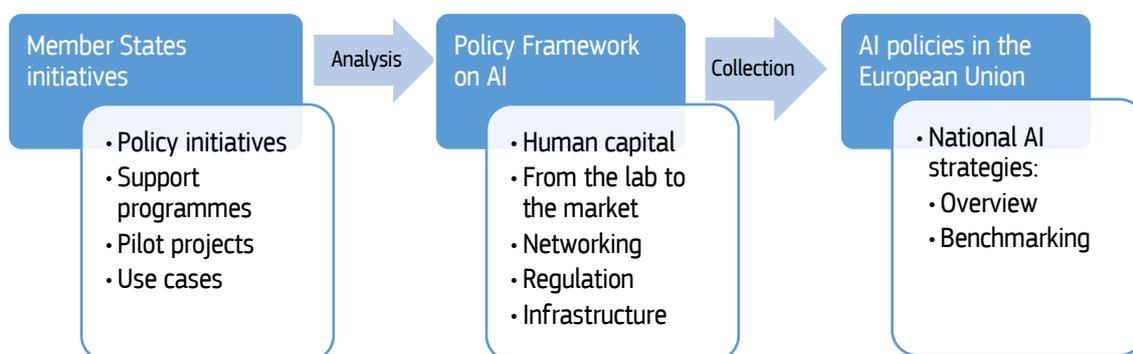
In recent years, there are clear signs of an accelerating speed of AI diffusion and development across society. This calls for action to anticipate and identify policy needs to prepare for the future of AI. Outlining a national AI strategy is far from an easy task, given the numerous perspectives from which the transformative nature of AI can be explored.

In order to provide a synthetic overview of what is happening in Europe in terms of national AI strategies and to show progresses made in the strategies' implementations, the following methodology will be followed to gather information on EU Member States' AI policies:

- Collecting EU Member States strategies and initiatives on AI;
- Developing a common Policy Framework on AI;
- Monitoring the progress of MSs in developing strategic actions and policy measures for the creation of vibrant AI ecosystems.

Figure 2 presents an overview of the various steps to monitor the implementation of EU Member States National AI Strategies and initiatives in the European Union.

**Figure 2.** Methodology to collect EU Member States National AI Strategies and initiatives



Source: JRC – European Commission

The common **Policy Framework on AI** aims at identifying the main building blocks of the policy initiatives presented in national AI strategies of EU Member States. One of the main advantages of this conceptualisation approach is to emphasize the different layers and structural elements of AI and to highlight the numerous policy perspectives from which AI can be explored. It aims to facilitate the allocation of policy initiatives to their respective policy aims in order to conduct cross-comparisons of national AI strategies.

The policy initiatives identified in the AI national strategies relate to the following **policy areas**: human capital, from the lab to the market, networking, infrastructure and regulation. Initiatives categorised as **human capital** target all policies to foster the educational development of people in using and developing artificial intelligence solutions. It includes aspects of formal education and training (e.g. reforms of educational systems towards inclusion of AI courses and programs), vocational and continuing learning (e.g. training of existing workforce to obtain AI-related skills and competences), and labour market intelligence and needs (e.g. identifying forthcoming skill needs due to changes in technology developments). **From the lab to the market** encompasses policy initiatives to encourage research and innovation in AI towards business growth in the private sector and increased efficiency of public services. This section also includes policy instruments to facilitate testing and experimenting newly developed AI pilots and services. **Networking** presents all policy initiatives related to AI collaborations across private and/or public sectors and directed to increasing the (inter)national attractiveness of the country (e.g. policies aiming at attracting foreign AI talented individuals and firms to the focal country). This category also includes policies related to the dissemination and uptake of AI such as promotion campaigns and mapping of AI players and applications. **Regulation** highlights policies for the development of ethical guidelines, legislative reforms and (international) standardisation. Finally, **infrastructure** covers initiatives to encourage data collection and responsible usage of it, and to foster the digital and telecommunication infrastructure.

Table 3 presents the common Policy Framework on AI. This conceptual framework should serve as guideline to classify existing policy initiatives to their respective objectives, with a clear distinction among policy initiatives relevant to the private or public sector.

**Table 3.** Policy framework on AI

Policy areas		Public and Private sector initiatives on:
Human Capital	Formal Education (& Training)	Enhancement of AI-related skills in primary, secondary and tertiary education: <ul style="list-style-type: none"> <li>- Education reforms in primary and secondary education (incl early childhood education and initial vocational education &amp; training)</li> <li>- Education reforms in tertiary education and above, incl. specialist skills</li> <li>- Initiatives targeting teachers &amp; educators</li> </ul>
	Non Formal & Informal Lifelong Learning	Lifelong learning and continuing education: <ul style="list-style-type: none"> <li>- Initiatives targeting the workforce &amp; job seekers: up-skilling &amp; re-skilling</li> <li>- Initiatives that touch on citizens at large</li> </ul>
	Labour market intelligence / skills demand	Future labour market needs: <ul style="list-style-type: none"> <li>- Skills intelligence / needs assessment</li> <li>- Job versus skills mismatch</li> </ul>
From the lab to the market	R&D	Support and prioritization to research into AI and digital technologies: <ul style="list-style-type: none"> <li>- AI research-funding programs</li> <li>- National AI research centers</li> </ul>
	Innovation	Stimulation of innovative applications and use/adoption of AI: <ul style="list-style-type: none"> <li>- Financial support to launch innovative products and services on the market</li> <li>- Initiatives for innovations towards business growth and increased efficiency of public services</li> </ul>
	Testing	Promotion of experimentation facilities to test out promising AI applications: <ul style="list-style-type: none"> <li>- Innovation sandboxes</li> <li>- Open piloting and testing environments</li> </ul>
Networking	Collaboration	Enhancement of collaboration opportunities: <ul style="list-style-type: none"> <li>- Stepping up public-private partnerships (PPPs)</li> <li>- Network of Interdisciplinary Institutions for AI</li> </ul>
	International attractiveness	Gaining access to international top expertise: <ul style="list-style-type: none"> <li>- Improve (financial) working conditions for foreign talent</li> <li>- Reduce red tape to hire international AI experts</li> </ul>
	Dissemination and uptake	Monitoring the dissemination and uptake of AI: <ul style="list-style-type: none"> <li>- Mapping of AI applications and players</li> <li>- Promotion campaigns to foster the understanding and uptake of AI</li> </ul>
Infrastructure	Data	Enhancement of data access, usage, sharing and protection: <ul style="list-style-type: none"> <li>- Increase availability and quality of data without violating personal rights</li> <li>- Develop fair, equitable and secure data sharing frameworks</li> </ul>
	Digital & Telecom	Improvement of digital infrastructure to leverage opportunities of AI: <ul style="list-style-type: none"> <li>- Deployment of large-scale computing infrastructures</li> <li>- Development of network infrastructure (e.g. 5G standard)</li> </ul>
Regulation	Ethical	Implementation of norms and ethical principles of AI
	Legal	Review of the legal framework for AI-based applications
	Standardisation	Enhance and define interoperable technical standards

Source: JRC – European Commission



## 4 Austria

In August 2017, the Ministry for Transport, Innovation and Technology established a [Council on Robotics and Artificial Intelligence](#). It consists of experts on robotics and artificial intelligence from research centres, academia and industry and it serves as an advisory board to provide recommendations about the current and future challenges and opportunities of AI. The council has been commissioned to help the Ministry to develop a national AI strategy in a two-year period. The national strategy is close to final but its official publication will be postponed after the new government formation.

In the meantime, the Austrian government has been very active in shaping policy initiatives for the future of AI in Austria. In November 2018, the Council published a [white paper](#) with policy recommendations on robotics and AI, covering policy areas related to smart governance, smart innovation and smart regulations. In June 2019, the government of Austria issued [Artificial Intelligence Mission Austria 2030](#) (Austria, 2019) providing the first steps towards an official strategy for AI.

The stakeholder consultation for the Austrian national AI strategy is completed. The Austrian Caretaker Government has approved the results from this process.

The report identifies seven priority areas in which to invest to foster the development of AI in Austria:

- Qualification and training;
- Research and innovation;
- AI in the economy;
- AI in the public sector;
- Society, ethics and labour market;
- AI governance, security and law;
- Infrastructure for industrial leadership positions.

It is the task of the new Austrian Government to finalize and approve the AI strategy, including structure, prioritization and budgets.



## 5 Belgium

In order to position Belgium into the European landscape of AI, the [AI4BELGIUM](#) coalition (Belgium, 2019) launched a policy recommendation report in March 2019. This report has been prepared by a multidisciplinary team of forty experts stemming from various institutional backgrounds, including AI practitioners, academics and governmental representatives. The policy recommendations outlined in this report constitute a first step towards an ambitious and official Belgian AI Strategy. The AI4Belgium coalition now has more than 500 members.

In order to match the yearly investments per capita of France, Germany and Finland, the coalition recommends a minimum investment level of €80 million per year which corresponds to at least €1 billion by 2030.

An external consultant has been commissioned by the Federal Ministry of Economy to draft, by mid-2020, a Belgian AI strategy supported by all Belgian Regions and the Federal State.

### 5.1 Human capital

One of the main recommendations for a future Belgian strategy is the creation of a new learning deal. The new learning deal encompasses a range of policy recommendations on skills building programmes to prepare existing and upcoming generations to the societal transformations that AI technologies bring along. These recommended skills building programmes do not only target the reskilling of adults on the job market, but should also include reforms of the educational system to include AI (related) courses in all levels of the school curriculum.

The future national strategy of Belgium should advocate tailored and sufficient incentives for **lifelong learning and reskilling** at large scale through:

- Improved tools and standards to invite workers to identify skills and skill gaps and find appropriate reskilling programmes;
- Give all labour-market stakeholders the responsibility to invest in lifelong learning;
- Development of massive open online course (MOOCs) on AI to train at least 1% of Belgian citizens;
- Improved opportunities to engage in lifelong learning and make lifelong learning a core mission of all schools.

In addition, the Belgian coalition of experts recommends the **reinforcement of human skills in AI at all education levels** which would not only target students but would also provide the necessary training to teachers in order to use innovative AI-enhanced tutoring techniques. This could include following initiatives:

- Reforms of primary and secondary education towards increasing soft skills (creativity and critical thinking) and integrating coding, use of technology and data courses;
- Introduction of data, technology and AI courses in higher education while stimulating cross-disciplinary learning;
- Training and upskilling teachers to teach AI-related courses.

In order to grow and attract more AI talent, particular attention is devoted to initiatives that enhance the university and post-graduate offering of AI subjects. One of the proposed approaches would be to increase the amount of AI courses in Bachelors and Masters Programmes and to include studies on Data Translator, Business Analyst and High-level Data Engineering with a strong AI methodology. Another initiative relates to the creation of a country-wide AI/Machine-learning doctoral school to grow the stock of AI experts in Belgium.

### 5.2 From the lab to the market

One of the main objectives in every AI Member States' strategy is to enhance the competitiveness of companies through the use of artificial intelligence. This can be reached through the creation of an enterprise-driven ecosystem in which companies are effectively supported to conduct world-class research and are provided with the necessary incentives for setting up AI testing facilities and eventually for bringing promising AI applications successfully on the market. Belgian's support actions for the innovative process of companies - from the lab to the market - should comprise both financial funding and **initiatives to fuel research and innovation power in the private sector** such as reinforced research laboratories and projects. Financial instruments would target SMEs in particular in order to alleviate their constraints to experiment with AI and to allow them scaling up. Hence, policy initiatives should include among others:

- Position Belgium as the European AI Lab by scaling up research laboratories and setting up sandboxes for testing purposes;
- Set up large-scale blue-sky projects to fuel research;
- Set up financial instruments for SMEs to experiment with AI;
- Support SMEs when applying for European investment programmes;
- Support scale-up growth through a large-scale AI public-private matching investment fund.

The Belgian coalition of experts also calls for a substantial **transformation of the public sector ecosystem**. Currently only few public sector organisations are experimenting with and implementing AI applications in Belgium. To reverse this trend, a change in paradigm is needed. The public sector should not only be service provider but should play an active role in AI development. It should become a facilitator and platform towards AI experimentation and exploration. To this purpose, the experts recommend various tools ranging from strategic investments to governance efforts in the public sector:

- Create rolling fund and task force for experimentation with AI in public institutions;
- Redesign public procurement processes to enable trial and error;
- Appointing a Chief Digital Officer to coordinate nationwide efforts;
- Select use cases in public institutions to improve service and build expertise.

### 5.3 Networking

Collaborations between companies, research institutes and society are important engines for a swift deployment of AI. Bringing the community together and combining expertise and efforts from various sources are indispensable tools to seize (the often ambitious) AI opportunities. This calls for policy initiatives to support local collaborations, but also to target large-scale ecosystems and hubs that encompass all AI stakeholders which do not necessarily restrict to the country borders but expand to international communities. According to the Belgian coalition experts, increased collaborations could be reached through effective knowledge and data sharing related to technological, administrative, organisational and training issues, among others. Policy building blocks to **foster networking and collaboration** would be:

- Set up a Belgian Innovation Hub;
- Set up partnerships with industry and public sector to allow AI and PhD students to work on practical applications;
- Create a confederation of Belgian laboratories and join European initiatives (ELLIS, CLAIRE);
- Develop an independent Belgian data-sharing platform.

The Belgian coalition of experts expresses the need for an enhanced national and international visibility, displaying the high-quality AI developments of the country. In addition to increasing its visibility abroad, Belgium should also aim at attracting foreign talented individuals and firms in AI. Hence, talent exchange and selective migration of high potentials to Belgium should be encouraged. Proposed initiatives towards **increasing the (inter)national attractiveness of AI** include:

- Organise large-scale events that showcases Belgian AI successes;
- Set up a public programme that supports AI projects with positive social impact;
- Simplify visa procedures and selective immigration for top foreign talent;
- Actively chase private research initiatives to bring them to Belgium.

### 5.4 Regulation

Public trust is the cornerstone of any AI and data strategy. Hence, the **development of ethical guidelines is key** to support the use and the development of AI. Trustworthy and ethical AI should account for both individual and collective rights and should address notions of accountability, legitimacy, non-discrimination, respect for privacy and transparency, among others. The Belgian coalition of experts recommends the following initiatives to address several of these notions and principles:

- Create a Belgian ethical committee to provide guidance on ethical topics to all AI players;
- Support communication, transparency and shared guidelines between public and private sectors about AI ethics policies;
- Integrate civil society in the design and decision process.

Successful and smooth deployment of AI across the economy and society also requires a **robust and up-to-date legislative framework**. Following initiatives are advocated by the experts to reach a relevant and effective regulatory framework:

- Development of digital and AI literacy among policymakers and regulators to foster the policy dialogue towards regulation;
- Development of a regulatory framework in AI that includes sector-specific legislation, but also covers horizontal legal aspects that transcend sectoral issues.

Besides the development of a legal framework and ethical rules for AI, the policy recommendation report briefly mentions the **importance of standardisation**. In particular private-public partnerships and government to government (G2G) collaborations should be supported towards data sharing and the development of common standards. The focus should however lie on the development of pan-European and international standards rather than on country-specific ones.

## 5.5 Infrastructure

The policy recommendation report does not explicitly mention policy initiatives for the reinforcement of the digital and telecommunication infrastructure.

## 5.6 Regional strategies

The transversal nature of artificial intelligence and its pervasive impact on the Belgian economy and society at large, necessitates an intra-Belgium **multilevel governance approach** given the division of competences in a federal state such as Belgium.

### Flanders

In March 2019, the Flemish government launched the [Flemish action plan](#) to foster artificial intelligence in Flanders. The Flemish AI action plan provides funding complementing funding that is available through the regular, bottom-up instruments of both FWO (funding for HEIs) and VLAIO (funding for enterprises). Thanks to these regular instruments, in 2019 FWO invested more than €15 million and VLAIO more than €41 million in AI related projects. The Flemish AI action plan foresees an additional annual budget of €32 million for its implementation that is centered around 3 pillars:

- Basic Applied Research (12 million euros). Four strategic challenges will be addressed. Applying (and combining) the research results of these four challenges will happen in the context of for use cases or proofs of concept, in particular in health and industry4.0:
  - Help to Make Complex Decisions Through Data Science: Hybrid, Automated, Trusted, and Actionable;
  - Deliver Artificial Intelligence to the Edge: Realtime & Power Efficient AI;
  - Interact Autonomously with Other Decision-Making Entities: Multi-Agent Collaborative AI.
  - Communicate and Collaborate Seamlessly with Humans: Human Like Artificial Intelligence
- Technology Transfer and Industrial Applications (15 million euros):
  - The existing Flemish policy mix of support mechanisms for enterprises will not be extended (e.g., no specific extra evaluation criteria) but additional funding for AI related proposals is earmarked on beforehand (with a clear definition on how important the share of AI is supposed to be) with the clear intention to support a substantial extra number of AI related project.
- Supporting activities (awareness, training, ethics) (5 million euros):
  - A “data and society” research centre has been created to support practitioners in including various ethical issues in the design, creation, implementation and roll-out of AI-driven applications. In addition, many kinds of awareness rising activities will be launched and different types of educational and training material for various target groups and skills levels.

Actual activities under the umbrella of the action plan have started as from July, 1st 2019. Noteworthy items to be mentioned are: a research roadmap with four major challenges (including several proofs of concept), dedicated calls to support AI take-up and development by companies, the set-up of a expertise centre on “data & society” and the creation of various outreach and educational material on AI.

## Brussels Region

An analysis of all regional AI activities and initiatives in the Brussels Region is underway in order to draw up a comprehensive overview of AI actors and support programmes in the regional ecosystem. This overview should be available by mid-2020 and will help identify potential gaps in the current policy setting.

However, the Brussels Region is already very advanced in AI, since it has been building up several initiatives in order to boost AI-related activities in Brussels. In the last two years, the regional innovation funding body [Innoviris](#) has been playing a major role in the support of AI-related research and innovation effort, through a strong development of its support programs with a dedicated budget of EUR 20 million. In particular, one can mention the launch in 2017 of an AI call (“Team Up”) aiming at fostering collaboration between academia and industry. This program is a reflection of the Brussels region approach to AI development, which puts a great emphasis on collaborative research and open innovation. Academics get access to use cases and data while companies receive the expertise they often lack. The scheme has proven to be very successful with nineteen collaborative projects funded amounting to EUR 12 millions of subsidies.

Furthermore, to complement the above industrially focused approach, in 2018, AI was also made a focus on another R&I program called “Anticipate”. The objective there was to fund projects which present a prospective vision of AI and the impact of its development on a social and economic scale in the Region. This type of program is key with regards to AI development since it helps understanding all the ethical, social, and economic implications of AI and in turn will be useful for the design of an inclusive and ethical AI strategy.

Moreover, it is worth noting that besides these two specific calls, Innoviris funds AI/Data related projects for more than 6MEur subsidy per year (equivalent to quarter of its budget dedicated to industrial support) through its open call dedicated to companies.

While the approach so far was meant to be cross-sectorial, Innoviris is now engaged in a more specialized track with for example an ongoing call dedicated to predictive medicine and an upcoming call dedicated to Industry 4.0.

The Brussels Region also offers a large panel of services to support companies in their AI endeavours – both from technical and business point of views.

As for the technical aspects, one can mention the leading role of [Sirris Brussels](#) through its Elucidata laboratory (10 experts) and the [ICiTy.Bru](#) technology hub, both co-funded by the Brussels Region and ERDF. Furthermore, Innoviris has recently expanded its list of accredited centres to several AI labs to provide services via Innovation Vouchers.

When it comes to awareness raising, the Region is also funding, still through Innoviris, various programmes aiming at boosting skills in ICT. One can mention the mobile fablab programme, which visits schools in Brussels to promote new technologies amongst Brussels youth. Besides, Innoviris organises each year a festival on science for a wide audience.

Innoviris also launches open calls for proposal dedicated to STEM awareness, where innovative projects on STEM awareness would get funding in order to stimulate another vision of STEM around youth. Innoviris also took part in the platform Women in Tech and is a partner of de Women Code Week, in cooperation with the Brussels Agency for Enterprise [Hub.Brussels](#).

## The Walloon Region

Supported by the Digital Agency, Agoria, the ICT Cluster Infopole and the AI Network, the [DigitalWallonia4.ai](#) program has the main objective of accelerating the adoption of artificial intelligence (AI) in Wallonia and the development of its Walloon ecosystem. Its official launch was celebrated on November 27, 2019 but the effective start took place on July 1, 2019. Here is a first assessment.

The strategy developed for the DigitalWallonia4.ai project is based on four structuring axes:

- Society and AI;
- Companies and AI;
- Training and AI;
- Partnerships and AI.

*Axis 1: Society and AI*

Numerous awareness-raising actions took place in 2019, aimed at businesses, public authorities and citizens. One of the first was the implementation of the DigitalWallonia4.ai project published on the Digital Wallonia platform which brings together all the resources (e.g. events, profiles, publications) related to the project.

#### *Axis 2: Companies and AI*

Two actions, linked to axis 2 which aims to support and accelerate the digital transformation processes within Walloon companies in order to create "augmented" products and services, were implemented in 2019: Start AI and Tremplin AI.

Start AI whose objective is to support companies in their discovery of artificial intelligence, through a 3-day coaching by one of the members of the AI expert pool of Digital Wallonia.

Tremplin AI, program intended to establish demonstrators (PoCs) on artificial intelligence in the Walloon Region. The objective is to launch at least 2 individual PoCs, and 3 collective PoCs before the second half of 2020.

#### *Axis 3: Training and AI*

Preparation of two public contracts (still in progress) for the implementation of training programs on AI throughout the Walloon territory. These markets will be published in early 2020.

The AI course developed by Agoria is available online for free on the [DigitalWallonia4.ai](https://digitalwallonia4.ai) portal. First level of training for companies and individuals.

#### *Axis 4: Partnerships and AI*

The 4 referent partners of the DigitalWallonia4.ai project were joined by around twenty official partners as part of the regional dynamic, in connection with the national (AI4BELGIUM) and European strategy.



## **6 Bulgaria**

The Bulgarian government is currently in the process of preparing its national AI strategy, while also preparing specific policy reports focusing on education, training, and research.

This section will be updated with more information as soon as the Bulgarian AI strategy is published.



## 7 Croatia

The Croatian government is currently working on its national strategy for AI. A final version of the national AI strategy will be completed by mid-May 2020. It is expected that the full strategy will be published in the near future.



## 8 Cyprus

In January 2020, the Council of Ministers has approved the [National Artificial Intelligence strategy](#) of Cyprus (Cyprus, 2019a).

Cyprus will focus on the following priority areas:

- Cultivating talent, skills and lifelong learning;
- Increasing the competitiveness of businesses through support initiatives towards research and innovation and maximising opportunities for networking and partnerships;
- Improving the quality of public services through the use of digital and AI-related applications;
- Creating national data areas;
- Developing ethical and reliable AI.

### 8.1 Human capital

Concerning improvements to the **education in AI**, the policy report mentions among others the creation and upgrade of higher education programs in AI, the development of reskilling and upskilling opportunities for the labour force and an overall extension of societal knowledge in the use and application of AI technologies.

**Education reforms** will aim to support new technological skills, particularly in STEM subjects and will provide support to teachers to improve their education methods. Besides improving technological skills, the Cyprian government emphasises the importance of integrating soft skills in students' curricula, such as interpersonal, communication and problem solving skills. At higher education levels, Bachelors and Master programs will be created in the field of AI in collaboration with the [Higher Education Quality Assurance and Accreditation Agency](#) of Cyprus.

To ensure that education programs are **adapted to the rapidly changing needs of the labour market**, the Cyprian strategy recommends the creation of tailor-made programs for further training and lifelong learning for the workforce. The introduction of Massive Open Online courses (MOOCs) in AI will be considered as an effective tool to educate citizens in general. More flexible and personalised trainings could target the working population and respond to the new labour market challenges. In this perspective the Cyprus Human Resource Authority ([AnAD](#)) can provide information and incentives to employers for upgrading the workforce skills and competences in digital and AI-related fields.

#### 8.1 From the lab to the market

The Cyprian government devotes particular attention to policy actions fostering research and innovation, including the creation of a **Centre of Excellence for applied research in AI**, and the formation of new financial support and funding schemes. The establishment of a special Task Force for Researchers is also considered to help the AI Expert Group in developing AI policies.

A vibrant start-up ecosystem in AI will be fostered through the development of an **AI accelerator program**, to support the successful launch and survival of new AI business ventures. This program will provide expertise in developing AI solutions, and will help firms accessing expert communities. Besides creating opportunities to team up with other firms and research institutions, and facilitating the access to **flexible and effective financial funding**, this program will also provide dedicated support to testing and open data environments (including regulatory sandboxes). The growth of the AI start-up ecosystem will be encouraged through national funding programs and state incentives, which will be complemented with European funding programs (e.g. Horizon2020).

The Cyprian government also commits to encourage the usage of AI in the public administration by means of automatic decision chains to accelerate administrative processes. Introducing more AI-related applications in the public sector will increase transparency and foster citizens' trust in the state and institutions.

#### 8.1 Networking

Regarding networking, the Cyprian strategy highlights the need to encourage partnerships with leading international organisations to increase the level of research and innovation in AI. This will be achieved by setting up new collaboration models. Among others, **Digital Innovation Hubs (DIH)** will be expanded and meetings will be organised with foreign countries to obtain guidance and good practices about successful AI

applications. These collaborative meetings will also aim to assess how public-private partnerships can be improved in the future.

At national level, Cyprus has already established several DIHs such as the [CYRIC Digital Innovation Hub](#), the [KIOS Innovation Hub](#), the Robotics Control and Decision Systems ([RCDS](#)) Lab at the University of Technology, and the [Entrepreneurship Centre](#) at the Cyprus University. These DIHs are active in various market segments (e.g. agriculture, health, construction, transport, manufacturing and energy) and in a wide range of technological areas, including AI, Big Data, cloud computing and cybersecurity. The AI Expert Group considers the creation of a (virtual) AI DIH with dedicated AI research programs that could serve as a platform where the scientific and business community could access and share knowledge.

To determine in which domains collaborations are most favourable, the AI Expert Group can make use of the recently published [Competitiveness Report](#) of the Council of Economy and Competitiveness (Cyprus, 2019b). This report provides a general overview of the structure and performance of the Cyprian economy, highlighting the comparative advantages, weaknesses and risks to the economy, including recommendations to address these risks and weaknesses.

The Cyprian government will increase the **international visibility of the country** to attract AI experts from abroad. To do so, the Cyprian government considers setting up mobility programs for experts between research centres in Cyprus and abroad. In addition, the AI Expert Group recommends to create an inventory of researchers and experts in the field of AI in order to assess the country's needs and areas in which to attract foreign talents.

## 8.1 Regulation

The Cyprian government will develop a **clear legislative framework** to ensure the availability of data with transparent regulations, in particular on data protection. This legislative framework will take into account EU directives on the [free flow of data](#) and [general data protection](#) and will facilitate the interoperability of data. To this purpose, it is important that the new legislative framework enables digital services to use up-to-date and high-quality information at the right moment, while taking into account the protection of personal data.

With respect to ethics, the government of Cyprus is currently developing guidelines to ensure **ethically sound and reliable developments in AI**, i.e. by defining measures of transparency, responsibility, privacy, equality, diversity and safety among others. The developed guidelines should preserve human rights and social values. To coordinate the development of ethical guidelines, the Cyprian strategy advocates the creation of a **National Committee on Ethical and Reliable AI**. This Committee will continuously and systematically monitor and analyse issues or problems related to the usage or development of AI technologies and provide recommendations for legal and ethical interventions. To successfully conduct this exercise, the Committee will take into account the [Ethics Guidelines for Trustworthy Artificial Intelligence](#) as prepared by the High-Level Expert Group on Artificial Intelligence.

Cyprus is also active in developing **international standards for AI** to foster and facilitate industrial and economic developments in this field. The Cyprus Organisation for Standardisation ([CYS](#)), will establish a National Commission constituting of technical experts from the public and private sectors to monitor and evaluate the work of International and European Committees on AI. It will also be responsible to apply and introduce AI standards in all sectors of the Cyprian economy.

## 8.1 Infrastructure

The Cyprian government commits to create a **data ecosystem** with clear regulations about data interoperability and data exchange agreements. Respecting the anonymization process during data collection is of particular importance in data exchange agreements, as to prevent the leakage of personal data contents. Overall, the national data environment will be reinforced through the further development of the [National Open Data Portal](#), and the creation of a National Research Data Portal. The National Open Data Portal is an API interface that provides access to a large data repository of the public administration. In the same vein, the National Research Data Portal will provide access to data produced by research institutions. In general, both initiatives aim at fostering the availability of open, high-quality and trustworthy data to leverage the benefits of research and development in the field of AI.

In terms of **digital and telecommunication infrastructure**, the Cyprian strategy recommends to improve access to analytical systems such as Platform-as-a-Service (PaaS) and Machine Learning as-a-Service (MLaaS). Investing in High Performance Computing infrastructures such as those offered by [Cathos-Cyl](#) is

also considered. In this respect, Cyprus is participating in the joint pan-European undertaking for developing supercomputers ([EuroHPC](#)).

## **8.1 Update**

The national AI strategy of Cyprus will be reviewed on a regular basis to assess the policy progress and to foster the development and use of AI.



## 9 Czech Republic

The Czech Republic released its [National strategy for Artificial Intelligence](#) in May 2019 (Czech Republic, 2019). The aim of the strategy is to improve the country's economic growth and competitiveness in AI by creating favourable policy conditions to:

- The development of a responsible and trusted AI ecosystem;
- The digital transformation of enterprises, in particular SMEs;
- The economic development of society as a whole, based on equitable opportunities and benefits in AI.

To achieve these objectives, the Czech government presents policy actions across a wide range of key areas, including education, R&D support, financing, industry, social impacts, regulation and international cooperation. The overall coordination of the AI strategy is taken up by the Ministry of Industry and Trade, while the coordination of specific key areas are assigned to their appropriate Ministry.

The strategy is structured in the following way: for each key area, the policy report highlights the responsible Ministry, the policy initiatives that will be developed, the cooperating entities, and the key objectives that are targeted at short-term (until 2021), medium-term (until 2027) and long-term (until 2035). In annex, it provides more information about the entities engaged in AI activities in the country, with figures on the number of employees and researchers, the scientific fields covered and the funding estimations for both the public and private sector.

The funding estimations presented in the annex of the strategy report a total of CZK 9.5 million for research teams in AI in the coming years (including national and international funding programs). Estimations for the private sector are less clear given that figures are based on a survey of 50 companies.

As of August 2019, the Czech national topic in the area of AI is “Artificial Intelligence for citizen's safety and security,” that builds on specific historical experience and track record. To emphasize a common commitment in this regard, a memorandum of cooperation was signed between the Ministry of Industry and Trade and top-level research teams from technical universities. The Czech government wants to pursue the positive narrative of AI technologies as the most suitable tool to ensure the safety of European citizens, which is the very precondition for the true implementation of fundamental rights.

### 9.1 Human capital

With respect to education, the Czech Republic recognises the need to **reform the primary, secondary and higher education** towards new ways of learning AI. Primary and secondary education systems will integrate courses on IT, digital literacy and AI, but equally courses on soft skills such as creative thinking. Higher education reforms include dedicated Masters Programs and doctoral studies in AI. Teacher support will also be provided. To support educational transformation, the Czech Republic can take stock of its ongoing [Strategy for digital education](#) which aims to respond to the continuous development of digital technologies in teaching curricula.

The Czech strategy emphasises the importance to continuously support the current and upcoming labour force by means of **lifelong learning, vocational training and reskilling opportunities**. Given the increasing pace of AI transformations in society, educational reforms should be constantly aligned with changes in the labour market. To this purpose, the Czech government will regularly monitor the impact of technological changes on the labour market. It will commission prediction analyses to estimate the extent in which AI may impact future losses and creations of jobs. Predictions for the **future requirements of the labour market** will be systematically monitored and inserted into the National Register of Professions and the Central Competence Database. The collected information will then be used to develop dedicated support to labour market adaptations and to promote the development of new job opportunities through career guidance, increased worker mobility and reskilling opportunities.

### 9.2 From the lab to the market

A successful deployment of AI can only be achieved with sufficient **support to basic and applied research in the field of AI**. To this purpose, the Czech government will participate in establishing a Centre of Excellence in AI Research, Digital Innovation Hubs and a Centre for Humanities and Social Science to analyse the impact of AI on the economy.

One of the main priorities of the Czech Republic is to **encourage breakthrough innovations in AI** by developing an efficient entrepreneurial ecosystem in the field of AI. Local economic activity and AI innovations will be stimulated through the creation of an Innovation Hub in AI (IHAI), funded by [CzechInvest](#), and through the establishment of start-up support programs and accelerator instruments, among others.

The Czech Government has introduced the new [2019-2030 Innovation Strategy](#) with a clear roadmap to improve the entire innovation system, from strategic management, through education and research to the monitoring of the latest trends and the development of digital and other modern technologies, and skills.

As an implementation tool for the Innovation Strategy, the Ministry of Industry and Trade has prepared "**The Country for the Future**" (CFF) programme to support in its first chapter the emergence of innovative companies, the development of digital services and the deployment of R&D-based innovations with overall allocation of CZK 6.1 billion. The second chapter of the CFF Programme (called The Digital Leaders) anticipates the national co-financing of the Digital Europe Programme. The programme also focuses on the support of establishing and internationalisation of start-ups in its third chapter.

The Czech strategy foresees a wide range of **financial instruments to support the development of AI** in the private and public sector. The Centre of Excellence in AI research will be financed through the [Digital Czech Republic program](#), resources of the City of Prague and private partners. In the long-term, the Czech Republic also considers to set up grant programs for AI that could be funded by the [Grant Agency of the Czech Republic](#) (GA CR) and the [Technology Agency of the Czech Republic](#) (TA CR). In addition, market-based financial instruments of the [Czech-Moravian Guarantee and Development Bank](#) will be created to improve the access to finance for AI businesses. Other AI developments could be funded by European initiatives such as Digital Europe, Horizon Europe, and Connecting Europe Facility, among others. The Czech government will also develop specific support grants and investment programs for SMEs, start-ups and spinoffs with highly innovative services and business models. While most financing tools are targeting the private sector, Czech Ministries consider developing start-up support programs focusing on AI applications in the public sector.

In addition to these financial instruments, alternative and new forms of financing will be advanced. The effectiveness of support programs will be regularly evaluated based on AI mapping in order to update them where needed.

### 9.3 Networking

In terms of networking, the Czech strategy foresees a series of policy recommendations to foster both **national and international partnerships**. This will be done by connecting domestic and foreign entities to implement joint AI projects. Among others, the Czech government suggests to integrate AI as a theme into the V4 priorities in order to increase collaboration in this field across Poland, Czech Republic, Slovakia, and Hungary. Also bilateral collaborations are considered such as the Czech-German strategic dialogue on research, development and innovation, the Czech-French Strategic partnership on digitisation or the Czech-Slovak partnership on dual education and industry 4.0. Finally, the Czech government increase networking opportunities through its active participation in working groups of international organisations (EU, OECD, UN), through the creation of the European Centre of Excellence in AI Research and through the establishment Digital Innovation Hubs.

A program will be set up to increase **collaborations between SMEs, start-ups and scientific research centres**. Among others, the [Knowledge Transfer Partnerships](#) programme aims to support the development of mutually beneficial cooperation between the business community and research organizations. The Czech Republic will also launch calls for tenders specifically targeting AI developments in multidisciplinary teams. In addition, an expert group composed of representatives of academia, public and private sector will be put in place to support and develop collaborative investments programs in AI.

In order to **increase the international attractiveness** of the country, the Czech government foresees various policies to attract and retain foreign talent in AI. Among others, the Czech strategy mentions the revision of the Act on the Residence of Foreigners and long-term residence permits for scientific researchers. The upcoming governmental program will introduce simplified and accelerated procedures to acquire a residence and a working permit for researchers and their family members. Scientific researchers will be allowed to stay in the country up to nine months after the completion of their work contract to allow them to search for a job in the country.

To capture the **dissemination and uptake of AI** in the economy, the Czech Republic is recommending promotion campaigns to foster the national and international interest in the Czech AI ecosystem. To this

purpose, the Ministry of Industry and Trade, in collaboration with CzechInvest, the Confederation of Industry and AICZECHIA, has prepared an [interactive web mapping](#) application displaying subjects from the private sector as well as from the academia and other institutions involved in artificial intelligence activities in the Czech Republic. This tool is not only useful to follow the development progress of AI in the country, but can considerably increase the potential to obtain financial support from investors and can attract foreign talents to the Czech Republic. More in-depth analyses will also be launched to analyse the socio-economic impacts of the technological changes due to AI developments.

## 9.4 Regulation

The development of human-centric AI requires an effective regulatory environment to ensure the protection of fundamental rights and clear-cut definitions of responsibilities, intellectual property rights and liabilities. To provide regulatory guidance for a successful development of AI, the Czech strategy has a dedicated section on legal and social aspects of AI, ethical rules, consumer protection and security issues.

The overall objective is to create and define **ethical and legal rules** to alleviate any regulatory constraint to the development of AI technologies. In first instance, the Czech Republic will identify which sectors are refrained in their research and development efforts in AI due to obsolete or inexistent legislation. During this exercise, particular attention will be devoted to issues of data access, data ownership and (personal) data protection. A sector-specific approach is recommended given the different nature of legislation that will be required in each sector. The Czech Republic will establish an AI Committee to work for instance on new legislation for autonomous cars. Other examples relate to the development of certificates and standardisation in the field of cybersecurity, and specific data regulations for the health care sector. Regulatory sandboxes will be used to create optimal conditions for testing AI concepts.

**Legislation reforms** will not only target the private sector (and in particular legal frameworks towards new business models and start-ups in AI), but it will also be directed to the public sector. In a second phase, public consultations will be used to gather feedback and recommendations from relevant stakeholders. Lastly, the Czech Republic has launched the [AI Observatory and Forum](#) (AIO&F), an expert platform on legal aspects of AI. The aim of the AIO&F is to contribute to creation of a favourable social and legal environment for research, development and use of beneficial and responsible AI. System audits in the public and private sector are also considered to detect and assess the existence of legal barriers that should be addressed.

## 9.5 Infrastructure

Recognising that data is one of the most important prerequisites for AI developments, the Czech government pays special attention to the provision of a **well-functioning data infrastructure**. To this purpose, the Czech strategy will set up an open data portal to facilitate the access to high-quality databases of the public administration. In addition, the Czech Republic also set up a [National Strategy on Open Access to Research Information](#) for the years 2017-2020 to initiate a gradual process of implementation of open access to scientific information at national level.

The provision of high-quality data will be further fostered through the modernisation of the **digital and telecommunication infrastructure**. The Czech government will expand the [IT4Innovations national supercomputing centre](#) and will actively participate in the European [EuroHPC](#) project for supercomputing facilities. As highlighted in the [Digital Czech Republic](#) strategy, one of the priorities of the government in the coming years is also to enhance the connectivity by improving the internet infrastructure and deploying 5G networks in the country.

To this purpose, the Ministry of Industry and Trade of the Czech Republic and the Bavarian State Chancellery have been working to create a common 5G-corridor between Munich and Prague. This 5G-corridor project should become an active part of the European Commission's "[Connecting Europe Facility](#)" program under the multiannual financial framework 2021-2027.

## 9.6 Update

While the national AI strategy of the Czech Republic is coordinated by the Ministry of Industry and Trade, an AI committee has been established to supervise its implementation. The AI committee is a subcommittee of the Steering Committee of the [Digital Czech Republic](#) strategy. The strategy consists of seven chapters, each with a dedicated working group targeting a specific key area on education, R&D support, financing, industry, social impacts, regulation and international cooperation.

Each working group should follow-up to fulfil the objectives of the strategy according to their respective responsibilities. Once a year, an interim report will be submitted to the Steering Committee and the government to inform about the progress of the strategy implementation.



## 10 Denmark

In March 2019, the Danish government has published its [national strategy for artificial intelligence](#) (Denmark, 2019). The Danish strategy sets out the goals and visions for AI development in Denmark, it presents the challenges to be addressed and eventually it identifies specific policy initiatives and priority areas.

It aims at putting Denmark at the forefront of responsible development of artificial intelligence and sets out four objective to achieve this goal:

- Develop a common ethical and human-centred basis for AI;
- Prioritise and support research in AI;
- Encourage the growth of Danish businesses by developing and using AI;
- Ensure that the public sector uses AI to offer world-class services for the benefits of citizens and society.

The strategy contained 24 initiatives for which €9.2 million has been reserved by the Danish government for the period 2019-2027. The budget has since been reprioritised and lowered to €5 million. The government plans to evaluate the strategy in order to determine future actions regarding artificial intelligence.

In addition, the Finance Act 2019 earmarked €39.5 million for research in new digital technologies. Furthermore, €26.8 million is being earmarked for a new Investment Fund (2019-2022) helping the dissemination of digital welfare solutions and new technologies. Technological possibilities, such as artificial intelligence, also play a role in the research funding established via the Finance Act 2020.

The outlined policy initiatives below also include those presented in the [Strategy for Denmark's Digital Growth](#) (Denmark, 2018): a policy report setting the direction on how Denmark can seize the opportunities of the digital transformation. This report contains 38 initiatives. A part of them relates directly to artificial intelligence or provides initial policy steps that will affect the development of artificial intelligence technologies.

### 10.1 Human capital

While access to technology and data is primordial for the development of AI, it only adds value in interaction with people. Hence, fully exploiting the benefits of artificial intelligence requires governments to invest in people as to have the right digital competences and skills. In terms of **formal education and training**, the Danish Government has launched these programs:

- Technology Pact: the [pact](#) signed by 80 participating institutions aims to attract 250 participating members and to increase the number of students choosing STEM subjects ((science, technology, engineering and mathematics) by 20%, or 10,000 students by 2028;
- A four-year test program has been launched (2019-2021) to strengthen technology understanding in primary and lower secondary education. Various teaching models will be evaluated and efforts will be devoted to developing the skills of teachers.

Furthermore, a national action plan to strengthen digital competences and digital learning on higher education institutions was launched in April 2019, including funding to support continuous upskilling courses for teachers (€6 million in 2019).

The Danish government is not only targeting an increased uptake of education in digital and AI-related skills, but is also promoting a **culture of lifelong learning and continuous up/reskilling of the existing workforce**. The government thus has set up a vocational adult education and training working group to advise new forms of vocational education programs to target the upcoming needs of the labour market. The Government will set up a centre for the application of IT in vocational education teaching, and will support vocational courses, among others in AI.

### 10.2 From the lab to the market

As mentioned above regarding the Finance Acts 2019 and 2020, Denmark is investing in a range of programs to **boost research and development** in digital and artificial intelligence research and pilot projects. Policy initiatives include among others:

- The creation of the National Centre for Research in Digital Technologies: the aim of the [centre](#) is to develop and support the digital field through research in AI, Big Data, Internet-of-Things (IoT) and IT Security;
- AI research funds: The [Innovation Fund Denmark](#) and the [Independent Research Fund Denmark](#) financially support research into new technological possibilities such as artificial intelligence.

In order to increase **innovation in AI** and foster the creation and growth of AI businesses, the Danish strategy highlights the following policy initiatives and investment instruments:

- Investment for AI businesses: The Danish Growth Fund will launch a pilot project in the form of an investment pool of €3.1 million over four years targeting companies with a business model based on artificial intelligence. It will take the form of co-investments with private investors;
- [Sprint:Digital](#) – a coordinated scheme to support the digital transformation of Danish SMEs, which can benefit their ability to innovate in AI. The aim of this policy is to promote the digital transformation of SMEs by using agile design sprints to develop and test new digital solutions and business models.

The Danish AI strategy foresees the following **four priority areas**:

- Healthcare;
- Energy and utilities;
- Agriculture;
- Transport.

Besides policies directed to the private sector, the Danish government aims also to support more effective deployment and use of new technologies, including **artificial intelligence, across the public sector**:

- National Centre for Public Sector Innovation (COI): this [centre](#) supports more effective deployment and use of new technologies, such as AI, in the public sector;
- The Danish government has launched [15 signature projects](#) within health, social affairs, employment, and cross-sector case processing, to foster the use of artificial intelligence;
- The [Digital Strategy 2016-2020](#) sets the course for Danish public sector digitisation efforts and their interaction with businesses and industry. It prepares the public sector to upcoming technological challenges and opportunities of AI and big data (Denmark, 2016).

In order to develop artificial intelligence tools into effective and efficient products and services, both public and private sector players should have the **possibility of testing AI solutions**. To this purpose, the Danish government foresees several policy initiatives:

- Digital welfare solutions: the Danish government allocates investment fund to test and deploy new technologies and digital welfare solutions in municipalities and regions;
- [Performance contracts](#) with seven Danish [GTS](#) institutes: the government is setting up performance contracts with seven GTS institutes allowing them to test new technologies, including for instance AI.

### 10.3 Networking

A major challenge for the Danish government is to create a collaborative environment for the development of digital technologies. In this respect, the Danish AI strategy pays particular attention to **improve opportunities for partnerships between public and private sectors**, in particular for new technologies such as the Internet of Things, artificial intelligence and data analysis:

- National Centre for Public Sector Innovation: one of the objectives of this [centre](#) is to help strengthen public-private collaboration, so that the public sector incorporates private sector competences, resources and experience.

### 10.4 Regulation

The use of AI technologies is expected to raise new ethical and legal issues, calling for the development of a responsible ethical and legal framework for the use of artificial intelligence.

The Danish strategy foresees to develop an ethical framework based on six principles in order to improve the level of trust and confidence in AI. The six principles for AI relate to self-determination (i.e. ensuring that citizens can make informed and independent decisions) and to human dignity, equality and justice (i.e.

ensuring that there is no infringement of human rights and maintaining respect for diversity). It also covers aspects of responsibility and explainability (i.e. openness and transparency). The sixth principle stipulates that AI development should be ethically responsible. To ensure that **ethical issues** are taken up, the Danish government advocates:

- In May 2019 an independent [Data Ethics Council](#) was launched with the purpose of making recommendations on ethical issues, in particular on responsible and sustainable use of data by the public and private sector;
- In December 2019 a [Data Ethics Toolbox](#) was launched to support companies to adopt and implement data ethics into their business models;
- A [joint cybersecurity and data ethics seal](#) is a labelling scheme has been agreed upon and is expected to be launched in the first half of 2020 by an independent multi-stakeholder consortium involving consumer groups, research institutes and the industry;
- The Danish government is going to present a law on disclosure of Data Ethics Policy for the largest Danish companies in spring 2020. This means that companies will have to explain their company data ethics policy and comply with the aforementioned law – in a similar way as they are already doing for their corporate social responsibility policies.

In terms of **legislation**, the Danish strategy highlights the need to evaluate the current legal framework and to adopt new legislation to guarantee a responsible development of artificial intelligence applications. New legislation relates among others to data ethics and security regulations and include initiatives as:

- Setting up an inter-ministerial working group to analyse to what extent the existing legislative framework is sufficiently covering the current needs of AI regulations, and to determine if new legislation should be launched;
- Legislative amendment to the Danish Financial Statements Act with the obligation for businesses to report about their data-ethics policy;
- Cyber security directive: This directive, properly known as the Directive on security of network and information systems (NIS) requires Member States to adopt a national cyber-security strategy. The [Danish cyber-security strategy](#) has been published in May 2018.

The Danish strategy recognises the importance of **international standards** in AI. In this regard, the Danish government will initiate work to develop national technical specifications based on the specific needs of Danish businesses. In particular, the [Strategy for Denmark's Digital Growth](#) foresees to:

- Support the development of international standards for small and collaborative robots (cobots).

## 10.5 Infrastructure

Data is an essential prerequisite for the use of artificial intelligence. Hence, the Danish government recognises the importance of facilitating access to data and making it available for citizens, businesses, public authorities and researchers. Concretely, the Danish government foresees to develop the following **policy initiatives related to data infrastructure** in the near future:

- Common Danish language resource: the need to develop a structured collection of digital datasets that will be made free available to everyone. The aim is to foster language technology solutions by providing access to a high-quality shared language resources;
- Access to public sector data: the need to prepare a strategy for data in the public sector which will encourage the use and dissemination of public-sector data. A concrete example:
  - Danish Health data: The Copenhagen Healthtech Cluster – a partnership of public and private actors – develops the [Data Saves Lives](#) initiative that aims to provide better use and access to Danish health data;
- Development of digital export certificates: the government supports the development of digital certificates for exported goods (in particular in food sector) aiming at improving traceability and transparency of the export process. The use of Big Data from the system will be used for smarter and more focused guidance for exporters;
- Fostering the [Open Science Policy](#): the Danish Government's policy of Open Science is focused on three important elements, including open access to scientific publications, research integrity and open research data.

In addition, the policy framework for artificial intelligence is further strengthened with initiatives for a good **digital and telecom infrastructure**, including a modernised telecommunications agreement and a 5G action plan:

- Cloud technologies: the need to establish a strategy for fostering data storage in the cloud in order to cheap access to massive computational power and storage capacity.
- A new national strategy for digital research infrastructure was launched in 2019 comprising recommendations for a strengthened national cooperation with respect to digital research infrastructure.

## 10.6 Update

The outlined strategy constitutes a first step towards the development of AI in Denmark. As new challenges will arise in the future, it will be necessary to adjust existing initiatives and to define new policy actions. To this purpose, the Danish government will monitor developments and will evaluate the strategy on an annual basis.



## 11 Estonia

In July 2019, an expert group led by Ministry of Economic Affairs and Communications and the Government Office presented [Estonia's national AI strategy](#) (Estonia, 2019a); the report of Estonia's AI Taskforce on which the strategy builds is available [here](#) (Estonia, 2019b). Estonia's strategy provides a comprehensive overview of both existing and proposed policy measures, along with their objectives, deadlines and budget estimations. The objective of the strategy is to fully harness the potential of artificial intelligence by developing and implementing policy measures in the following areas:

- Encouraging the use and development of AI applications in both the public and private sector;
- Providing direct support to research in AI and increasing the relevant skills and competences to do so;
- Developing a legal environment to facilitate the uptake of AI.

As per funding, the Estonian government estimates an investment of at least €10 million euros in 2019-2021 for the implementation of its AI strategy.

### 11.1 Human capital

Estonia's strategy foresees several **reforms to the formal education and training** systems in order to increase skills and competences in AI. Reforms at the level of preschool, primary and secondary education will be primarily covered through an upgrade of the [ProgeTiger program](#), which offers technology and AI-related curriculums to schools. Reforms to the higher education will include the uptake of Master programs in the field of data science and AI (a procurement process was concluded in June 2019 and in autumn 2020 the first students will be admitted to the [course](#) at the University of Tartu), the promotion of elective courses on AI in postgraduate disciplines (including also non-ICT disciplines), and the increase of [PhD scholarships](#) in AI-related fields. The [Innovation Centre](#) of the Information Technology Foundation for Education ([HITSA](#)) also offers digital learning resources for **vocational training and lifelong learning**. Additional further education trainings are in preparation and include among others online courses for citizens to raise the public awareness of AI, training courses in AI for managers in the public sector, and a training program targeting employees of companies developing AI solutions. In addition, an Estonian language version of [Elements of AI](#) has been launched by TalTech in November 2019. The importance of providing a digital focus on lifelong learning was already anticipated in the [Estonian Lifelong Learning Strategy 2020](#) published in 2014.

#### 11.1 From the lab to the market

To foster AI developments, the Estonian foresees to **increase the capacity of AI research**. This is achieved by developing [AI-related research](#) support measures and by increasing the capacity and awareness of funding opportunities. The uptake and development of AI in the private sector will be supported through existing funding measures such as [innovation vouchers](#), [development vouchers](#) and [product development grants](#). Other existing policies, such as the Technology Competence Centre ([TCC](#)) and in particular the Competence Centre Specialised in Machine Learning and Data Science ([STACC](#)) are providing support measures for companies to develop innovative AI products and services. In addition, the Estonian government is preparing an innovation competition to promote AI developments based on governmental datasets. Another funding scheme provides financial support to pilot projects at various levels of their technology readiness. These instruments will be complemented with **new funding measures** to foster the [digitalisation of companies](#) (including AI) across selected economic sectors. Flexible and sufficient funding opportunities for AI uptake in the public sector has been earmarked through Structural Funds, joint procurements and new upcoming funding measures. Lastly, sandboxes are currently developed to foster testing and developing AI applications in the public sector.

#### 11.1 Networking

To **improve networking and collaboration** opportunities, the Estonian government is developing a policy tool to monitor available technology developments on the market and to liaise companies with R&D institutions. Another networking policy that is considered is the establishment of **Digital Innovation Hubs** in AI. These hubs will be used to systematically raise awareness on AI in Estonia. Dissemination and uptake of AI is also targeted in the public sector through among others the identification of use-cases, the organisation of meetings, conferences and a website to share experiences and good practices.

One of the actions of the AI strategy to foster public and private sector cooperation is ordering and making available AI core components, which can then be further trained by the subsequent institutions on the basis of their data and needs. The first such core component was made available through a public sector code repository in autumn 2019. A company called Texta concluded a memorandum of understanding with the Ministry of Economic Affairs and Communications to offer a [free open-source text and data analysis software](#) to all state authorities.

### 11.1 Regulation

With respect to **regulation**, the Estonian strategy foresees amendments to the legislation to facilitate the development and uptake of AI. A draft for submission to the parliament is expected to be ready in 2020. In addition, the Estonian government released voluntary [procurement guidelines](#) that aim to give an overview of the most common issues as well as possible solutions that could be considered in a data science project. Finally, the Estonian government is currently working on a self-assessment questionnaire for developers of AI that is based on the Assessment List accompanying the [Ethics Guidelines for Trustworthy AI](#).

### 11.1 Infrastructure

The Estonian strategy devotes salient attention to **data infrastructure policies**. It includes data governance tools, instruments to increase the availability and responsible use of data, the creation of a Chief Data Officer in various – and potentially all – ministries, the compilation of data catalogues/sharing platforms, and the provision of funding for data audits. Recommendations for an Open Science Policy in 2016 will be further developed into cost-effective solutions for implementing Open Science principles on a national level. In addition, Estonia joined the [EuroHPC](#) project to enjoy the benefits of supercomputing.

### 11.2 Update

A working group will be set up to monitor the implementation of this action plan, to initiate additional policy initiatives if necessary and to start the preparation of Estonia's long-term AI strategy for 2022.



## 12 Finland

In October 2017, the Finnish Ministry of Economic Affairs and Employment published a national AI strategy entitled [Finland's Age of Artificial Intelligence](#) (Finland, 2017). This report fits under the umbrella of a broader [Artificial Intelligence Programme](#) in Finland (also labelled as AI Finland) with a view to establishing artificial intelligence and robotics as the cornerstones of success for Finnish companies.

The strategy highlights Finland's possibilities in the global market along with its strengths and weaknesses in AI. It describes how artificial intelligence will transform society and provides a range of policy actions and recommendations for Finland to thrive in the age of artificial intelligence.

The goal is to position Finland as a leading country in artificial intelligence. Finland will adopt an open data policy and will create adequate conditions for a prosperous development of AI. Overall, it will strive to:

- Increase the competitiveness of business and industry;
- Provide high-quality public services and improve the efficiency of the public sector;
- Ensure a well-functioning society and wellbeing for its citizens.

Within the scope of the Artificial Intelligence programme of Finland, two other reports have been published on [Work in the Age of Artificial Intelligence](#) (Finland, 2018) and on [Leading the way into the Age of Artificial Intelligence](#) (Finland, 2019). The Finnish Ministry of Economic Affairs and Employment published the second and third report in September 2018 and June 2019. The list of policy recommendations outlined below aims to incorporate the reflections presented in these three reports.

On pages 80-82 of the third report, the Finnish government provides investment figures for several flagship policies. For instance, the AI Business Programme has been allocated €100 million over a four-year period. The Finnish Centre for Artificial Intelligence (FCAI) was granted € 8.3 million in flagship funding for 2019–2022.

### 12.1 Human capital

The presence of a well-established, harmonised and effective education system is one of Finland's main strengths. As a result, Finland has a highly educated and tech-friendly population. However, current available skills directed to the utilisation and development of artificial intelligence and robotics are mainly present in technological and mathematical fields, which are often too broadly defined to support society in these times of change. Hence, the Finnish Ministry proposes an active reform of education systems towards the provision of high-quality courses in AI. The reform should not only include AI-oriented courses but should also incorporate communication and social skills, problem solving and creativity.

A Competence and innovations committee has been established under the Artificial Intelligence Programme to support education reforms. In particular, the Finnish strategy provides the following policy recommendations towards **education and training in AI**:

- Guaranteeing artificial intelligence literacy across the Finnish population (including elderly) to ensure that all citizens have a basic understanding of AI applications. This can be achieved through MOOCs to ensure elementary knowledge on AI:
- MOOC on elements of AI ([English](#) – [Finnish](#));
- Online introduction course to [Python](#).
- Introducing Masters and Bachelors programmes at university providing courses in artificial intelligence. Examples:
  - [Master's program](#) in machine learning, data science and AI at Aalto university;
  - [Master's programs](#) on data science or digital humanities at University of Helsinki.
- Incentives and training mechanisms for teachers to use artificial intelligence in their courses and teaching methods.

Particular attention is devoted to the working-age population with policy recommendations targeting **vocational training and lifelong learning opportunities**:

- MOOCs: Massive open online courses in AI and programming as a possible tool for further education of people in the labour market;
- Lifelong learning opportunities to train working-age population with the provision of personalised and motivating learning methods.

- To promote lifelong learning, a skills account or voucher will be created for all working-age people, which they can use to update their skills and purchase the training they need.

As mentioned in the second AI report, about one million Finns are estimated to need reskilling/upskilling training to adapt to changes in occupational structures. In order to **close the gap of available skills and the needs of the labour market**, the Finnish strategy advocates modular education programmes to address incompatibilities between current skills and new skills requirements:

- Opportunities for expanding qualification contents will be integrated in education programmes to facilitate adaptations to workforce's skills needs.

## 12.2 From the lab to the market

Bringing AI developments from the lab to the market can only be successful in a developed and well-supported enterprise-driven ecosystem with sufficient scope and funding for R&D and innovation activities, including incentives for experimentation and trial and error. Funding and support programmes should target the development of initial ideas to pave the path towards promising emerging fields in AI. In addition, it is critical to provide support to transform AI concepts into successful products and services, with policy instruments all along the innovation process from the lab to the market.

In this perspective, [Business Finland](#), Finland's main funding agency for innovation, plays an important role in providing finance and support to AI companies. Initiatives from this agency are complemented with technical support on research and innovation from [VTT](#), the Technical Research Centre of Finland.

In particular, the Finnish government is implementing the following policy initiatives to **encourage research and innovation in AI**:

- The creation of an [AI maturity tool](#) helping organisations to increase their business opportunities in identifying their most important areas for improvement in AI;
- The formation of a [Finnish Centre for Artificial Intelligence](#) (FCAI) to promote both AI research, and the use and application of AI in companies and elsewhere in society;
- The launch of an [Artificial Intelligence Accelerator](#) to facilitate companies in bringing AI experiments into production;
- The use of innovation vouchers to support companies to innovate and grow;
- The launch of an [AI Business Programme](#) that offers innovation funding, networking and internationalization services for R&D, among others;
- The [Hyteairo](#) Programme (Well-being and Health Sector's Artificial Intelligence and Robotics Programme) to support utilisation of artificial intelligence and robotics in the well-being sector;
- Support to the development of significant test environments and testbeds.

## 12.3 Networking

Fully exploiting the potential of artificial intelligence requires seamless collaborations and networking between various players. Finnish businesses have traditionally low thresholds in engaging in collaborations. In this respect, the AI Business Programme supports 15 enterprise-driven ecosystems<sup>2</sup> organised in platforms to encourage the share of competences at different levels (e.g. innovative solutions, data, but also legislation, ethical guidelines or standards).

Besides this initiative, the Finnish government highlights various support instruments and reforms to **foster collaborations in AI**:

- Business Finland – Growth Engines: creating new AI business opportunities and growth areas in Finland through an enterprise-driven partnership model of companies, research organizations and public actors;
- Business Finland – Connected Intelligent Industries supporting AI and digital collaboration and joint-efforts of SMEs, large companies, R&D institutions and research organizations at every stage of innovation;

<sup>2</sup> Open customer-centred ecosystem, CleverHealth Network, Communication network operations, Connected Intelligence, Corridor as a service, Digital design and manufacturing excellence, Digital Fiber, Intelligent Industry Ecosystem, Intelligent Packaging, OneSea - Autonomous Maritime Ecosystem, OuluHealth ecosystem, Research alliance for Autonomous systems, Smart building ecosystem, Smart Otaniemi, Reboot IoT Factory.

- Support for the creation of Digital Innovation Hubs in Finland to foster the digital and AI transformation of industries, particularly SMEs based on multi-actor networks and ecosystems;
- AIPSE programme: a [programme](#) to promote novel applications of artificial intelligence in physical sciences and engineering research with special focus on international collaborations;
- [DIMECC](#): a co-creation network to encourage breakthrough innovations and collaborations with companies, universities and research institutions. It is a large network of R&D&I professionals from a wide range of organisations providing support to speed up innovations and to supply courses in machine learning for industrial employees);
- [AuroraAI](#) is a national artificial intelligence programme to prepare Finland for a human-centric and ethical society in the age of artificial intelligence. It provides a decentralised open network and data-based model for smart services and applications. AuroraAI is speeding up the establishment of an ecosystem serving the needs of citizens, public administration and industry.

A main priority in many AI strategies – besides ensuring top-level expertise in AI by means of an outstanding and high-quality education system – is attracting promising AI talents from abroad. To **improve the international attractiveness of Finland** for foreign AI talents and start-ups, the Finnish government launched the following initiatives:

- [Talent Boost](#) – International talents boosting growth action plan: a sectoral programme to make Finland more attractive to international talents. To attract start-ups from outside the EU in particular, this programme includes a [Finnish Startup Permit](#).

In terms of **monitoring and dissemination of the use and understanding of** AI to a larger population, the Finnish government provides following initiatives:

- The development of a Finnish AI landscape presenting a regularly updated list of top AI companies in Finland;
- The Business Finland's AI Business programme promoted the establishment of local AI Hubs in Tampere and Turku and disseminated AI and platform economy knowledge in smaller localities;
- A blog and forum on the [Artificial Intelligence programme](#) website of Finland used to share understanding and information about the business impacts of the application of artificial intelligence with concrete examples.

## 12.4 Regulation

In December 2018, the Finnish Government has proposed a new information policy to promote the good management and the effective utilisation of information. The policy report on [Ethical information policy in an age of artificial intelligence](#) outlines principles for fair data governance, including guidelines for the use of information and ethical values.

Information policies discussed in the report relate to data access rights, data ownership, copyrights, security and personal data protection. The development and deployment of AI raises uncertainty about the application of the current legislation on these issues and increases the need for a reform of the legislative and regulatory framework.

Policy recommendations or initiatives towards a **reform of the legislative or regulatory framework** in Finland include among others:

- Reform of the [national cybersecurity strategy](#) by the Finnish Security Committee in view of developing comprehensive state security and expanding towards the fields of AI and digitalisation;
- [Act on Public Administration Information Management](#): defined the entire lifecycle of information in public administration. This reform intends to ensure consistent management of the authorities' data sets and secure data processing. It will take effect on 1 January 2020;
- A review of the [Public Procurement Act](#) is needed in such a manner that it would enable effective public-private co-development. In addition, public sector operators should be secured sufficient resources and incentives to engage in such development, paying particular attention to sort out the rights of the outcomes of co-development;
- A new national intellectual property (IP) strategy is currently in preparation to improve the present IP situation in Finland.

In terms of ethics and values, the Finnish Government advocates the development of ethical foundations ensuring a sustainable use of AI that rests on fundamental and human rights. The creation of ethical

principles are a first step towards a trust-based use of AI. It should be based among others on principles of transparency, reliability, and accountability, in which ownership and responsibilities are clearly defined.

The Finnish government has established an AI ethics committee to gain understanding on ethical principles and to ensure that Finland's AI development is human-oriented and based on trust. Policies directed to the development of **ethical guidelines** include:

- Setting up an AI ethics challenge on the [Artificial Intelligence programme](#) website to incentivise companies to contribute to the creation of ethical principles for AI;
- Preparing the foundations for ethical guidelines in the public administration's ecosystem-based AuroraAI programme.

## 12.5 Infrastructure

Data is the fuel that powers artificial intelligence. Hence, excellent data quality and effective use of data in all sectors is critical for the success of artificial intelligence. This requires in first instance a robust data infrastructure ensuring the needs of information security, data protection, the gathering and combining of information, information disclosure and storage.

While several data infrastructure initiatives are deployed at large scale, others are proposed in a restricted environment and serve as regulatory sandboxes. In the public sector, regulatory sandboxes can for instance serve to 1) pilot opportunities for second use of personal data by the public sector with consent of citizens, 2) evaluate the usefulness for citizens and 3) prepare an appropriate legislative framework for successful deployment.

In terms of **data infrastructure with a regulatory sandbox philosophy**, the Finnish government proposes following policy initiatives among others:

- Providing support to the [MyData](#) service<sup>3</sup>: a human-centred, open and compatible data management approach fostering data interoperability, sharing and protection of individual's rights on personal data. Two examples of initiatives complying with the MyData philosophy are:
  - [Koski service](#): a comprehensive data repository of study credits, degrees and qualifications of citizens. This national education warehouse can also be used to promote vocational training and lifelong learning;
  - HUCS diabetes sandbox: a sandbox organised at the Helsinki University Central Hospital (HUCS) to simplify diabetes treatment with the help of AI services on patients' data and consent. The implementation is based on the [IHAN concept](#), which provides an operating model to ensure fair exchange and exploitation of data with citizens' consent.

A committee on Data and platform economy has been established to propose policy to facilitate the construction and use of data resources in all sectors. These initiatives are complemented and in line with an [Open Science policy](#) to coordinate and foster a research community in which open science aims can be reached and monitored.

To foster the **digital infrastructure** for research purposes, the Ministry of Education and Culture has developed a research infrastructure [development program for data management and computing](#) with research and innovation actors in 2017–2021. The development program foresaw an investment of EUR 37 million in data management and computing infrastructures and related services.

## 12.6 Update

In 2017, the Finnish Government has launched the [Artificial Intelligence Programme](#) to draw up an AI strategy for Finland. The programme has been finalised in spring 2019 and delivered among others three policy reports with concrete policy actions as outlined above. In the final report, the steering group of the Artificial Intelligence Programme has produced an implementation plan for the coming years and presents a vision of Finland in the age of artificial intelligence in 2025.

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<sup>3</sup> The following white paper published by the Finnish Ministry of Transport and Communications provides more details about the aim and working of the MyData service: <https://www.lvm.fi/documents/20181/859937/MyData-nordic-model/2e9b4eb0-68d7-463b-9460-821493449a63?version=1.0>.



## 13 France

In March 2018, The President of the French Republic presented his vision and strategy to make France a leader in artificial intelligence (AI). The French AI strategy is entitled [AI for humanity](#) (France, 2018a) and has been developed on the basis of the [AI policy report](#) (France, 2018b) prepared by French deputy Cédric Villani.

The main objectives of the French AI strategy as highlighted by the French President are to:

- Improve the AI education and training ecosystem to develop and attract the best AI talent;
- Establish an open data policy for the implementation of AI applications and pooling assets together;
- Develop an ethical framework for a transparent and fair use of AI applications.

To this purpose, the French government will dedicate €1.5 billion to the development of artificial intelligence by the end of 2022, including €700 million for research.

### 13.1 Human capital

To ensure a smooth transition towards an AI-oriented economy, a thorough transformation of learning paths is needed, involving both reforms to the initial education of upcoming generations and opportunities of vocational training and lifelong learning for the current and upcoming workforce.

The AI for Humanity strategy highlights two important prerequisites for the successful development of human capital in AI. A first prerequisite relates to the inclusion of effective and compulsory digital and AI-related disciplines at all levels of the education and training curricula. This requires both reforms to the course content and to the teaching methods used. A second prerequisite is that the proposed education pathways should be free of any social inequality. This could be achieved by setting up incentive policies to ensure more diversity and to achieve more equality in participation rates, with a special attention to counteract any form of gender stereotyping (e.g. by incentivising participation of women into digital and AI courses).

In terms of **formal education and training policies**, the French strategy foresees to:

- Launch AI training and education programmes at all levels of education, with a particular focus on higher education programmes at the [Interdisciplinary Institutes of Artificial Intelligence \(3IA\)](#). The aim is to double the number of students in AI;
- Foster education of all players involved in the "algorithmic chain" (designers, professionals, citizens) and enable each citizen to improve its digital literacy to better understand the inner working of machines and the benefits of AI.

In terms of **vocational training and lifelong learning** initiatives, the French government highlights:

- The formation of the Grande Ecole du Numerique (GEN): the [GEN](#) has been created to support training that help to integrate people at risk of unemployment to the job market by developing their digital skills;
- The need for governmental funding support for vocational training of employees.

The deployment of AI technologies will have a major impact on the job market. According to France's Employment Orientation Council roughly half of the occupations could be automated. To tackle this issue, the French AI strategy devotes particular attention to a **better understanding of future labour demand and skill needs** to prepare successfully for professional transitions. The following policy recommendation is targeting increased labour market intelligence and forward-looking skills predictions:

- The creation of a public laboratory on the transformation of work to encourage reflection on the ways in which automation is changing occupations and to provide support for professional transitions. In this respect the Global Partnership for AI (initiative lead by France and Canada) may come up with the setting of a Labour Lab. This will be discussed in the near future by the experts enrolled.

### 13.2 From the lab to the market

The ambitious goals set by the AI for Humanity strategy are extensively relying on research and innovation. The responsibility for coordinating the research side of the AI for Humanity strategy has been given to the French national research institute for the digital sciences ([Inria](#)), with a clear objective: to strengthen the entire French AI sector. Among others, the research institute will coordinate the strategy's implementation,

provide scientific and technological expertise and develop bilateral cooperation initiatives, in particular with Germany.

One of the main AI flagships that Inria is currently leading and coordinating is the establishment of 3IA Institutes, a network of AI research institutes within universities to **foster nation-wide AI research**:

- The creation of interdisciplinary AI institutes (3IA) in selected public higher education and research establishments. Four different institutes – Paris, Toulouse, Grenoble and Nice – were chosen to become [interdisciplinary institutes on Artificial Intelligence \(3IA\)](#). Each of these research centres took part in formulating a 3IA Institute project to foster AI research between regional academic and industry ecosystems. The four selected 3IA projects to spearhead research on AI in France are:
  - The “[MIAI@Grenoble-Alpes](#)” project sets up a Multidisciplinary Institute in Artificial Intelligence (MIAI) at Grenoble with two main research themes: Future AI Systems and AI for Human Beings and the Environment. It will pay particular attention to the fields of personalised healthcare, medical devices, the environment and energy;
  - The “[3IA Côte d'Azur](#)” project led by the Université Côte d'Azur in Nice brings together over a hundred researchers around training, research and transfer projects, particularly in the fields of healthcare and regional development.
  - The “[PRAIRIE](#)” project launches an institute with several academic and industry partners. The PaRis Artificial Intelligence Research InstitutE (PRAIRIE) aims to drive progress in fundamental knowledge in AI. The objective of the institute is to be a catalyst for exchanges between the academic and industrial world, and to play a role in leading and coordinating the community. It will focus in particular in the fields of healthcare, transport and the environment.
  - The “[ANITI](#)” project sets up an Artificial and natural intelligence Toulouse Institute (ANITI) led by the University of Toulouse. The strategic application sectors targeted by the institute are mobility and transportation, and robotics/cobotics for the industry of the future. It will bring together 200 researchers from universities, research organisations and companies.
  - The launch of AI research and teaching chairs: a [multi-year programme](#) of 40 Chairs in Artificial Intelligence presented by the Minister of Higher Education, Research and Innovation and the Secretary of State for Digital Technology to provide necessary resources and support to host institutions for ambitious research projects in AI. The chairs need to be organised outside the 3IA Institutes mentioned above.

The AI for Humanity strategy proposes to target policy support for research and innovation to **specific sectors** that show sufficient maturity to embrace major AI transformations: **health, transport, the environment, defence and security**. Hence, this will require sector-specific policy, including sector-specific data platforms for data compilation and exchange, large-scale computing infrastructures and testing facilities. While many of these aspects touch upon infrastructure (cf. below), the French government advocates **creating test areas to facilitate the design and deployment of AI technologies**:

- Implement test areas and innovation sandboxes to facilitate experimentation in real-life conditions while temporarily reducing the regulatory burdens to help testing innovations.

### 13.3 Networking

The advantages of **networks and collaborations in AI** are manifold. It allows for multidisciplinary research and avoids thematic redundancy across institutions. Above all, it allows for an efficient sharing of knowledge associated to AI across the various stakeholders and increases their motivation to participate to cutting-edge AI research. Following initiatives are envisaged:

- [Inria](#) will coordinate the network of French AI expertise by means of the development of the 3IA Institutes and other research-oriented collaborative support mechanisms;
- Trilateral French-Japanese-German Research Projects on Artificial Intelligence: The French National Research Agency ([ANR](#)) together with the German Research Foundation ([DFG](#)), and the Japan Science and Technology Agency ([JST](#)) is announcing the first trilateral call for research proposals on AI. This [call](#) is intended to support collaborative projects of trilateral research teams over 3 years, bringing together research partners from France, Germany, and Japan;
- Fostering of public-private laboratories, so called LabComs to encourage collaborative AI research and innovations.

To **foster the international attractiveness of AI** in France, the French strategy expresses the need for policies to boost France's appeal to expatriates and foreign talent by improving working conditions and salaries of researchers.

### 13.4 Regulation

Ethical matters to ensure a fair and transparent use of AI technologies and algorithms are central to the French AI strategy. In this regard, Cédric Villani recommends in his policy report the creation of a “*digital technology and AI ethics committee in charge of leading public discussion in a transparent way, and organized and governed by law*” (p. 16). To this purpose, a Digital Committee has been created with the National Consultative Committee for Ethics. The **ethical principles** take shape through the following policy recommendations, among others:

- To guarantee ethical awareness from the design stage, ethics could be incorporated into the training of engineers and researchers studying AI;
- Strengthening ethics within businesses (e.g. setting up ethics committees, dissemination of sector-specific good practices, revising pre-existing codes of professional conduct, foresee ethical codes for research programs).
- Setting up a national platform for auditing algorithms. Evaluating the conformity to legal and ethical frameworks would increase transparency and reduce potential abuses to the use of AI;
- Launching a Global Partnership for AI (GPAI): a declaration has been signed with Canada to start a project on the creation of an international AI study group focused on developing responsible AI. This initiative will be launched in the near future with the support of the OECD.

Besides a well-defined ethical framework, it is essential to develop an ambitious legislation to control the boundaries and performance of AI systems and impede any forms of infringements. In this respect, the French strategy foresees the following pieces of law:

- Launch of the Digital Republic Act: a [law](#) to open up public data, to strengthen the protection of users' rights and data privacy and to ensure that the opportunities due to digitalisation benefit to all;
- Implementation of the cyber security directive: this directive properly known as the Directive on security of network and information systems (NIS) requires Member States to adopt a national cyber-security strategy. In France it has been implemented by the [French Act](#) No. 2018-133 in February 2018.

### 13.5 Infrastructure

Data is raw material of AI, and essential for the development of new AI practices and applications. To maximise its economic and social utility, policies should target the creation of a data infrastructure and ecosystems that do not only foster the collection of high-quality data, but also promotes – where possible – data circulation between stakeholders, while preserving elementary data protection rules and ensuring citizens' control on their personal data. While free access to private data is not always desirable, the French AI strategy proposes to adopt sector-specific data policies. In this way data policies could apply in particular to the public sectors, while others are targeting private sectors, with differentiations across priority areas such as health, transport and environment.

The French strategy highlights the following **data policy** initiatives:

- Data sharing in private sector: the government must encourage the creation of data commons and support an alternative data production and governance model based on reciprocity, cooperation and sharing. This includes also data sharing between private actors;
- Data of public interest: the government should encourage the access to databases, which could be freely accessible or restricted at sector levels. This perspective is reflected in the [Open Science policy](#) established by Inra and [the National Plan for Open Science](#);
- Increased data portability: The right to data portability should be supported, allowing migration of data from one service ecosystem to another without losing data history.

In terms of **digital and telecom infrastructure** to encourage the development of machine learning and AI algorithms, the French strategy foresees the following policy initiative:

- Investment in a supercomputer worth €115 million: this computer will have a processing power of over 10 Petaflops. It is meant to be functional in 2020 and will be installed at the “plateau de Saclay” – a scientific research hub to the South-West of Paris.

### **13.6 Update**

Inria, the French national research institute for the digital sciences, has committed to play a prominent role as coordinator of the national AI strategy. It will be responsible for its implementation, in particular on its research and innovation side. Inria will report annually on its coordination activities to the ministerial steering committee of the national AI strategy.



## 14 Germany

In November 2018, the Federal Government of Germany launched its [artificial intelligence strategy](#) jointly developed by the Federal Ministry of Education and Research, the Federal Ministry for Economic Affairs and Energy, and the Federal Ministry of Labour and Social Affairs (Germany, 2018).

The strategy presents the progress made in terms of AI in Germany, the goals to achieve in the future and a concrete plan of policy actions to realise them. The range of policy initiatives outlined in the strategy aim to achieve the following goals:

- Increasing and consolidating Germany's future competitiveness by making Germany and Europe a leading centre in AI;
- Guaranteeing a responsible development and deployment of AI which serves the good of society;
- Integrating AI in society in ethical, legal, cultural and institutional terms in the context of a broad societal dialogue and active political measures.

For the implementation of the strategy, the Federal Government of Germany intends to provide around €3 billion for the period 2019-2025.

### 14.1 Human capital

Establishing the right framework conditions towards human development is primordial to prepare current and upcoming generations to the tremendous changes that will arise from the use and deployment of AI. This calls for efforts to increase the awareness of citizens of the benefits and use of AI, but also to considerably expand the education and training capacities and facilities in the field of AI. The German strategy proposes a couple of **policy reforms and initiatives for formal training and education**, with special focus to the formation of teachers in order to guarantee a high-quality level of education in AI:

- Creation of the 'Teach-and-learn AI' platform to develop a solid skill base in AI targeting specific user groups;
- Creation of at least 100 additional professorships in the field of AI to ensure that AI has a strong foothold within the higher education system.

On top of this formal education and training reforms, the Federal Government proposes a broad-based set of instruments to **expand and upgrade AI-related skills of the workforce**. As the required skills of individuals will change significantly with the upcoming AI technologies, the Federal Government launches some large-scale qualifications initiatives with attention for lifelong learning and for reskilling and upskilling employees across their entire careers:

- The creation of the National Skills Strategy to promote advanced vocational training in digital and AI-related aspects among others. The Mittelstand 4.0 centres of excellence for SMEs will have "AI trainers" contact at least 1000 companies per year;
- The formation of regional Centres of Excellence for Labour Research studying and organising labour in an AI working environment and imparting the necessary skills to management and the workforce.

Other policy instruments aim to identify upcoming skills demand and to **respond in a flexible way to the digital and demographic changes of labour demand** on the job market. Hence, these initiatives aim at satisfying and bridging the needs of both the workforce and companies:

- The creation of a Skilled Labour Strategy: a skills monitoring system to identify which skills are needed in the future;
- The formation of regional Centres for the Future to provide upgrade skilling opportunities for employees in rural areas.

### 14.2 From the lab to the market

This pillar includes support actions towards the expansion of AI research, programs to foster entrepreneurship and to promote growth of AI start-ups in particular. It covers also funding instruments and infrastructure to encourage innovation and to facilitate the process of launching AI applications on the market. Most of these initiatives may also be allocated to the networking pillar below as the research and innovation process often leads to knowledge transfers across institutional players.

Funding schemes and support initiatives to **foster research in the field of AI** comprise among others:

- Gruender platform: online platform to support start-ups – including AI ones – from initial research to concrete AI applications;
- Industrial Collective Research programme fostering joint business and science research on collective AI projects in order to close the gap between basic research and industrial applications;
- Advisory and funding services to foster the growth of AI start-ups (e.g. EXIST focusing on university spinoffs) through for instance venture debt (e.g. Tech Growth Fund). This can also include policies to promote [company formations](#) in the field of top-rate research in human-machine interaction.

Support initiatives towards **innovation and testing** include:

- Founding an agency for breakthrough innovations with AI as a focus;
- Developing in-company innovation spaces to promote innovative solutions for digitalisation;
- Strengthening the Central Innovation Programme for SMEs: funding programme for SMEs targeting individual and collective R&D projects;
- Speeding up the process of AI innovations by launching so-called transfer initiatives, test beds and [regulatory sandboxes](#), and promoting pilot and flagship AI projects, for example those that benefit the environment and the climate.

### 14.3 Networking

The German strategy highlights a wide range of policy initiatives to **foster networks and collaborations** across the business community, academia and public research centres. The aim of networking is to encourage the development of multidisciplinary cutting-edge research and innovation projects and to fully exploit synergies and diversities across institutional players by promoting knowledge dissemination and transfers.

Support initiatives of the Federal Government of Germany to encourage collaborations include:

- The formation of a Franco-German R&D network (“virtual centre”): bilateral funding and training programme with bilateral AI clusters in specific industries (e.g. healthcare, environment, robotics, mobility);
- Expanding the [Plattform Lernende Systeme](#) into an Artificial Intelligence platform to host dialogue and networking between science, business community, civil society and the government;
- Platform Industrie4.0: a [platform](#) with a holistic approach to the shaping of digital ecosystems. It aims at supporting and promoting innovations and collaborations in a digital economy, with recently a more targeted focus on AI technologies;
- The development of [Next Generation Clusters](#): The aim of the initiative is to transfer fundamental, developable results from cutting-edge research into products and services, with a strong emphasis on collaborative partnerships;
- Further development of the [Digital Hub initiative](#) and the [Hubs for Tomorrow](#) initiative in Germany, in particular those related to artificial intelligence, cybersecurity and other AI-related fields;
- Considering the launch of an Important Project of Common European Interest (IPCEI) in the field of AI, where necessary;
- Promoting cross-company and cross-institutional flagship projects in AI;
- Considering the building of data partnerships between companies and research institutes.

Concerning efforts to foster the **international attractiveness** of the country, the Federal Government of Germany aims to improve working conditions and remuneration to draw in and retain the brightest minds. Along this side, the German strategy also proposes reforms of legislation to facilitate immigration procedures for skilled workers (cf. regulation).

Other initiatives aim to monitor current progress and uptake of AI in Germany and to disseminate nation-wide information about digitalisation and AI:

- Setting up a German AI observatory to monitor the uptake and impact of AI in society and the world of work;
- Establishing a Digital Work and Society Future Fund to set up an information and policy campaign in the field of digital technologies such as AI and to promote multidisciplinary social technology design;
- Monitoring and mapping interesting AI applications and their stakeholders aiming to encourage collaborations and the development of creative ideas.

## 14.4 Regulation

A successful deployment of AI technologies goes hand in hand with a well-developed and effective regulatory framework. Therefore, an innovation-friendly regulatory framework is important for Germany's industry and economy to thrive. The Federal Government of Germany launches initiatives to tackle among others issues related to information management, data ownership, free flow of data, and standardisation.

Reforms of the legislation target many domains, including codifying the rights of the labour force, consolidating competitiveness of the industry and developing rules with respect to data usage and protection.

Following initiatives provide initial steps towards a **legislative framework for AI**:

- The launch of a Commission on Competition Law 4.0 serving as a political platform for a debate on how to further develop competition and copyright law;
- The launch of the Opportunities for Qualifications Act, a legislation providing reskilling opportunities and support to employees whose job is at risk due to AI technologies;
- The adoption of the Skilled Labour Immigration Act, a legislation to facilitate the migration of skilled workers to Germany;
- The formation of a Workforce Data Protection Act to codify data protection regulation and privacy (i.e. safeguard the control on personal data), compliant with EU law;
- Review and if necessary adaption of the legislation concerning the use of non-personal data as well as copyright;
- Implementation of the cyber security directive: this directive properly known as the Directive on security of network and information systems (NIS) requires Member States to adopt a national cyber-security strategy. In Germany it has been implemented by the NIS Implementation Act in June 2017.

The Federal Government advocates using an “ethics by, in and for design” approach throughout all the development stages and use of AI-based applications. It highly recommends engaging in dialogue with other leading regions to reach an agreement on joint guidelines and ethical standards on AI. Hence, the strategy foresees to work on a **legal and ethical framework** aligned with European guidelines and taking into account recommendations of the national Data Ethics Commission:

- Guidelines for developing and using AI systems in compliance with data protection rules;
- Ethical requirements to ensure transparency, verifiability and predictability of AI systems (e.g. [ethical guidelines](#) for self-driving cars);
- Initiative to enforce a better coordination of ethical values at European level.

Besides ethical guidelines and legislative reforms, standards form an essential aspect of an adequate and effective regulatory framework. Standards act as a seal of excellence in ensuring high quality products and services. It reinforces security and opens up possibilities towards collaboration due to higher degrees of comparability and interoperability. Overall, standards for AI increase the public trust in the use and deployment of AI applications. With respect to **standardisation**, the Federal Government of Germany proposes following support initiatives:

- Funding for the development of data standards and formats to encourage EU-wide collaborations;
- Funding for experts, particularly from SMEs and start-ups in order to support their participation in international standardisation processes;
- Develop a roadmap on AI standardisation to review existing standards as to whether they are AI-compatible.

## 14.5 Infrastructure

Regarding infrastructure the Federal Government foresees to expand the current data infrastructure in order to create optimal conditions for the development of cutting-edge AI applications. The objective of data infrastructure investments is to obtain a trustworthy data and analysis environment to strengthen research in AI and to favour exchanges due to a more flexible data interoperability. In addition, the German AI strategy aims to develop the current telecommunication and digital infrastructure to ensure a better connectivity of the network and to improve cyber security. Lastly, the Federal Government is setting up funding to foster learning capabilities and experimentation in AI by improving the digital infrastructure in the education system.

In particular, the German strategy foresees the following initiatives for the **improvement of the infrastructure in AI**:

- Improving data sharing facilities by providing open access to governmental data and improving the infrastructure for access to the Earth observation data;
- Building a trustworthy data and analysis infrastructure based on cloud platforms and upgraded storage and computing capacity;
- Setting up a National Research Data infrastructure to provide science-driven data services to research communities;
- Improving security and performance of information and communication systems with particular focus on resilience of AI-systems in case of attacks;
- Providing funding from the Digital Pact for Schools programme to improve digital infrastructure in schools;
- Expanding the Learning Factories 4.0 initiative, which sets up professionally equipped laboratories and puts them at disposal of students for learning purposes in AI.

## **14.6 Update**

The Federal Government of Germany published an interim report presenting the German AI Strategy after one year in November 2019. It provides facts and figures on the implementation of the strategy, fields of actions that are currently ongoing and perspectives for the future. At the beginning of 2020, the strategy will be developed further in line with the status of the debate and the needs, and will be brought into line with the latest developments and requirements.



## 15 Greece

Greece is aiming to develop, by the end of 2020, a national AI strategy followed by the corresponding action plan on AI. Greece's vision is to combine effectively the knowledge of the academic and research community with the actual production so as to boost Greek economy and investments.

Towards this direction, Greece has already initiated the mapping of AI initiatives across sectors on a national level, as well as open dialogue discussions with all relevant stakeholders at academic, research and operational level, towards the effective combination of knowledge-research-production pillars.

Within the framework of the AI strategy, there are several issues that need to be addressed, such as the necessary legislative interventions that need to take place, the ethical dimension of AI, the issue of Data collection and quality, the advanced skills required as well as the AI for the Public Sector.



## 16 Hungary

In October 2018, the Hungarian government formed a [Coalition on Artificial Intelligence](#) as a partnership between governmental institutions, prominent academics and practitioners from leading IT businesses. Made up of more than 230 members, the AI Coalition is currently working on the development of Hungary's AI Strategy and various AI-related proposals.

The Hungarian national AI Strategy is currently foreseen to be completed and published in the first half of 2020. The comprehensive strategic document aims to support and boost all relevant sections of the AI value chain from data generation and management, through basic and applied research, to utilization of the technology and raising awareness of the possibilities inherent in practical AI applications. Through a multi-layered set of goals the Strategy aims to:

- Strengthen the **basic pillars** of the Hungarian AI ecosystem: data industry, R&D&I, applying AI, education, infrastructure development, and regulatory framework.
- **Focus on specific sectors** and technology fields with the highest acceleration potential for Hungary: manufacturing, healthcare, agriculture, public administration, transportation, logistics and energy.
- Initiate **transformative programs** with long term ambitious goals that offer direct benefits to citizens: climate-driven agriculture, energy grids focused on renewables, fully autonomous systems, AI supported personal competence development, data-wallet and personalized services, automated administration processes in Hungarian, health-consciousness in a digital world.

Already in October 2019, Hungary announced the launch of an [AI action plan](#), which provides initial steps towards a national AI strategy. The announcement of the AI action plan highlighted various preliminary initiatives that are to be further developed in the AI Strategy, such as:

- Encouraging the development of AI technologies by reinforcing opportunities for basic research and innovations in AI;
- Fostering education in AI-related skills and competences;
- Developing a regulatory framework and strengthening international relations;
- Supporting the creation of a well-developed infrastructure and data sharing facilities;

With respect to **education in AI**, the action plan's goal is to educate at least 1% of the population (or approximately 100,000 citizens) in AI-related subjects. In addition, the [Csopa](#), a science centre in Budapest may raise the population's awareness and understanding of AI through digital experiences. Transformations of the educational system to prepare for the digital world will take stock and build further on the policy recommendations outlined in the [Digital Education Strategy](#) that was released in October 2016.

The increase of AI developments will be achieved through the establishment of a **National Lab for basic research in AI**: this lab will be created through a consortium of the Institute for Computer Science and Control ([SZTAKI](#)) and institutions of the Eotvos Lorand research network. Encouragement of the development of AI technologies will be further enhanced through existing policies such as the [Digital Start-up Strategy](#) and the Industry 4.0 initiative aiming to improve the competitive advantage of Hungarian firms in the global digital economy

Concerning **regulation**, the Hungarian government foresees to adapt the EU ethical guidelines for the Hungarian context. The adaptation of the ethical guidelines will be developed by the AI coalition of Hungary.

To **foster networking and improve the visibility of AI efforts** in the country, the AI coalition also launched an [AI portal](#) in which AI developers can showcase local case-studies to foster collaboration and awareness.

In terms of data infrastructure, the action plan includes the establishment of a **National Data Asset Agency** to ensure a responsible and efficient data utilisation in the public sector. This initiative will be complemented with the creation of a **public data portal**, big data collections (e.g. on education, health, and transport data), and data market platforms with GDPR compliant data. Inventories of public-data assets and best practices can facilitate the implementation of these initiatives.



## 17 Ireland

The Department of Business, Enterprise and Innovation (DBEI) in Ireland is leading on the development of a national AI Strategy. The Strategy is expected to be finalised in the first quarter of 2020 (subject to Government approval).

The National AI Strategy for Ireland, under the working title of “AI - Here for Good”, will provide a high-level direction to the design, development and adoption of AI in Ireland. It will present an integrated, cross-Government framework giving direction for the steps needed to ensure that Ireland’s use of AI will benefit society. In line with the EU and OECD approaches, it is envisaged that the main areas covered by the Strategy will include: societal opportunities and challenges of AI; enterprise development and deployment of AI; RD&I; human capital considerations; data; digital and connective infrastructure; public sector use of AI; as well as ethics, governance, standards and regulatory framework.

The development of the Strategy has involved significant stakeholder engagement, including with industry, with industry representative bodies, with academic and research communities and with a multi-stakeholder group of experts. Consultations are continuing across the Government system and an online public consultation has also been conducted. As part of the strategy development, a Top Team on Standards for AI has been established, led by the National Standards Authority of Ireland (NSAI).



## 18 Italy

In August 2019, the Italian Ministry of Economic Development released a draft version of its [National Strategy on Artificial Intelligence](#) for public consultation (Italy, 2019a). At the same time, the Ministry also published a background paper, entitled [Proposals for an Italian strategy for AI](#), providing initial guiding principles and policy recommendations as a basis for Italy's AI strategy (Italy, 2019b). The public consultation closed on the 13<sup>th</sup> of September and a final draft is currently at hand with the high-level group that was commissioned to develop the AI strategy for Italy.

The policy report provides a long-term strategy for a sustainable development of AI. It presents key objectives to increase the development and competitiveness of AI in Italy:

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

As per funding, the Italian government earmarks €1 billion of public investments by 2025 for the strategy implementation. The high-level working group expects that the public investments will create a leverage effect on private investments of the same amount, resulting in a total investment volume of €2 billion.

### 18.1 Human capital

The deployment of AI technologies is largely dependent on the skills and competences of the people that develop them. Recognising this fact, the Italian government aims to strengthen the **provision of AI competences at all education levels**. At the primary and secondary education level, the government will develop a [National Plan for the Digital School](#) to update teachers' skills in digital education and AI-related courses and to incorporate these courses in the students' curricula. At higher education levels, the government will encourage the integration of courses with AI-related themes in Bachelors, Masters and doctoral programs. In addition, lifelong learning initiatives will be set up in the form of professional online courses in AI, and upskilling and reskilling training programs in AI for the workforce.

### 18.1 From the lab to the market

The **Italian AI research ecosystem** is backed by a wide range of national centres of excellence such as the Artificial Intelligence and Intelligent Systems Laboratory ([AIIS](#)) of the Italian Interuniversity Consortium for Informatics ([CINI](#)), the Italian Institute of Technology ([IIT](#)) and the Institute for Calculation and Networks for High Services ([ICAR](#)) of the National Research Council ([CNR](#)). To **increase the competitiveness of the AI industry** and the usage of AI applications in the public sector, the Italian government will reinforce the available public funding and will encourage public-private venture capital support. One of these initiatives is [Smart&Start Italia](#), a government-funded scheme that encourages new businesses in the digital economy. Dedicated funding schemes will be developed to finance experimentation and testing activities in blockchain, artificial intelligence and internet of things. In addition, the government recalls the establishment of the [National Innovation Fund](#) in 2019, which has an initial budget of €1 billion. Besides financial instruments, the government is also setting up advisory services through the appointment of innovation managers that will help SMEs during the technological and digital transformation process. **Priority sectors** that are particularly promising for the development of AI in Italy are: manufacturing industries, food, energy, healthcare, transport, smart cities, culture and tourism, and public administration. With respect to AI in the public administration, the Task Force on Artificial Intelligence of the [Agency for Digital Italy](#) recently released a white paper on [artificial intelligence at the service of citizens](#).

### 18.1 Networking

In terms of **networking**, the Italian strategy highlights that it will encourage the above mentioned centres of excellence to build up a network for research and development which will work in close relationship with the industrial community. A total of 8 Competence Centres, established by the Ministry of Economic Development,

and 12 European Technology Clusters, set up by the Ministry of Education, Universities and Research, will form the basis for a national network for knowledge exchange and collaboration. These nodes are integrated in the [Digital Europe Programme for the period 2021-2027](#) and constitute a backbone for pan-European networks together with the establishment of Digital Innovation Hubs. The Italian strategy mentions its proactive support to European initiatives such as the Confederation of Artificial Intelligence Laboratories in Europe ([CLAIRE](#)) and the public-private partnerships for electronic components and systems ([ECSEL](#)). The government also foresees to establish a central hub that will be in charge of coordinating national networking efforts and that will be duly equipped with appropriate digital infrastructure. To increase the **international attractiveness** of Italy in the field of AI, the Italian government foresees to strengthen existing policy instruments aiming to attract foreign talents such as the [EU Blue card](#) and the [Italian Startup Visa](#). Lastly, the **dissemination and uptake of AI** will be fostered through promotion campaigns via broadcasting and multimedia, targeting the population as whole. For the protection of citizens, special attention will be devoted to inform about fake news and issues of cyber security.

## 18.1 Regulation

To ensure that the design of AI systems is based on principles of transparency, reciprocity and reliability, the Italian government emphasises the need to establish a **regulatory and ethical framework for AI**. From an ethical point of view, the government commits to contribute to the European Ethical Guidelines and to consider the creation of certificates to validate and monitor AI applications developed in an ethically sound way. From a legal perspective, the government will analyse the current legislation and update it where needed in order to remove any barriers to a smooth AI development. Regulatory sandboxes will be set up to facilitate testing of AI applications.

## 18.1 Infrastructure

The Italian government will **harness the potential of the data economy** by improving the interoperability and accessibility of public administration data through API interfaces. To facilitate data exchanges, the government will actively promote the development of Data Sharing Agreements, in particular in strategic sectors with a high potential and collective interest. It will also launch pilot projects to evaluate the benefits of Data Trust models, aiming to ensure data sharing in a fair, safe and equitable way. Finally, the government will proactively support the creation of a [Common European Data Space](#). With regard to the development of a **digital and telecommunication infrastructure**, the Italian government is participating in the Joint Undertaking to develop a competitive European computing ecosystem ([EuroHPC](#)). In terms of connectivity, Italy is further expanding its ultra-broadband optical fibre network and explores ways to extent its 5G network.

## 18.1 Update

The Italian Ministry of Economic Development will monitor and evaluate the progress of the national AI strategy on a continuous basis and update its implementation where needed.



## 19 Latvia

In February 2020, the Latvian government released its national AI strategy on [Developing Artificial Intelligence Solutions](#) (Latvia, 2019). A draft of the national AI strategy was released in July 2019 for [public consultation](#). In order to collect the view and feedback from relevant stakeholders to move ahead in the preparation of the final national AI strategy. The objective of the Latvian strategy is to promote the uptake and growth of AI in the whole economy. The proposed strategy outlines policy actions in the following areas and devotes particular attention to the promotion of AI in the public administration:

- Raising the awareness of and competences in AI across society through education reforms;
- Promoting the adoption and development of AI in the public and private sector;
- Actively engage in national and international cooperation;
- Developing an appropriate legal and ethical framework for AI;
- Unleashing the benefits of a well-developed data ecosystem;
- Investing in a digital and telecommunication infrastructure to support AI developments.

The Latvian AI strategy highlights investment projections in line with the recommendations of the Coordinated Plan. These estimations amount at a public investment of €25 million per year, and a total investment (public and private sectors combined) of €74 million per year. More concrete investment plans will be defined and released at a later stage.

### 19.1 Human capital

Improving **skills and competences in AI-related fields** is primordial to accelerate the speed of AI deployment, usage and development. To this purpose the Latvian strategy advocates the integration of AI themes in the general education system at all levels. The Latvian government recognises the need to raise the awareness and understanding of AI among all citizens, and in particular students, researchers and professionals in the private and public sector. Taking the example of the Finnish course on [AI Elements](#), Latvia will develop an equivalent online course. The target audience of this course are expert level and management level specialists to help support digital transformation. Furthermore, the Latvian government intends to prepare a National Research Programme and to reform the education system.

### 19.1 From the lab to the market

In terms of research, the Latvian strategy highlights that several universities and research centres are currently conducting several **research projects in the field of AI**. The [LU Institute of Mathematics and Informatics](#) is active in the following research strands: speech recognition, semantic analysis, image analysis, natural language analysis, computer vision and robotics. The [Riga Technical University](#) (RTU) carries out research among others in autonomous systems and robots, image and sound processing and smart sensor systems. It has a dedicated Chair in Artificial Intelligence and Systems Engineering focusing on machine training and data mining. In addition, the RTU [Institute of Industrial Electronics and Electrical Engineering](#) is coordinating the NexIT project of the National Research Programme with the aim of fostering ICT services in the public sector and of consolidating data collection and processing. Finally, Latvia's strategy presents a range of ongoing research projects in the field of AI that are supported by the European Regional Development Fund and Horizon 2020.

The deployment of AI solutions in the industry and public administration will be encouraged through an increased pace of digitisation. To this purpose, the Latvian government is preparing Digital Transformation Guidelines by the second quarter of 2021 with policy measures to support the digital transformation. This will include financial provisions and support programs for research and innovation in AI. The Latvian strategy identifies **priority sectors** with a high potential for AI applications in the country, such as transport (Intelligent transport systems), culture, justice (AI as support for decision making and drafting legislation), agriculture (automated control), and translation. AI is also mentioned as an effective tool to create a virtual assistant platform in the public administration and to establish an efficient information system in the healthcare sector.

Lastly, several **value chain ecosystems** are currently developed by the Ministry of Economics. Three strategic value chain ecosystem pilots are being implemented – on Smart materials, Biomedicine and Smart city – to enhance state-of-the-art research and innovation in these fields. These priority areas are based on Latvia's [Smart specialization strategy](#). The ecosystems bring together innovation actors from private, public

and academic sectors. AI is a key enabling technology to facilitate the implementation of above-mentioned ecosystems.

## 19.1 Networking

To foster innovations in AI, research and development should not be conducted in isolation but rather in collaboration, by bringing together competences from national and international organisations. The Latvian government will encourage joint projects and increase opportunities for **public-private partnerships in AI**. Understanding the growing importance of the global landscape of AI, the government will pay particular attention to the involvement of international stakeholders in collaborative efforts. To increase Latvia's international visibility and to attract foreign investments, the Ministry of Foreign Affairs considers to set up a platform to present Latvia's achievements and best practices in AI. Networking opportunities will be further channelled through Latvia's Digital Innovation Hubs, being the [Ventspils High Technology Park](#), the Latvian [IT Cluster Association](#) and the [Institute of Electronics and Computer Sciences](#).

## 19.1 Regulation

As the proliferation of AI technologies brings along **new regulatory challenges**, the Latvian government calls for the development of a normative framework to define what is ethically and legally sound in the field of AI. At the moment, Latvia is relying on its current national legislation and on EU Directives defining regulations on product safety ([Directive 2001/95/EC](#)) and liabilities ([Directive 1985/374/EEC](#)). However, the government recognises the need to provide more clarity on these issues, in particular on AI goods and services. Hence, it will work on a new legal environment for AI and will set up regulatory sandboxes to facilitate testing of AI concepts and ideas. Regarding ethics, the government adopts the European [ethical guidelines](#) outlined by the European Commission for the Efficiency of Justice.

## 19.1 Infrastructure

Given that data is an important driver for the development of AI applications, the Latvian government has adopted guiding principles for e-government and data governance in the public administration. These [measures](#) aim to foster the development of new **information systems towards open data** and to facilitate the path towards the creation of single data centres. In June 2017, Latvia has launched an [Open Data Portal](#) to harmonise data collection and encourage data sharing. A survey targeting practitioners has also been launched in March 2019 to understand their data needs and to obtain recommendations and feedback on the data published in the open data portal. The Ministry of Environmental Protection and Regional Development ([VARAM](#)) has been appointed as national authority to coordinate open data policies and initiatives in the public administration. In the third quarter of 2019, an information report entitled "Latvian Open Data Strategy" will be published. This report will lay the foundations for strategic policy actions for the period 2019-2022 towards an open data governance in the public administration.

Latvia has currently two **High Performing Computing Centres**: the High Performance Computing Unit at the Ventspils International Radio Astronomy Centre ([VSRC](#)) and the RTU [Scientific Computing Centre](#). Besides these two centres, the Institute of Electronics and Computer Sciences ([EDI](#)), an independent scientific institute, has also invested in a high performance computer allowing to explore and analyse big data with cutting-edge techniques in AI. In addition, the Latvian strategy mentions the need to increase computing capacities through investments in cloud services and quantum computing.

## 19.1 Update

The implementation of the Latvian strategy will be monitored and evaluated on a regular basis and adjusted with additional policy initiatives where needed.



## 20 Lithuania

In April 2019, the Ministry of Economy and Innovation released the [Lithuanian Artificial Intelligence Strategy: a vision for the future](#) (Lithuania, 2019). The aim of the strategy (p. 4) is to *"modernise and expand the current AI ecosystem in Lithuania and ensure that the nation is ready for a future with AI"*. The strategy has been drafted by a working group consisting of representatives of the private sector, academia and governmental institutions.

The strategy provides an overview of the current AI landscape in Lithuania and a range of policy recommendations in key areas with the aim to:

- Improving the skills and education in AI for all citizens;
- Strengthening the national research and innovation ecosystem in the field of AI;
- Increasing the deployment, development and use of AI in all economic activities, including both the private and public sector;
- Promoting national and international collaborations in AI and enhancing network opportunities;
- Developing an ethical and legal framework for a sustainable and transparent development of AI applications;
- Establishing a responsible and efficient data ecosystem for AI.

The Lithuanian strategy does not include concrete policy initiatives but merely serves as a guiding document for all actors in the country with policy recommendations to align towards. It does not outline financial provisions for the implementation of the strategy.

### 20.1 Human capital

With respect to education, the Lithuanian strategy advocates the **development of skills and competences in AI at all education levels**, emphasising the need to start teaching AI foundations at an early age. Reforms to the primary and secondary education system could target AI basics for children as a learning objective, and could include more courses to develop technical skills. In addition, the Lithuanian government recommends to modernise STEM teaching subjects and to provide dedicated support to teachers to foster the quality of their education duties in AI. Master programs and PhD scholarships in AI should also be introduced in curricula of higher education systems. AI-related courses are particularly important for those study areas that are at risk of automation. Universities could develop a website portal to attract prospective students to AI-related programs. Finally, the Lithuanian strategy highlights the need for **lifelong learning opportunities and vocational training programs** in AI. Training in AI for citizens could be done by means of massive open online training courses. Overall, the main objective of education in AI is to prepare current and future workforces to the upcoming needs of the labour market.

### 20.1 From the lab to the market

The Lithuanian strategy presents policy recommendations for the **growth of research and development in the field of AI**. To this purpose, the government will establish a national research centre in AI and increase the financial support to AI research by developing new funding programs with the aim of meeting the standards set out by the European Commission (i.e. increasing funding for AI research by 70% by the end of 2020).

To **foster innovations in AI**, the government advances a range of policy recommendations towards increased adoption of AI in both the private and public sector. A vibrant entrepreneurial ecosystem could be encouraged by means of an AI start-up hub and Digital Innovation Hubs. Incentive mechanisms to increase the visibility of AI leading firms through awards such as seals of excellence or an AI badge are also considered. In the **private sector**, the Lithuanian government identifies the following **priority areas with high AI potential**: manufacturing, agriculture, healthcare, transport and energy. In the public sector, an Advisory Board will be created to advise on future AI policies and to foster an **innovative culture in the public administration**. Regulatory sandboxes will be established to provide optimal conditions for testing promising AI solutions. Lastly, guidance will be foreseen to public institutions to adopt and implement AI systems.

## 20.1 Networking

The AI ecosystem is further strengthened with **policies towards networking and opportunities for partnerships** across all relevant stakeholders. Research centres, businesses and public organisations are encouraged to join forces and to increase knowledge transfers among each other. The strategy presents policy recommendations to stimulate both national and international collaborations. To promote networking within the country, the government will set up and promote AI meetings and conferences and will foster the creation of communities of AI experts. At international level, the strategy recommends to strengthen its ties with adjacent countries Latvia and Estonia and to set up shared initiatives with extended neighbours of the Baltic region. Finally, Lithuania should continue supporting initiatives at the European Union level and beyond, seeking among others to cooperate with global leading companies in AI.

## 20.1 Regulation

To create a solid foundation for trustworthy developments of AI, the Lithuanian strategy sets out recommendations for the **creation of an ethical and legal regulatory framework**. To this purpose, the government will establish an AI ethics committee to develop a proposal for ethical guidelines. Lithuania strongly recommends the development of ethical principles and legal rules to overcome the current ethical and legal vacuum in the country. The development of this regulatory framework could take advantage of existing regulations at European level. Analyses of best practices could also be useful. Overall, new rules and regulations should aim to ensure explainability, transparency, fairness, trust, verifiability, safety and security against attacks. The creation of a national interdisciplinary centre on AI is also considered to promote discussions of surrounding issues on ethics of AI.

## 20.1 Infrastructure

The Lithuanian strategy emphasises the need to create a **stable and AI-friendly data environment**, with focus on the public sector. The government highlights the existence of an open data portal [Open.data.gov.lt](https://open.data.gov.lt). This portal provides an initial step towards the establishment of an open data ecosystem, but the current version is still limited in usability due to a large portion of data being uploaded in closed format. Hence, the government encourages setting up a centralised hub for open data with enforced standards for data management and sufficient data literacy for a proper use of the data. Finally, the data infrastructure should aim at meeting international standards with respect to findable, accessible, interoperable and reusable (FAIR) principles, and General Data Protection Regulation (GDPR).

## 20.1 Update

The government of the Republic of Lithuania will ensure a successful execution of the outlined recommendations in the coming years.



## 21 Luxembourg

In May 2019, the government of Luxembourg published its national AI strategy, entitled [Artificial Intelligence: a strategic vision for Luxembourg](#) (Luxembourg, 2019). The strategy is part of a broader policy program called [Digital Luxembourg](#) aiming at coordinating and strengthening Luxembourg's efforts in the digital transformation towards the development of a solid digital society.

The strategy acts as a vision paper outlining the ambitions of Luxembourg in the field of artificial intelligence and presenting strategic policy recommendations in key areas to achieve them. The policy vision of Luxembourg's strategy is to support the development of a human-centric AI based on an efficient and sustainable data-driven ecosystem. It aims at positioning Luxembourg as a leading digital society in the world. To achieve these objectives, the strategy advances a range of policy recommendations in the following key areas:

- Enhancing the skills and competences in the field of AI and providing opportunities for lifelong learning;
- Supporting research and development of AI, transforming Luxembourg in a living lab for applied AI;
- Increasing public and private investments in AI and related technologies;
- Fostering the adoption and use of AI in the public sector;
- Strengthening opportunities for national and international networks and collaborations with strategic partners in AI;
- Developing an ethical and regulatory framework, with particular attention for privacy regulation and security to ensure transparent and trustworthy AI development;
- Unleashing the potential of the data economy, as a cornerstone of AI development.

The national AI strategy of Luxembourg does not disclose financial provisions or estimations for its implementation.

### 21.1 Human capital

With respect to **formal education**, the government of Luxembourg recommends reforming the secondary and higher education systems and vocational training programs to include AI-related courses in their curricula. The strategy also emphasises the importance to increase the digital literacy and basic AI knowledge of citizens to prepare them for the digital transformation. To optimise **lifelong learning opportunities** for the workforce, it is advised to develop tailor-made learning experiences. This could be done in collaboration with leading AI companies to make sure that newly acquired skills and competences **fit the needs of the labour market**. To fully grasp whether the needs for AI-related skills for the public and private sector are met, the government is also planning to map the current education offer and to integrate AI courses in those disciplines that are subject to benefit most from AI. This mapping information could feed into existing policy programs such as [Digital Skills Bridge](#) and the recently launched [Talent Attraction Strategy](#) to further improve the fit between workforce's skills and the needs of the labour market.

### 21.1 From the lab to the market

To foster the creation of marketable products and services in AI, the government of Luxembourg has the ambition to transform the country into a **living lab for applied AI**. This will be done by encouraging a research culture in AI through the establishment of world-class testing facilities and regulatory sandboxes and through the development of research centres such as the Luxembourg [Digital Innovation Hub](#) hosted and managed by [Luxinnovation](#). To further **increase innovations in AI** with a particular focus to SMEs and start-ups, the strategy advocates the use and expansion of existing financial funds such as [The Future Fund](#), the [Digital Tech Fund](#) and the Société Nationale de Crédit et d'Investissement ([SNCI](#)) bank. With the aim to **improve the quality and efficiency of public services**, the government of Luxembourg is also setting up policy recommendations to foster AI innovations and usage in the public sector. This can be done among others by identifying potential projects that could provide human-centric AI solutions for citizens and by sharing best practices with the (international) AI community. Other instruments at hand to reinforce customer-oriented services are the creation of a centralised data ecosystem for public data and the [Digital by Default](#) initiative that aims support the digitalisation and simplification of the public administration.

## 21.1 Networking

The strategy of Luxembourg also includes several policy recommendations for **increasing national and international partnerships in AI**. The National Research Fund has dedicated funding for collaborative public-private research in fields as advanced robotics and digital manufacturing. Through the use of public-private partnerships (PPPs) the government is also prioritising more multidisciplinary research. The government has for instance recently launched an [AI Laboratory](#) in Luxembourg in partnership with NVIDIA. In addition, the strategy mentions the active participation of Luxembourg into European-wide initiatives as [CLAIRE](#) and [Copernicus](#).

## 21.2 Regulation

A new **regulatory framework** will be put in place to remove barriers to AI development. To ensure **ethical guidelines** for a trustworthy, transparent and sustainable AI, the government of Luxembourg is setting up an ethics advisory committee. Collaborations among governmental bodies aims also to ensure the adoption of proper corporate governance in AI. The government will also engage with the National Data Protection Authority to develop regulations with respect to privacy and data protection. The regulatory environment will aim to **enhance quality, accessibility and transparency of data**. Finally, the Luxembourgish institute for standardisation ([ILNAS](#)) will be consulted to coordinate standardisation processes in AI.

## 21.3 Infrastructure

The successful development of cutting-edge AI technologies requires a well-developed **data and telecommunication infrastructure**. To this purpose Luxembourg is heavily investing in data centres, computing infrastructure and ICT resources. The Luxembourg Commercial Internet eXchange ([LU-CIX](#)) for instance provides access to six data centres, with a fast and reliable network stability and high-volume data transfer speeds. Luxembourg is also participating in the European initiative on High-Performance Computing ([EuroHPC](#)) aiming to develop expensive computing resources. In addition, Luxembourg will deploy and invest in 5G pilot zones in the upcoming years.

## 21.4 Update

The inter-ministerial coordination group, under leadership of the Prime Minister, will set up a governance mechanism to continuously follow up on strategic initiatives that support Luxembourg's AI development. It will regularly assess the strategic vision and set up a framework for upcoming actions in the future.



## 22 Malta

In October 2019, the Maltese government published [Malta's national AI strategy](#) (Malta, 2019a). The objective for Malta is to gain a strategic competitive advantage in the global economy in the field of AI. To achieve this objective, the policy report presents three pillars to lay the foundations for Malta's AI strategy:

- The creation of a solid AI ecosystem based on investments, start-up support and innovation;
- Support for increased adoption of AI in the public sector;
- Support measures for the adoption of AI in the private sector.

The successful achievement of these objectives relies on three horizontal enablers that cut across the three aforementioned areas: education and workforce, legal and ethical framework and infrastructure. The national AI strategy of Malta has been based on Malta's AI workforce [high-level policy document](#) that was released in March 2019 for public consultation (Malta, 2019b).

Malta's government has launched a dedicated web portal [malta.ai](#) to outline and present the progress made in implementing the national strategy in AI.

The Maltese AI strategy does not disclose financial provisions or estimations for its overall implementation.

### 22.1 Human capital

With regard to the human capital needed to foster and embrace a widespread adoption of AI across the economy, Malta will introduce **fundamental changes to the educational system and actual workforce**. In order to prepare for AI opportunities and to reduce potential skills gaps, the educational system will undergo a series of reforms. In first instance educational **courses and study programmes should incorporate AI** and should cross-link with other disciplines such as healthcare, marketing, sociology, and physics, among others. The Maltese strategy proposes a range of policies towards the reform of primary, secondary and higher education systems as well as support for teachers to enhance their course offerings in AI:

- At early age levels and for primary education levels, the Ministry of Education and Employment will support initiatives as the AI Family Challenge, a program for children with AI hands-on workshops and the AI Olympiad, focusing on learning and using AI methods. The Ministry will also introduce AI trainings in the secondary education system;
- In higher education, several Master programs, PhD scholarships and postgraduate programs in AI will be introduced in the upcoming years. These will be developed and coordinated by the Malta College of Arts, Science & Technology ([MCAST](#)) and the University of Malta ([UoM](#)), among others;
- The Ministry of Education and Employment will provide support for teachers on how AI solutions could be incorporated in the education curriculum of teachers. This will be done in collaboration with the [Malta Union of Teachers](#);

With respect to education reforms, the Malta College of Arts, Science & Technology has released an [AI Strategy and Action Plan 2020-2025](#) in which it outlines policy actions towards the introduction of AI in education systems in Malta (2019c).

**Reskilling the workforce** is key to get prepared for the upcoming opportunities brought along by innovative AI technologies. Malta's AI strategy makes references to both continuing education / lifelong learning and screening of labour market for upcoming skills demand. The strategy proposes the following actions among others:

- Set up of a **think tank to assess the more vulnerable skills and jobs** due to automation and AI in order to propose a transition plan;
- Employment reforms and safeguards to offset the impact of automation;
- Creation of a **national reskilling programme** to facilitate peoples' transition into areas that are complementary to AI based tasks or that require stronger elements of creative thought and cognitive aptitude;
- Promoting access to training for the workforce through the [Investing in Skills program](#);
- The [eSkills Malta Foundation](#) can provide advice on reforms in the ICT educational offerings and AI-related courses for professionals;
- Promoting **continuous learning** and Massively Open Online Courses (MOOCs) to keep up with the speed of change due to AI technologies.

## 22.2 From the lab to the market

The pillar from the lab to the market includes all possible initiatives to increase research, innovation and testing of new AI technologies and applications. Malta's strategy foresees increased research activities, dedicated investment instruments, start-ups development and innovation support in both the public and private sector.

Both the University of Malta and the College of Arts, Science & Technology will be supported with public funding to **increase applied research output in AI**. According to Malta's strategy, financial support for AI-related research could be partially funded through the [R&I FUSION Programme](#) which has an annual budget of €2.2 million.

The government will provide **additional funding** to governmental accelerators and incubators in order to support AI-related businesses and start-ups. The accelerator [YouStartIT](#), run by the MITA Innovation Hub, will be given funding to develop an AI-based program to help the early startup of AI businesses. Extra public funding will also be attributed to the [TAKEOFF Seed Fund Award](#), a seed funding initiative to researchers and entrepreneurs. In addition, the government will organise events where AI start-ups and scale-ups can meet and team up with angel investors and venture capitalists. Lastly, the government will establish an investment fund, and will encourage co-investments from the public and private sector. It has also reformed the [Seed Investments Scheme](#) with more favourable tax credit conditions for innovative AI firms.

Other policy measures to **accelerate private sector AI adoption** in Malta contain, among others:

- The creation of a Private Sector AI Readiness Index to assess the digital and AI maturity of business and to identify where to provide government guidance and policy actions. This index will be updated annually;
- Increasing the awareness and knowledge of the private sector on the benefits of AI and improving their trust in AI (as outlined in the section on Regulation).

Malta's strategy emphasizes that policy measures enabling the use, development and integration of AI will be targeting businesses of all sizes, but particular attention will be given to SMEs as it constitute the largest proportion of Maltese businesses.

The main objectives in stimulating the adoption and **uptake of AI in the public sectors** include the provision of better services to citizens/businesses, the improvement of economic and social well-being of citizens/businesses and the improvement of internal operations of the public sector. The responsibility for fostering the deployment of AI in the public administration will be done by respective Ministries and Chief Information Officers. In addition, a Technical Committee will be established to review the architecture of AI solutions in the public administration. Overall, the strategy foresees the following range of initiatives for the public sector:

- Promote AI pilot projects in the public sector and provide support along the entire implementation phase, from use-case selection, prototype and testing until successful implementation. Maltase strategy highlights pilot projects on AI in traffic management, education, healthcare, customer service, tourism, better utilities and energy;
- Enable automation and better use of data across public sector;
- Policy measures to support the public procurement of emerging technology solutions;
- Training and awareness programmes to support AI in the public sector.

## 22.3 Networking

The AI strategy of Malta foresees the development of a detailed **framework for collaboration between industry, educational and research institutes**. This includes the design of a collaboration model, tools, guidelines, and relevant standards that facilitate interactions. The strategy highlights the need for support actions to promote collaborations at different levels of granularity (e.g. both nationally and internationally oriented) and emphasizes the importance of collaborations across institutions of both public and private sectors, ranging from research institutes, private companies of any size level (with particular importance for start-ups), and educational institutions. Support actions for collaboration in AI includes, among others:

- Supporting cross-sector sharing, co-innovations with the (inter)national community;
- Increasing opportunities for collaborations with the government by opening up calls for proposals for researchers, businesses and public sector representatives on Maltese [web portal for AI](#);

- The launch of a Digital Innovation Hub with a focus on AI, which will serve as a collaboration platform to foster AI opportunities in the public and private sector by bringing research and innovation communities together.

Besides support for enhancing collaboration, the strategy of Malta is also proposing initiatives towards **increasing the international attractiveness** of the country for international talents, entrepreneurs and investors:

- The launch of a Start-up visa, which provides a simplified procedure for start-up founders and their families members from outside the EU to reside and work in Malta;
- Malta's [Key Employee Initiative](#) provides fast-track services to highly-specialised Third-country professionals employed in Malta;
- The government has re-introduced the [Qualifying Employment in Innovation and Creativity](#) (Personal Tax) Scheme. This measure facilitates employment of non-residents in roles which are currently not addressed by the local labour market by temporarily easing the tax expenses incurred by such individuals through a fiscal incentive.

In terms of **dissemination and uptake of AI**, the Maltese high-level workforce suggests:

- To organise promotion campaigns and outreach programmes to highlight the benefits of AI. The Maltese strategy announces a public investment of €1 million per year for this activity.

## 22.4 Regulation

The **development of a legal and ethical framework** is salient step towards a successful adoption and subsequent widespread deployment and use of AI across the economy. In October 2019, Malta published its [strategy towards trustworthy AI](#) (Malta, 2019d). It outlines Malta's vision for an ethical and trustworthy AI and sets out for ethical AI principles to achieve this:

- Human autonomy;
- Prevent harm;
- Fairness;
- Explicability.

Complementing this ethical framework, Malta's government has also set up the following policy initiatives towards the development of an ethical AI:

- The creation of a National Technology Ethics Committee to oversee the Ethical AI Framework and to ensure its monitoring and implementation;
- The launch of a national AI certification framework: a certification issued by the Malta Digital Innovation Authority ([MDIA](#)) as valuable recognition in the marketplace that the AI systems of successful applicants have been developed in an ethically aligned, transparent and socially responsible manner.

To encourage the adoption of AI, particular emphasis is placed to the development of **regulation and legislation**, including:

- A Technology Regulation Advisory Committee will be appointed to advise on legal matters and develop legal guidelines where needed (legislation to clarify IP ownership rights and liability in AI will be a priority);
- Malta is currently working on a Private Law Bill aiming to clarify IP and liability issues.
- Malta is setting up a regulatory sandbox for AI providing regulatory exceptions to firms to foster testing of AI solutions. In addition, a Data sandbox will be developed to provide guidance on how data protection rules apply.

In terms of **standardisation**, Malta's AI strategy emphasizes the importance to collaborate with international organisations on emerging standards and norms in AI. This goes along with the provision of a common definition on AI aligned with the one provided by the EU High-Level Expert Group on AI.

## 22.5 Infrastructure

The delivery of AI research, development and adoption can only be achieved in a well-developed and **cutting-edge infrastructure ecosystem**. As highlighted in Malta's strategy, an enabling infrastructure should be

part of a holistic AI strategy and contains various dimensions such as data and connectivity resources, compute capabilities and data sharing platforms for all institutional players, ranging from research institutes, regulatory authorities, and start-up ecosystems to innovation hubs. Among others, the strategy proposes to set up the following support initiatives:

- Similar to Denmark, Malta will invest in Maltase language resources and tools in order to foster language technology solutions;
- Further investments in data centres to meeting the growing needs of computing power and storage. [Malta Enterprise](#), Malta's economic development agency, will offer incentives and support measures in this regard;
- Increasing access to open data with the launch of [Malta Data Portal](#), an open data repository developed by the Malta Information Technology Agency ([MITA](#));
- Provide cost-effective access to computing capacity through various initiatives such as supercomputing cluster [A.L.B.E.R.T.](#), and Malta's participation in the European Initiative [EuroHPC](#) to develop a pan-European supercomputing infrastructure;
- Enable access to cloud platforms for the public and private sector by means of initiatives such as [Malta Hybrid Cloud](#) procured by MITA.

## 22.6 Update

The national AI strategy of Malta sets out a vision at long-term, aiming to transform Malta into a leading economy in the field of AI by 2030. The policies outlined in the strategy are meant to be undertaken in the period 2019-2022. Their implementation will be monitored and evaluated at regular basis. [Malta's web portal on AI](#) will be used to release forthcoming information on the progress of the strategy's implementation.



## 23 Netherlands

In October 2019, the Dutch government has released its [strategic action for artificial intelligence](#) (Netherlands, 2019a); a less extensive version is also available in [English](#) (Netherlands, 2019b). The policy report presents a range of policy initiatives and action plans to strengthen Netherlands' competitiveness in AI on the global market. The vision of the Dutch AI strategy relies on three strategic pillars, aiming at:

- Capitalising on societal and economic opportunities: policies encouraging the adoption, use and development of AI in the private and public sector and promoting the use of AI to tackle societal challenges;
- Creating the right conditions: policies supporting education and skills development in AI; fostering research and innovation in AI, facilitating the access to qualitative data and improving the digital infrastructure;
- Strengthening the foundations: including policy actions related to ethical issues, such as trust, human rights, consumer protection, and safety of citizens.

The strategy contains an extensive list of initiatives aiming at fostering AI in the economy through policies related to education, research and innovation developments from the lab to the market, networking, regulation and infrastructure.

As per funding, the Dutch version of the strategy mentions in annex that the yearly governmental budget to AI innovation and research is estimated at €45 million. The supercomputer developed at SURF and financed by the Ministry of Education, Culture and Science has a cost of €18 million.

### 23.1 Human capital

Formal education and training reforms are foreseen through policies targeting increased digital literacy in primary and secondary education and providing more opportunities to develop skills and competences in data science in higher education ([National Data Science Trainee program](#)). A national [online course on AI](#) is also available for civil servants in the Netherlands. Vocational training initiatives funded by the [Regional Investment Fund](#) will target more closely the future (digital) needs of the labour market. Further training and lifelong learning are fostered with the [STAP-scheme](#) – a €200 million investment to create training opportunities in AI and digital skills for individuals – and with a multi-annual programme for the improvement of [Lifelong Development](#), with particular focus on digital skills.

### 23.2 From the lab to the market

In order to stimulate basic and applied research in AI, the [Dutch Research Council](#) is supporting a new research programme on artificial intelligence. To complement this initiative, the Dutch AI-coalition proposes the establishment of an AI Competence Centre. In order to create favourable conditions for companies to invest in AI, the Dutch government improves access to innovation funding and venture capital through [Innovation Credits](#), the [Seed Capital Scheme](#) and the [Dutch Venture Initiative](#). In addition, the Chamber of Commerce offers hands-on information on AI, which could support companies in their innovation efforts.

### 23.3 Networking

The Dutch government highly values collaborations and partnerships in AI. To this purpose, the Dutch AI-coalition is currently drafting a plan to enhance synergies between research, education and organisations. Examples of public-private partnerships (PPPs) in the Netherlands are [Commit2Data](#) and [VWData](#) with a focus on big data. The importance of PPPs is further emphasized in the [Knowledge & Innovation Agenda 2020-2023](#) mentioning the need for collaboration on key technologies as machine learning and artificial intelligence. Furthermore, the strategy highlights examples of national collaborations in using AI applications in the legal environment (e.g. document automation and due diligence based on AI) and the public domain (e.g. chatbots). Finally, collaborations across the national borders are encouraged by strengthening Netherlands' partnership in European AI consortia (e.g. [BVDA/EURobotics](#), [AI4EU](#), [CLAIRE](#) and [ELLIS](#)) and international AI collaborations such as [Holland Innovation Network](#).

### 23.4 Regulation

Regarding regulation, the Dutch government advocates an ethical, trustworthy and responsible use of AI with respect for human rights and consumer protection, and based on a well-developed legal framework. Policy

actions relate to various research activities on ethical, legal and transparency aspects, and responsible use of AI. The Dutch government also highlights its active participation into High Level Experts Groups and European Directives on these issues.

### **23.5 Infrastructure**

The Dutch strategy includes policy initiatives to foster the data infrastructure and to provide foundations for data usage and sharing. It includes the promotion of FAIR principles for private data sharing, the participation into the [Common European Data Space](#) and the creation of an inventory of data sharing solutions. In terms of digital and telecommunication infrastructure, the Dutch strategy mentions among others the [Digital Connectivity Action Plan](#) (aiming at setting up a high-quality connectivity) and the government investments in supercomputing power (e.g. supercomputer at [SURF](#) and Netherlands' commitment in the [Digital Europe Program](#)).

### **23.6 Update**

The outlined strategy will be annually reviewed and updated by the Dutch government.



## 24 Poland

In August 2019, the Ministry of Digitisation has published a draft of its national AI strategy, entitled [Artificial Intelligence Development Policy in Poland for 2019-2027](#) (Poland, 2019). The policy draft has been released for public consultation, with the aim of gathering feedback and recommendations from relevant stakeholders. The public consultation lasted until September 9<sup>th</sup>. The collected feedback will be used to revise the actual draft. The current progress and milestones in developing the national AI strategy can be followed on a [roadmap](#) released by the Ministry of Digitisation. The Polish Government foresees to approve the national AI strategy by the end of the first quarter of 2020.

The Committee of the Council of Ministers for Digitalisation has been appointed to govern and coordinate the implementation of the national AI strategy of Poland and to evaluate it on a yearly basis.

The objective of Poland's strategy is to encourage the growth and innovation of the knowledge-based economy by supporting AI science and research developments and to prepare citizens for the digital transformation by improving their competences. Along the process of achieving these objectives it is important to account for the protection of human dignity and to ensure conditions for fair competition.

In particular, the Polish strategy is providing strategic guidance and policy initiatives to develop a holistic AI ecosystem with the aim of meeting the following objectives:

- Reforming the educational system and providing lifelong learning opportunities in AI-related fields;
- Encouraging growth and innovation of AI companies through dedicated support in AI research, including the provision of sufficient financial resources;
- Increasing national and international partnerships in AI;
- Creating a data ecosystem with trustworthy and high-quality data and increased data exchange mechanisms;
- Reinforcing the digital infrastructure, regulatory framework and test environments to foster the development of AI innovations.

In terms of funding, the Polish strategy presents initial estimations on the budget that could be earmarked to foster AI developments in Poland. According to these projections, the total of national and international coordinated investments for AI innovations (including private funds of Venture Capital) allocated until 2023 amount at PLN 1.8 billion. More concrete investment plans will be defined and released at a later stage.

### 24.1 Human capital

Educating the population to gain awareness of the benefits of AI and to acquire the necessary competences and skills to develop AI applications is an essential element to prepare for the transformations and challenges that AI will bring along. To this purpose, the Polish government is setting up a range of policy initiatives to reform the educational system. To foster AI and digital competences of students in **preschool, primary and secondary education**, the Polish government proposes to increase courses in IT, to create traineeship programs in AI in various disciplines, to develop programming and coding courses (such as R and Python) and to train students in data processing. Winter and summer schools in the field of AI are also considered for younger students to prepare them with basic knowledge in AI. **The revision of children's' and students' curricula should not only focus on acquiring technical skills but should equally target soft skills such as critical thinking, empathy and interpersonal skills.**

In terms of **higher education**, the Polish strategy foresees the development of Master programs in AI with modular courses to prepare students to particular key sectors such as healthcare and logistics. An Academy of Digital Applications will be set up to develop courses in AI, machine learning and cybersecurity at university level and will target around 1000 students. This initiative will be complemented with the 'Algorithm and Programming' championships that challenges above-average students of higher education to solve complex algorithmic and programming problems. Finally, the Polish Academy of Sciences has established a [Doctoral School on Information Technology and Biomedicine](#) providing PhD scholarships in AI related fields. To facilitate the transition of PhDs to the labour market, the Ministry of Science and Higher Education is providing grants to doctoral students to be employed by an entrepreneur while he/she is still conducting its basic research at the university.

Besides policy initiatives to support formal education in AI, the Polish government is aiming to raise the awareness of AI to the citizens in general and to foster a **culture of lifelong learning** for the workforce in particular. **Raising the public awareness** will be encouraged among others through the development of

Massive Open Online Courses (MOOCs) and the creation of an online platform providing an overview of the educational offerings in AI. Entrepreneurs will be informed about the available competence programs for lifelong learning trainings in AI. Finally, the upgrade of AI competences will also be encouraged in the public administration.

## 24.2 From the lab to the market

To foster basic and applied research in AI, the Polish government will set up a **Virtual Research Institute for Artificial Intelligence (VIR)**, in collaboration with businesses, academia and non-governmental organisations. The VIR for AI will support the Committee of the Council of Minister for Digitalisation in coordinating research challenges of the Polish AI Strategy. The [NASK Public Research Institute](#) will take up this role as a Centre for CyberSecAI. This institute is primarily focused on monitoring, testing and responding to threats on AI systems and on standardising and certifying cyber security procedures for AI systems. Furthermore, research and innovation in AI will be encouraged through a wide range of **funding mechanisms**, supported by funding programs of the Polish Development Fund ([PFR](#)), the Digital Poland Project Centre ([POPC](#)), the National Centre for Research and Development ([NCBiR](#)) and the Polish National Science Centre ([NCN](#)). It includes funding instruments such as public procurement (with the objective to earmark at least 10% of budgets of governmental entities to AI) and other dedicated funding in the field of AI. In addition, the Committee of the Council of Ministers for Digitalisation will set up guaranteed credit and loan programs to foster AI developments in Polish industries. These instruments could be complemented with European funding schemes (e.g. Horizon2020, Horizon Europe and Digital Europe), venture capital and crowdfunding initiatives. The Polish strategy identifies the following **priority sectors** with the highest potential to benefit from AI applications: industry, healthcare, transport and logistics, agriculture, energy, public administration, trade and marketing, construction and cybersecurity.

## 24.3 Networking

To foster the competitiveness of the Polish industry and to strengthen the research competences of the scientific community, the Polish strategy proposes various policy initiatives to encourage a **culture of collaborations in AI developments**. The [Future Industry Platform](#), the [Virtual Research Institute](#) and the [GovTech program](#) have recently been created to respond to the traditional lack of cooperation. The objective of these programs is to create synergies across the research and industry community and to serve as a platform for sharing expertise and partnership opportunities. The development of a collaborative AI ecosystem will be further encouraged through Digital Innovation Hubs which aims at fostering the dialogue between the public administration, the industry and scientific community. Lastly, AI Challenges Platforms similar to [kaggle.com](#) will be set up to foster collaborative research and developments of AI applications.

## 24.4 Regulation

In order to create a **trustworthy and sustainable environment for the development of AI**, the Polish government will set up a range of observatories and chairs to tackle ethical and legal issues. An AI Observatory for the Labour Market will be established to analyse the impact of AI on the labour market and to propose legislative and regulatory reforms for social policies. An Observatory of international AI policy and Digital Transformation will be formed to monitor European and international policies and regulations. Its task will be to coordinate and formulate recommendations for international initiatives. As part of the Virtual Research Institute for AI, a Department of Ethics and Law which will be set up to research and analyse the challenges related to law and ethics in AI and to come up with recommendation for legislative reforms and ethical guidelines. The Committee of Minister of Digitalization will be entitled to set up a legal task force to analyse and formulate legal initiatives.

The Polish government will support mutual recognition of interoperability standards and certification or compliance procedures of trustworthy AI. The priority of this policy will be securing trade secrets.

## 24.5 Infrastructure

Recognising that data is an essential enabler for the development of AI solutions, the Polish government is setting up **data policies** to ensure the availability of high-quality data and to improve interoperability and data sharing. To this purpose, the strategy foresees to further extent the [open data platform](#) containing open data collections of the public administration. In the same vein, virtual data warehouses will be created in which companies can share their industrial data in trustworthy and cyber secured data spaces. These

warehouses will act as API interfaces with transparent interoperability rules and clear data protection regulations to foster cooperations across companies in decentralised networks of like-minded members. The government will also investigate the use of data trusts. Overall, the governments' objective will be to incentivise public institutions and businesses towards data collection and data sharing. To do so, the Ministry of Digital Affairs will create an inventory of available data sources, which could be classified by sector (e.g. medical, energy, industrial, agricultural or transport). To facilitate data analyses, the Polish government intends to invest in **cutting-edge digital and telecommunication infrastructure**, such as high computer performance centres and increased connectivity through 5G networks.

## 24.6 Update

The Polish strategy will be monitored and evaluated on a yearly basis.



## 25 Portugal

In June 2019, the Portuguese government presented its national AI strategy entitled [AI Portugal 2030](#) (Portugal, 2019). It is setting out the challenges and opportunities of a rapidly growing AI ecosystem in Portugal. It presents a strategic vision for the upcoming years to foster and consolidate the use and development of AI in the public and private sector. Given that people constitute the main engine for the successful deployment of AI, the outlined strategy concentrates its action lines along the notions of inclusion, education, qualification, specialisation and research.

The national AI strategy of Portugal does not disclose financial provisions or estimations for its implementation.

### 25.1 Human capital

One of the main objectives outlined in the strategy relates to **human development** and in particular to the enablement and reinforcement of the population to the challenges and priorities that AI technologies bring along. This is achieved in the strategy based on three of its main axes: increasing the overall level of education in AI, upgrading the qualifications of the labour force and foster specialisation in AI-related fields.

Regarding education, the strategy emphasises the importance to prepare future generations for a digital and AI society. This can be reached through a well-developed education infrastructure providing the necessary basis for education in AI including training to younger students and to higher qualification levels such as bachelors, masters, post-graduates and PhDs. Finally, continuous support to encourage students' interest and specialisation in computer and data science in particular and STEM subjects in general is needed to create a highly skilled and qualified labour force in computer science, engineering and AI related areas.

Specific actions related to **reforms of the education system in AI** include among others:

- Teaching young students the fundamentals of machine learning, through the [Ciência Viva Clubs](#) initiative;
- Developing programming/coding capabilities and creativity capabilities for problem solving;
- Creating a teaching programs in AI at each level of education;
- Development of graduate specialisation programmes (MSc and PhD) for executive education for adults.

In terms of qualification and specialisation, the strategy targets a more skilled labour force by means of AI and data science (re)skilling qualification programmes. Increasing the stock of active population with digital and AI skills is primordial to meet the upcoming demands of employment in AI. The strategy provides particular attention to support actions that increase the digital and science competences in the public sector.

Specific actions to develop qualification programmes for **reskilling and upskilling the population** to meet market demands and **lifelong learning initiatives** include:

- Creation of Regional/local Networks for Digital Qualification for reskilling and upskilling adult training;
- Creation of qualification vouchers and lifelong learning opportunities;
- E-learning courses on AI and specific application domains;
- Reinforcing already existing AI and data science skill qualification programmes in public sector.

### 25.2 From the lab to the market

The objective of support actions from the lab to the market all aim to the development of an AI knowledge-intensive research and innovation ecosystem. It comprises support actions towards the creation of a community of young, vibrant, knowledge-intensive AI companies able to develop cutting-edge technologies in AI. To this purpose, the Portuguese strategy proposes policy initiatives to reinforce the research and innovation potential in AI. Actions outlined in the strategy to **establish a strong research and innovation ecosystem** include among others:

- Support for application based and fundamental research;
- Participation to the development of a Centre of excellence for AI R&D;
- Promotion of new and innovative solutions for administrative simplification in the public sector ([SIMPLEX](#) program);
- Launch of Innovation funding programmes;

- Creation of sandboxes and testing facilities;
- Refinement of the innovation voucher instrument;
- Reinforcement of the national structure for funding management and identify KPI for investment evaluation.

Besides these support actions, the Portuguese strategy highlights the importance of promoting research and innovation in specific scientific areas. **Priority sectors that will be promoted as "living labs"** for new experimentation in AI are:

- AI for urban transformation (sustainable cities);
- AI for sustainable energy networks;
- AI for biodiversity (green and blue economy);
- AI for autonomous driving;
- AI for cybersecurity;
- Quantum materials for AI;
- Adaptive learning curricula for students.

**Specialised services** based on AI applications will include:

- Natural Language Processing (for automatic translation and other automatable services);
- Real time AI (for securing business and financial transactions);
- AI for software development;
- AI for edge-computing.

Other policy initiatives not explicitly mentioned in the AI strategy report, may contribute to the creation of a vibrant enterprise ecosystem in Portugal, such as [incentive systems](#) for technological R&D in companies, [Startup Portugal](#), [Incubation vouchers](#), [Industry 4.0 National Strategy](#), among others.

Policy actions towards advanced use and deployment of AI in the public administration include among others, [LabX](#) – aiming to create a culture of experimentation and innovation in the public sector –, and [InnoLabs](#) to share good practices across the public administration.

## 25.3 Networking

There is a widespread consensus that AI will profoundly transform our world and will provide powerful solutions to the current challenges we are facing nowadays. The opportunities offered by AI are ambitious. To fully leverage these ambitions, **a collaborative and networking approach is essential**. The Portuguese strategy proposes a wide range of support actions to forge partnerships across both public and private institutional players. The strategy advocates that joint undertakings should not only be restricted within Portugal, but should include European-wide and international collaborations.

Support actions to increase networking and collaborations include:

- Extension of collaborative laboratories ([CoLabs](#)) and Digital Innovation Hubs (DIHs) (e.g. current DIHs in Portugal are: Produtech (production technologies), iMan Norte Hub (manufacturing) and HUB4AGRI (agriculture));
- Increase partnerships with other Member States through joint participations on electronic components and systems (ECSEL), high-performance computing ([EuroHPC](#)), and the Quantum Flagship (H2020);
- Fostering of long-term collaboration between academia and companies through framework contracts and data/technology sharing platforms;
- Participation in European Networks, European AI excellence centres and other European DIHs (e.g. DIH on cybersecurity at Leon or the DIH on IoT in Salamanca).

Besides networking support, the strategy provides ample attention to instruments that **promote the national and international attractiveness of AI** in Portugal by means of dissemination campaigns. Dissemination campaigns are essential to ensure digital inclusion by informing the whole population about the benefits of AI technologies. International campaigns in turn aim to attract international AI and ICT talents to study and work in Portugal.

Hence, support actions to promote the national and international attractiveness of AI include:

- Promote the attractiveness of Portugal to foreign talent, including students, researchers and experienced professionals, and reduce border obstacles;
- Spread the awareness about AI and technology in the whole of the population.

## 25.4 Regulation

The emergence and expanding use of AI is driving regulatory efforts to come up with a framework and guidelines on how to develop and use AI technologies. **Legal, regulatory and ethical frameworks** are essential for the development of standards in artificial intelligence regarding issues of transparency, accountability, liability and ownership. In terms of regulation, the Portuguese strategy proposes the following actions:

- Creation of an ethical committee for AI and Automation to define and deploy guidelines for ethical-by-design AI;
- Support for the development of a legal and regulatory framework, to determine among others liability issues in case of conflicts due the involvement of AI decision making;
- Support should be given to companies and regulators to find appropriate legal frameworks.

## 25.5 Infrastructure

In terms of infrastructure to enable the development of AI technologies, the Portuguese strategy proposes following support actions:

- The creation of a National Data Infrastructure (a centralised repository for administrative data). This action fits in the same line as the [Open Data Policy](#) of the Portuguese Foundation for Science and Technology (FCT) providing guidelines for managing and sharing data in the scientific community;
- The establishment of supercomputing and quantum computing facilities. In this respect, the Portuguese government has developed the [Advanced Computing Portugal 2030](#) strategy to define objectives for the creation of high-performance computing in Portugal.

## 25.6 Update

The outlined strategy will be annually reviewed and updated by the Portuguese national funding agency for science, research and technology.



## 26 Romania

The Romanian government is currently preparing its national AI strategy. Romania's AI strategy should be released for public consultation at the end of 2019, according to a [recent statement](#) of the communication minister, Alexandru Petrescu, at the 2019 Ministerial Council meeting of the Organization for Economic Cooperation and Development (OECD) in Paris.

According to the minister, Romania's strategy aims to ensure the adoption of safe AI application in every day's life, and to promote fundamental research leading to genuine AI applications and developments, while preserving human rights and social values.



## 27 Slovakia

Slovakia is one of the Member States that includes its AI-related policies as part of a broader digitalisation strategy. In October 2019, the Slovakian government published an English version of the [Action plan for the digital transformation of Slovakia for 2019 –2022](#) (Slovakia, 2019a). The action plan offers a set of concrete steps on how to start building a sustainable and human centric, and trustworthy AI ecosystem. The action plan is based on a wider [Strategy of the Digital Transformation of Slovakia 2030](#) (Slovakia, 2019b), setting out the long-term perspective of Slovakia for a successful digital transformation of the economy and society. While the strategy report provides a broader picture, the action plan is more detailed and includes concrete policy measures for the years 2019-2022.

The Slovakian Action Plan sets out a list of policy initiatives with a short-term time horizon that covers the following strategic areas:

- Supporting digital transformation of schools and education to prepare for digital skills needed in the digital era;
- Strengthening the basis for a digital and data economy;
- Improving abilities of the public administration to innovate and use the data for the benefit of citizens;
- Supporting the development of an AI ecosystem.

As per funding, the [Analysis for budgetary implications for public administration](#) (under Analýza vplyvov na rozpočet verejnej správy), that accompanies the Action plan, provides general government budget projections for the coming years. Budget figures on AI in particular will be estimated at a further stage, together with the relevant partners from business, academia and civic society including non-profit organisations.

### 27.1 Human capital

One of the milestones of the Slovakian strategy is to build the foundations to educate current and upcoming generations in the field of AI. With respect to **formal education and training reforms**, the Slovakian strategy highlights the following initiatives:

- The Ministry of Education will prepare a **program for Informatisation of education until 2030**: this program will include the provision and update of ICT infrastructure of the educational system, but will also target the improvement of quality of education. To address the latter issue, the government will encourage the reform of educational programs to develop competences and skills needed in the digital transformation, including AI-related competences;
- The Office of the Deputy Prime Minister of the Slovak Republic for Investments and Informatisation (ODPMII) in collaboration with relevant ministries will analyse the current condition of digital skills in Slovakian SMEs and come up with measures and standards to increase digital literacy of its employees;
- The Ministry of Education and the ODPMII are setting up an **expert group for coordination of educational activities in artificial intelligence**. Among others, this expert group will work on mapping and analysing relevant international and Slovakian educational programmes in order to assess where and how reforms could be introduced. Recommendations for educational reforms should also be based on consultations with relevant stakeholders as school, public authorities and business sector.

Besides a strong emphasis on reforms to formal education systems, the Slovakian strategy also devotes particular attention to **lifelong learning opportunities and vocational training** in the digital era, with an important impact on AI-related fields:

- The Ministry of Education and the Ministry of Labour are setting up a policy initiative to support **lifelong learning opportunities for employees**. Together with universities, these ministries will assess new training requirements on the labour market due to technology changes and digital transformations such as AI. They will adapt training and education possibilities for the current workforce and upcoming job seekers.

Rapidly changing technologies implies the need to adapt skills and competences to the labour market. Hence, the Slovakian strategy aims at aligning the education in AI to the current and forthcoming skills needs in the public and private sector:

- Education reforms to **prepare employees for the needs of the economy**: an initiative to support transformations to the educational system in view of meeting upcoming labour market requirements. Among others, its objective is to explore and analyse forthcoming needs, and to support changes in educational paradigms and systems (e.g. teaching of algorithmic thinking, creativity and problem solving, teaching support, transformations at all levels of education).

## 27.2 From the lab to the market

One of the main building blocks for the successful development and deployment of AI is the creation of opportunities to conduct research and to launch innovative products and services on the market. Initiatives fostering both research and innovation should target both the public and private sector. In terms of policies aiming to **increase the research potential in AI** of the public and private sector, the Slovakian strategy highlights the following instruments:

- The ODPMII and other relevant ministries supported the creation of a **national platform for research and utilisation of AI**: the [Slovak AI](#) platform does not only aim to strengthen the research in AI but also serves for AI education, attracting international talents, increasing networking opportunities and developing ethical principles in AI;
- The ODPMII and relevant ministries will prepare and disseminate **calls for grant schemes for basic and applied research in AI**. Direct financial support of this kind aims at increasing the Slovakian's research capacity in AI;
- The ODPMII, the Ministry of Education and the Ministry of Economy will set a policy to **increase private sector research in AI**. This initiative aims at encouraging the creation of a start-up ecosystem in AI with increased investment opportunities for AI companies;
- The ODPMII will commission the development of a **tool for natural language processing** to accelerate the development of AI in the private sector and improve the quality of public services;
- The National Security Authority and the ODPMII are establishing a national **competence and coordination centre for cyber security**. This centre will serve to develop new technologies in the field of cyber security, such as encryption. Among others, it will also evaluate the use of AI for automating security procedures;

While basic and applied research in AI is important, it is equally crucial to provide opportunities to develop high-potential ideas into successful products and services. In terms of policies **increasing the innovation potential in AI**, the Slovakian strategy foresees the following:

- The Ministry of Transport is establishing a range of **policies to support smart mobility** (e.g. self-driving cars and other sophisticated transport services): the aim of these policies is to prepare a strategy on how the public sector can collaborate with the private sector to innovate in this particular field. The creation of an action plan is foreseen to define tasks, responsibilities and priorities for the participating stakeholders. The Ministry is also taking steps towards:
  - Assessing the need to review regulations for smart mobility;
  - Setting up a Smart Mobility Lab to increase basic and applied research opportunities in this field;
  - Facilitating the development of proof of concepts in smart mobility and creating test environments for self-driving cars.
- The ODPMII and the Ministry of Economy are developing a **manual for companies for deployment of AI**. It is meant to provide guidelines and hands-on support for companies that would like to start using artificial intelligence and can at long-term improve the innovativeness of Slovakian companies in AI.
- Several policies aim to foster innovations in the public sector. Among others, the Slovakian government is supporting following initiatives:
  - The creation of a platform where public administration can launch calls for creative solutions for digital and AI-related problems they are currently facing. Such a platform could follow the example of the US public platform [challenge.gov](#);
  - The creation of an open API platform to improve the diversity of service to citizens and to open up data to the wider public which can increase the innovation potential in AI-related issues.

## 27.3 Networking

Although many of the previously mentioned policies aim indirectly to increase **networking opportunities** and partnership, the Slovakian government also supports hubs and platforms with a dedicated networking objective, such as:

- In collaboration with the Ministry of Economy and IT Association of Slovakia, the ODPMII will prepare a feasibility study to assess measures for supporting and setting up a European **Digital Innovation Hub** in Slovakia;
- The Slovakian government supported the creation of a civil organisation [Slovak.AI](#) with the aim of building an AI ecosystem to foster collaborations and networking.

The Slovakian strategy has a dedicated policy to increase the **international visibility** of AI by making education more accessible to foreign students:

- The Ministry of Education is launching a **joint education initiative in AI** to increase the attractiveness of AI in Slovakia. Among others, this policy initiative includes the preparation of AI courses in English that could be taught through “blended learning” methods. Overall, this initiative can serve to attract talented foreign students in AI.

To measure the **dissemination and uptake of AI** in Slovakia, the Deputy Prime Ministers Office launched an initiative to collect proposals of AI and innovative projects from public sector institutions via a [web portal](#). In the near future, the portal will be expanded with analyses and summary details of the submitted projects. In addition, a survey has been launched to measure AI uptake by companies and companies’ attitude towards AI. Results of this survey will be published in March 2020.

Finally, the Slovakian strategy mentions the use of AI technologies to prevent dissemination of fake news and disinformation:

- The Security Council will establish a **working group on disinformation and fake news**: the objective of this working group is to coordinate the creation of measures to counter the dissemination of disinformation and fake news. Mechanisms to do so will be using artificial intelligence.

## 27.4 Regulation

One of the main prerequisites for a successful and sustainable deployment of AI is related to social values of trust and transparency. Building trustworthy AI systems requires proper **ethical guidelines** aiming to define concepts of integrity, explainability, and reproducibility in AI. To this purpose, the Slovakian government proposes to work on:

- Principles for a **transparent and ethical use of AI**: the objective of this policy launched by the ODPMII and the Ministry of Economy aims to define guidelines and legislation for a trustworthy use and responsible deployment of AI. Among others, the policies related to ethical guidelines will include:
  - The launch of a public survey to obtain the point of view of citizens and companies on ethical AI. The results of the survey will help policy makers to define ethical guidelines;
  - The establishment of committee for ethics and regulations in AI.

In addition, the action plan emphasises the need for a modernisation of regulations and legislation. In general, the Slovak government advocates the creation of a **goal-oriented and dynamic regulation** that leaves more freedom for experimentation. Such a dynamic regulation would enhance the scope for innovative developments and would be less restrictive in an environment that is rapidly changing due to constant evolving technologies. To this purpose, the strategy proposes:

- The development of a **legal framework for data**: the ODPMII is currently preparing a new Act on Data to better define regulations on data protection, disclosure principles, data access and open data regulations;
- A revision of the **regulatory environment for AI**: An advisory group consisting of experts from academia, businesses and governmental institutions will be set up to provide dedicated recommendations for the need to assess the current legislation and regulatory framework for AI. Among others it will assess to what extent the current AI regulation models on data management, cyber security and intellectual property should be revised.

## 27.5 Infrastructure

Understanding that data is the main fuel for a successful development of AI, one of the main goals of the Slovakian action plan is to become a **dynamic data economy**. To this purpose, the Slovakian government will put in place digital data platforms to ensure the needs of artificial intelligence by providing access to high-quality and trustworthy data. In this respect, following policy initiatives are presented in the action plan:

- The creation of an **Institute for trustworthy data**: the role of this institute is to guarantee the provision of trustworthy data from public administration. Hence, its objective is to provide open access to high value databases after having controlled them for verified them on validity, constancy and credibility;
- **Analytical tools for management of data in the public administration**: a policy of the ODPMII to facilitate policy making based on data in the public administration by elevating technical barriers of data management to the end users. This will done by developing and putting at disposal a range of analytical tools (SQL tools, machine learning, visualisation tools, simulation tools or statistical tools) to facilitate analytical research without having to care about the technical and data management issues;
- Setting up a **Personal Information Management System (PIMS)**: a centralised data repository containing all data on citizens that has been collected by public administration. The data repository will respect citizens' rights on data protection and data sharing, allow them to provide their prior consent on these issues;
- The Ministry of Environment is setting up a **platform for sharing harmonised spatial data**: to comply with the INSPIRE directive, the Slovakian government is currently establishing a platform to provide access to harmonised spatial data.

Lastly, the Slovakian strategy incorporates several policy initiatives to improve the digital and telecommunication infrastructure of the country:

- Support and setting up a national **high-performance computing** competence centre and participating in the joint European undertaking [EuroHPC](#) that aims to pool European resources to develop supercomputers;
- Policy support for the completion of a **gigabit fibre infrastructure**. A related policy initiative provides support to 5G for Europe Action Plan. Both initiatives aim to increase internet connectivity and achieving the goals of the EU gigabit society.

## 27.6 Update

The Slovakian government will monitor policy implementations on annual basis. The annual evaluation report will be send to the government on the 30<sup>st</sup> of September of each year. Results of the monitoring exercise will then be used to update the implementation roadmap of the Action Plan.



## 28 Slovenia

The development of a national AI strategy for Slovenia is ongoing. A high-level working group consisting of representatives of various ministries, research institutions and government departments has been put in place to develop the strategy. This working group is currently drafting the strategy outlining the various policy initiatives to support Slovenia in increasing its international competitiveness in AI. As artificial intelligence is a multidisciplinary field, the working group takes a holistic perspective towards strategic actions and policies in AI, targeting among other the following objectives:

- Analysing the state of artificial intelligence in the country;
- Strengthening technological and industrial capacities in the field of artificial intelligence;
- Responding to socio-economic changes, such as changes in the labour market, education system;
- Examining possible foreign best practices in this field;
- Formulating proposals for systemic regulation of the field;
- Providing an appropriate ethical and legal framework;
- Harmonizing systemic system proposals with country and EU strategic documents;

One of the main flagships of the Slovenian strategy is the establishment of an international [AI research centre](#) in Ljubljana, as reported in April 2019. The research centre will be located in the premises of the Jožef Stefan Institute and will make use of the existing research staff. However, the research subjects will be drastically different. The department of intelligence systems will be transformed into a centre focusing on governance and policies in AI. In order to improve scientific research in the fields of AI and big data, Slovenia is currently rolling out the HPC RIVR VEGA project to establish a national high-performance computing infrastructure.



## 29 Spain

In March 2019, the government of Spain's Ministry of Science, Innovation and Universities published the [RDI Strategy in Artificial Intelligence](#) (Spain, 2019). It establishes a series of priorities and policy recommendations to create the appropriate ecosystem for the development and application of AI technologies. Although the policy report is mainly focused on the creation of a framework for a solid Research, Development and Innovation (RDI) ecosystem in AI, it serves as the initial structure for the development of a national AI strategy. The RDI strategy in AI identifies the following priorities:

- Developing a framework for the development of solid IA RDI system and the analysis of its socio-economic impact;
- Identifying key priority areas in which research and innovation in AI should be maximised;
- Facilitating the transfer of knowledge and its return to society;
- Fostering the development of education and competences in the field of AI;
- Establishing a digital data ecosystem and enhance the available digital infrastructures;
- Analysing and developing an ethical framework from an RDI perspective.

The first priority aiming at developing an organisational structure for a solid RDI system in AI will be supported by various policy initiatives increasing the **opportunities for collaborative partnerships**. Among others, it will include the creation of a Network of Centres of Excellence in AI and Digital Innovation Hubs. This network can be primarily formed by existing national AI research centres and other [research centres](#) with significant dedication to **AI research** such as Severo Ochoa Excellence Centres and María de Maeztu Excellence Unit. Other initiatives. The nodes of this network will not only be fruitful to strengthen RDI activities in AI but will also be effective means to promote public-private collaborations, to foster knowledge transfers and to attract and retain international talent. To encourage collaboration opportunities, the RDI strategy proposes the launch of an AI Capability Map, which would survey and map the AI capabilities and competences of the various science and technology communities in Spain.

The policy document identifies a set of priority areas where to develop RDI activities: connected industry 4.0, smart cities and territories, health, energy and environment, safety and security, culture and tourism, public administration and education. According to the timeline outlined in the RDI strategy report, sectorial strategies will be developed to define dedicated policy actions to **strengthen the innovation capabilities** and competitiveness in above mentioned key sectors. Key sectors of the RDI strategy are highly similar to those identified by the Italian national strategy. Similar to Italy, the Spanish RDI strategy has a **dedicated focus on the public sector**. It recommends the creation of a National Data Institute for a better data governance and improved quality of public services. AI applications based on natural language processing such as chatbots could serve a better interaction between public services and citizens.

With respect to education, the RDI strategy recommends **education reforms** to maximise the opportunities to improve skills and competences in AI and digital subjects. The Spanish Ministry recognises the need for transversal and specific training following the developments of AI in all education levels. This calls for basic and advanced AI training in primary, secondary and higher education (Degree, Master, and Doctorate). These measures should be complemented with specific trainings for professionals, offering **lifelong learning and reskilling opportunities**. Promoting continuous training throughout professional life is primordial to keep competences up to date and aligned with future labour market demands. To this purpose, the RDI strategy also considers setting up specialised MOOCs to respond to competences required by future professions.

The RDI strategy recognises the essential value of data in the development of AI. Hence it advocates the **creation of a digital data ecosystem** consisting of high-quality databases with open data access. To ensure high-quality of the data, it is recommended to create quality management systems and certification schemes. One of the Spanish policy initiatives for open data following the Public Sector Information ([PSI](#)) directive is the creation of an open data portal as [datos.gob.es](#). Other initiatives include the provision of AI algorithms and software platforms to facilitate the exploitation of open databases. The Spanish government has also set up physical computing infrastructures such as the Spanish Super Computing Network ([RES](#)), a distributed network of thirteen supercomputers. In addition, the Spanish government is participating to the implementation of the European Open Science Cloud ([EOSC](#)) initiative, a cloud infrastructure to promote open science at European level. Spanish efforts to support the development of future 5G communication networks, supercomputing and cloud computing are also channelled through the policy on [Digital Enabling Technologies](#), a program to support R&D grants in these specific fields.

Finally, the RDI strategy recommends to set up a Spanish **Committee on Research Ethics** to draft an ethics code for AI and to define ethical guidelines for a fair and sustainable use and development of AI.



## 30 Sweden

In May 2018, the Swedish Ministry of Enterprise and Innovation released its AI strategy, [National Approach for Artificial Intelligence](#) (Sweden, 2018). It does not outline concrete policy actions and initiatives, but acts as a guiding document with policy announcements and strategic priorities for all AI players in Sweden. In this sense, the strategy document serves as a reference to help the government to outline forthcoming policy initiatives aiming at strengthening Sweden's welfare and competitiveness by fully exploiting the benefits of AI. To this purpose, the Swedish strategy proposes to focus on the following priority areas:

- Increase education and training in AI skills and competences;
- Strengthen basic and applied research in AI;
- Foster innovation and use of AI and collaborative partnerships;
- Ensure the development of a legal and ethical framework for AI and create adequate digital infrastructure.

Prior to the release of the strategy, [Vinnova](#) – Sweden's innovation agency – published an extensive [policy report](#) outlining the opportunities and challenges of AI in Sweden, and Sweden's capabilities to embrace the full potential of AI (with concrete examples of ongoing AI projects).

This section presents the policy recommendations of Sweden's AI strategy. Where possible, it aims to incorporate new policy initiatives that have been rolled out since the launch of the strategy in May 2018. Among others, this includes funding for [AI-training for professionals](#), [prospecting skills needs for the future](#), and [AI-related innovation projects](#) through Vinnova.

Most of these policy initiatives are organised under the umbrella of an ambitious flagship program for AI in Sweden, called [AI Innovation of Sweden](#) and hosted by the [Lindholmen Science Park AB](#). It is organised as a national centre for applied AI research and innovation and takes a holistic approach to foster AI in Sweden by supporting education, research, innovations and collaborations and by providing access to a well-developed technology and data infrastructure. As this AI program targets a wide range of policy areas, many of their policies are scattered across the various sections below.

The Swedish AI strategy does not disclose financial provisions or estimations for its implementation.

### 30.1 Human capital

Training and education instruments to increase the stock of AI talent and to encourage skills development are primary conditions for the successful deployment of AI. Endorsing this point of view, the Swedish government assesses the need for **formal education and training** in AI in the following two policy recommendations:

- Encouraging education institutions to provide a sufficient number of people with AI education and training. Swedish universities have started proposing bachelor's and master's programs in AI fields, e.g.:
  - Master programs on [Data engineering](#), [Machine learning and statistics](#), [Image analysis and machine learning](#) at Uppsala University;
  - Master programs on [Design for Creative and Immersive Technology](#) at Stockholm University;
  - Master programs on [Machine learning](#), and [Systems, Control and Robotics](#) at KTH Royal Institute of Technology.
  - Master programs on [Language technology](#) and [Logic](#) at the University of Gothenburg;
  - Three newly launched [AI-related](#) master programs on [Data science and AI](#), [High-Performance computer systems](#) and [Physics](#) at Chalmers University.
- Incorporating a strong AI component in non-technical programmes as to foster a broad understanding of the use of AI.

In addition, the rapid development of AI calls for increased opportunities of **lifelong learning and continuing education** to keep professionals up-to-date and aligned with forthcoming skills needs on the labour market. To this purpose, the Swedish strategy recommends the following policy:

- Continuing and further education for professionals. This recommendation has been rolled out in an effective policy in the form of a course on the Elements of AI (a policy under the AI Innovation of Sweden program).

Finally, in order to evaluate and prepare for **changes in skill needs on the labour market** due to AI technology developments, the following policy has been set up:

- A [pilot project](#) to identify the need for skills development of companies and organizations in the southern region to better utilize new smart technologies based on artificial intelligence. The aim is then to develop AI courses in accordance to the needs that have been identified.

### 30.2 From the lab to the market

The creation, use and further deployment of AI applications largely depend on the opportunities to conduct research in the field of AI and on the available support to transform innovative ideas into market products and services. In this respect, the Swedish strategy emphasizes the need for a **strong basic and applied research environment in AI**. This is achieved by means of the following policy initiative:

- [AI Innovation of Sweden](#): an ambitious program with a holistic approach to foster the development of AI applications in Sweden. It is organised as a national centre for applied AI research and innovation with more than 50 partners from the industrial and public sectors, research institutions, and the academic world. Besides supporting AI research and innovations, it provides a platform for collaborations, and technology/data infrastructure. Many of the policy initiatives outlined in the policy summary tables are under the umbrella of this program.

A large part of the Swedish strategy is devoted to policy recommendations to stimulate innovative applications and use of AI in society. To aim is to develop Sweden's competitiveness by fully exploiting the value creation of AI technologies. Usage and development of AI should be fostered in both private and public sectors. This is primarily done by **supporting innovative projects to develop new AI applications**, with policy initiatives such as:

- A series of [innovative projects](#) within the area of applied AI run under the umbrella of the AI Innovation of Sweden program. They relate to various fields, such as: space data, language technology, education, and heart imagery;
- [AI-related innovation projects](#) financed through [Vinnova](#), Sweden's innovation agency. On 19<sup>th</sup> of November 2019, a total of 187 ongoing projects have been retrieved in Vinnova's project database with the keywords "artificial intelligence" and "AI". They may be overlapping with the projects mentioned under the AI Innovation of Sweden program.
- [Startup AI activities](#): Vinnova also provides funding support to SMEs and public organisations to start their first innovation project in AI. A call for proposals of projects has been closed recently in which participants can apply for a maximum of SEK 500,000.

All the above mentioned policy instruments aim at accelerating the introduction of new AI applications and technologies by means of support to pilot projects, **testbeds and specialised testing environments**. Sweden's innovation agency foresees the following initiative to strengthen the prospects for testbeds in Sweden:

- Vinnova is pointed out as national coordinator to strengthen [testbeds and demonstration](#) activities in Sweden. To this purpose it disseminates information on the hundreds of ongoing testbeds in Sweden, among others in the field of AI.

### 30.3 Networking

Building networks and partnerships is essential to harness the benefits of new AI opportunities, in particular for a small country such as Sweden with a relatively limited domestic market. Hence, teaming up with prominent players within the country or across borders with other Member States or beyond the EU is primordial to extent the possibilities of developing AI applications and technologies. To this purpose, the Swedish government is setting up policies to **foster AI collaborations and partnerships**, such as:

- Nodes and co-locations: within the framework of the AI Innovation of Sweden program, [nodes and co-location areas](#) are created across Sweden to boost and enable collaborations and partnerships for AI innovation, e.g.:
  - [Gothenburg node](#): placed at Lindholmen, the Gothenburg office space offers workspaces and meeting areas for the research partners;
  - [Greater Stockholm node](#): a pre-study is ongoing to shape the collaborative office space in this region;
  - [Southern Sweden node](#): a pre-study is ongoing to study how the southern Swedish AI hub should be organised and financed in the long term;

- [Northern Sweden node](#): In March 2020 a plan for the set-up of the northern node should be ready;
- [Örebro node](#): a collaboration between Örebro University and Region Örebro County, will form the foundations of the new node in Örebro, which will work among others on health issues.
- Analytic Imaging Diagnostic Arena ([AIDA](#)): a Swedish arena for research and innovation on analytic image-based diagnostics. AIDA is a **cross-disciplinary and cross-sectoral collaboration** aiming for largescale usefulness from Artificial Intelligence (AI) in healthcare.

In terms of **international attractiveness** the Swedish strategy (p. 5) claims that “if Sweden can strengthen policy conditions across all policy areas, it will be well placed to offer an internationally attractive working environment for business, researchers and others interested in AI research, development and use”.

### 30.4 Regulation

Regulation is an integral part of every Member States strategy. It includes recommendations for the development of a legislation to foster AI innovations, it covers aspects of ethics and inclusion, and it incorporates standard settings to drive the adoption and application of AI.

With regard to **ethical and sustainable AI**, it is important to develop ethical guidelines to ensure a transparent, explainable, and non-discriminatory development of AI. This is particularly important in systems that may affect the physical world, such as self-driving vehicles or AI applications in health care. To this purpose, the Swedish government established a Committee for Technological Innovation and Ethics ([KOMET](#)) in August 2018. Following initiatives have been launched to foster the creation of ethical and sustainable AI:

- The establishment of the AI sustainability centre: a [hub](#) co-founded by companies, universities and public authorities with a specific focus on social and ethical aspects of AI;
- [Seminars](#) at universities on the ethical challenges of AI in business, administration and across various sectoral areas.

The Swedish strategy recommends a well-established **legislation** to foster the use of AI and to prevent risks for both society and individuals. In this sense, the new legislation should safeguard privacy, ethics, trust and social values. At the time of writing this report, new legislation is still in the starting blocks and hence Swedish legislation related to data protection and ownership for instance is largely based on EU law.

The development of appropriate frameworks of **(international) standards** is also suggested in the Swedish strategy. In terms of standardisation, Sweden has the following organisations and bodies:

- Swedish Institute for Standards ([SIS](#)): an international organisation specialised in national and international standards;
- Swedish Standards Council: the principal body for all Swedish standardization. Its task is to promote interest in standardisation and to encourage the use of standards.

### 30.5 Infrastructure

The Swedish strategy emphasizes the need for a digital infrastructure to harness the opportunities that AI can provide, including both a high-quality data infrastructure and a well-developed digital and telecommunication infrastructure in terms of computer power, connectivity and network capacity. Both the development of the data infrastructure – by improving data quality, data availability and data sharing opportunities – and the setting up of the IT infrastructure are covered by the AI Innovation of Sweden program.

With regard to the **data infrastructure**, the AI Innovation of Sweden program foresees the following policy:

- Access to datasets through the [Data Factory](#): in order to accelerate AI innovation and applications, the Data Factory aims to provide horizontal resources to all research partners, ensuring that data sets are made available across industries and application areas.

In terms of **telecom and IT infrastructure** the AI Innovation of Sweden program proposes:

- Access to costly technical infrastructure through the [Data Factory infrastructure](#): storage, computational power and access management tools are made available to the research partners of AI Innovation of Sweden in order to analyse large and complex databases. Access to this IT infrastructure is primarily made available through a partnership with [CGit](#), a company that owns large data centres offering computational resources and optimised services for data access.

### **30.6 Update**

The Swedish national strategy on AI will be reviewed on a regular basis to assess the policy progress and to foster the development and use of AI.



## 31 United Kingdom

In April 2018, the government of the United Kingdom (UK) published their national AI strategy entitled [AI Sector Deal](#) (United Kingdom, 2018).<sup>4</sup> This strategy has been updated after one year in May 2019. A dedicated [web portal](#) developed by the Ministerial Department for Business, Energy & Industrial Strategy and the Ministerial Department of Digital, Culture, Media & Sport presents an update of the progress. These ministries have developed an [Office for Artificial Intelligence](#) in charge of coordinating the implementation efforts set out in the AI Sector Deal.

The objective of the AI Sector Deal is to prepare the economy and society for the transformations that AI brings along. It provides the foundations to foster UK's global position as a leader in developing AI technologies. To this purposes, the strategy is focusing on improving UK's position in the following 5 key areas:

- Ideas - the world's most innovative economy;
- People - good jobs and greater earning power for all;
- Infrastructure - a major upgrade to the UK's infrastructure;
- Business environment - the best place to start and grow a business;
- Places - prosperous communities across the UK.

These 5 key areas boil down to the policy areas identified by the AI Policy Framework highlighted in Section 3 of this report: human capital, from the lab to the market, networking, regulation, and infrastructure.

The government has earmarked a budget of £0.95 billion for the implementation of the AI Sector Deal, which is supplemented with £1.7 billion stemming from the Industrial Strategy Challenge Fund.

### 31.1 Human capital

In terms of **formal education and training** towards increasing AI-related skills and competences of future generations in the UK, the government is proposing the following policy initiatives:

- The creation of 16 [New Centres for Doctoral Training](#) at universities across the country, delivering 1,000 new PhDs over the next 5 years;
- Industry-funding for [new AI Masters places](#). In addition, 2,500 places have been created for AI and data conversion courses starting in 2020;
- Funding to encourage education in mathematics, digital and technical fields to foster [skills in STEM-related subjects](#) (£406 million);
- The creation of a pilot for a [Teacher Development Premium](#) (£42 million). In this pilot budget will be allocated for high-quality professional development for teachers in less developed areas.

The AI Sector Deal strategy has also a range of policy initiatives **towards lifelong learning and reskilling/upskilling opportunities** in order to foster the workforce's knowledge and skills in AI:

- New prestigious [AI Turing Fellowships](#) to attract and retain the top AI researchers;
- The creation of a new [National Retraining Scheme](#) providing reskilling opportunities, with a dedicated investment budget for digital training.

### 31.2 From the lab to the market

As stated in UK's AI strategy, the long-term objective for research support in general is to raise the total R&D investment to 2.4% of the GDP by 2027. To foster research in the short run, UK's government recently increased the rate of R&D expenditure credit to 12 per cent. The government actions to **support research in AI** include:

- A wide range of funding instruments from the Engineering and Physical Science Research Council ([EPSRC](#)):
  - Funding for research in "data science and AI" (£300 million), which complements the new centres for doctoral training;
  - Funding for 179 AI grants in [Artificial Intelligence Technologies Research Area](#) (£157 million);

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<sup>4</sup> The United Kingdom is mentioned as an EU Member State, as this report presents the state of affairs in 2019.

- Funding for the [Alan Turing Institute](#) (£42 million in the period 2015–2020)), complemented with funding from private partners (£30 million);
- The AI Sector Deal strategy of May 2019 announced the current funding of three research projects on analysing consumer attitudes in AI and on exploring the use of AI in the insurance and law sector;
- New AI programmes are also announced on engineering, urban planning and healthcare (£79 million);
- UK’s government is providing £50 million funding for the launch of a [Centre for Industrial Digitisation, Robotics and Automation](#) to support industry in Northern Ireland;
- UK’s government is also funding the [Early Diagnosis Mission](#), a programme aiming at developing early diagnosis and treatment of chronic disease using AI technologies.

In addition to policies boosting research activities in AI, UK’s government outlines a wide range of policies towards increasing **innovation in the public and private sector**, including funding programmes and instruments to foster business development and efficiency of public services:

- The government’s [Industrial Strategy Challenge Fund](#) provides funding to conduct leading research and find innovative solutions to tackle important societal and industrial challenges. A budget of £725 million has been allocated for the period 2018–2019 to tackle grand challenges on artificial intelligence, clean growth, the future of mobility and meeting the needs of ageing society:
  - A part of the Industrial Strategy Challenge Fund is devoted to the fields of [robotics and AI](#) in extreme environments programme (£93 million);
  - The development of AI applications in the [service sector](#) is funded by the Industrial Strategy Challenge Fund with an investment of £20 million. This will include a network of Innovation Research Centres and opportunities for collaborative R&D to develop new applications of AI and data-driven technologies in service sectors;
  - The launch of [centres of excellence in medical imaging and digital pathology](#) using advanced artificial intelligence technologies.
- More efficient public services through innovative solutions amongst others in AI are stimulated by the [GovTech Fund](#) (£20 million). This fund supports technology businesses in developing innovations for the government;
- An [Investment Fund](#) of £2.5 billion has been launched by the British Business Bank to foster high-growth potential firms. This fund will help firms to scale up and to fully reap the benefits of their innovative business models;
- Other funding instruments to support high-growth businesses such as the Enterprise Investment Scheme ([EIS](#)) and Venture Capital Trusts (VCTs), are reformed to allocate £7 billion of new investment into those firms over the next 10 years.

With respect to the public sector, the UK Government has published a guide on how to build and use [artificial intelligence in the public sector](#). These guidelines will be updated, as public sector use of AI evolves, to incorporate new learnings and best practices.

### 31.3 Networking

UK’s government is also taking policy actions for **networking and partnerships in AI**. Following policy initiatives aim at bringing together leading industry experts, innovation support professionals, and recognised scientist to improve multidisciplinary research and innovation:

- Establishment of the [AI council](#) to strengthen networking opportunities between academia, industry, and the public sector by sharing expertise and fostering dialogue among them;
- The creation of data-driven innovation hubs such as the [Bayes Centre](#) in Edinburgh, a centre for data science and AI (funded for £30 million by the government).

Policies boosting the **international attractiveness of UK in the field of AI** for both foreign talented researchers and leading industries include among others:

- Increasing the amount of [Exceptional Talent](#) (Tier 1) visas (up to 2,000 per year) to attract the best and brightest talent in a wide range of scientific fields, including science, technology and AI specialists. Dialogues are ongoing with [Tech Nation](#) to outline best ways to promote this policy;
- The [immigration rules](#) for leading scientists and researchers with an Exceptional Talent visa, offering the possibility to apply for an accelerated settlement after 3 years;
- The red tape to hire international researchers has been significantly reduced in order to facilitate recruitment of highly-skilled candidates;

### 31.4 Regulation

To build trust for the usage, adoption and development of AI across society, UK's government is putting in place governance regimes for data-driven AI. This includes among others the development of ethical guidelines for a sustainable, transparent, replicable use of AI with clear definitions on responsibilities, liabilities, and data protection issues. To this purpose, UK's government has created the following centre:

- A [Centre for Data Ethics and Innovation](#) has been established to provide recommendations for a sustainable, safe, and ethical use of AI;

In collaboration with the Government Digital Service, the Office for Artificial Intelligence has recently published a [guidance on AI ethics and safety](#). This guidance is part of a wider collection on [Using Artificial Intelligence in the public sector](#).

In terms of legislation, UK's AI Sector Deal mentions the need to provide legal certainty about data sharing, data usage and data protection. Reforms to the **legal framework** are taken up by the following initiative (and also in data trust frameworks as presented in the infrastructure section below):

- Strengthening the [Data Protection Act](#) to define the regulation for the collection, storage and usage of personal data and objections in case of misuse of data;

### 31.5 Infrastructure

Policy initiatives for the development of a trustworthy and qualitative **data infrastructure** include among others:

- Three pilot projects are currently ongoing to explore and define a framework for safe, secure and equitable data transfer. These frameworks – called [data trusts](#) – have been set up in collaboration with the Open Data Institute and Innovate UK. They target three pilot projects on tackling illegal wildlife trade, reducing food waste, and improving public services in south-east London.
- Developing a data infrastructure to make available high-quality public data in an open, reusable and accessible format for machine learning. This calls for initial steps towards an open data culture, such as the [Open Data Institute](#), the [Open Data Research Forum](#) and the [Open Access](#) policy of UK Research and Innovation;
- The establishment of the [Geospatial Commission](#) to improve access to geospatial data to a wider public, including businesses innovating in AI technologies.

Support to the development of **digital and telecommunication infrastructure** include the following initiatives:

- The [National Productivity Investment Fund](#) has been increased to £31 billion in 2017 in order to support among others the development of a digital infrastructure;
- In 2018 the UK government has set up a [Charging Infrastructure Investment Fund](#) to support electric vehicles, complemented with a [plug-in grant](#) for low-emission cars;
- UK's strategy mentions a public investment of £1 billion of public investment to boost the digital infrastructure, which includes £176 million for 5G and £200 million for full-fibre networks;
- A new [Transforming Cities fund](#) to improve intra-city transport and connections across city-regions (£1.7 billion).

### 31.6 Update

A dedicated [Office for Artificial Intelligence](#) will be in charge of coordinating the implementation efforts set out in UK's national AI strategy and will report annually on the [AI Sector Deal website](#) about the progress made.

## 32 Conclusions

The objective of this report is to present and gather information on all EU Member States' national AI strategies in a structured and comprehensive way. It aims to help Member States to compare their strategy and to identify areas for strengthening synergies and collaboration. Published national AI strategies are analysed to identify the most relevant policy areas and to develop a common AI Policy Framework that can be used for the presentation of policy initiatives. In this sense, this report follows a similar approach as used in the AI strategies, by presenting policy initiatives from a holistic perspective. To highlight the numerous economic and policy outlooks from which the transformative nature of AI can be explored, this report presents policy initiatives across various policy areas, including human capital (i.e. educational development), from the lab to the market (i.e. Research & Development and innovation, business and public sector development), networking (i.e. collaboration and dissemination), regulation (i.e. ethical guidelines, legislation and standardisation) and infrastructure (i.e. data and telecommunication infrastructure).

This report takes inspiration from prior attempts to overview national AI strategies, such as OECD's initiatives on [Going Digital](#) and the [Observatory of Public Sector Innovations](#), a comprehensive policy review from [FutureGrasp](#) and Tim Dutton's website on [Medium](#). It complements prior attempts and aims to provide an in-depth and fine-grained analysis of the policy initiatives by structuring them along their policy areas. It has been enriched with policy initiatives of an interactive database of AI policies jointly launched by the OECD and the EC in February 2020. The interactive database can be accessed on [OECD's AI Policy Observatory](#).

This report will be part of a series of reports that will be published in 2021 and 2022. While this first report aims to assemble a synthetic overview of what is happening in Europe in terms of AI policies, subsequent reports will provide annual updates and will provide more in-depth analyses based on benchmarking indicators. In addition, it will monitor to what extent Member States have incorporated recommended strategic actions and policy measures of the EU Coordination Plan in their national strategies.

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