

Iniciativa Nacional Competências Digitais, INCoDe.2030

(Portuguese National Initiative on Digital Skills)

# AI Portugal 2030

An innovation and growth strategy to foster *Artificial Intelligence* in Portugal in the European context

Promoted through the *Coordination Office* of INCoDe.2030 Initiative in close cooperation with the Portuguese Science and Technology Foundation (FCT), The Portuguese Innovation Agency (ANI), Ciencia Viva and the Portuguese Agency for Administrative Modernization (AMA)

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**AI Portugal 2030:** a dynamic and evolutive process:

- **September 2016:** initial preparation of INCoDe.2030, a national initiative to foster digital skills;
- **April 2017:** formal launching of INCoDe.2030, with 5 lines of action: inclusion, education, qualification for employment; specialization, research;
- **7 December 2017:** 1<sup>st</sup> National Forum on Digital Skills - INCoDe.2030, including specific sessions on AI;
- **January 2018:** Portugal participates actively in the preparation of the “European AI declaration” with EC’s DG Connect;
- **January 2018:** preparatory meetings and consultations for developing new research activities and further developing competences in AI within Public Administration in Portugal;
- **February 2018:** Identification and launching of 4 pilot R&D projects to foster AI within Public Administration, in close interaction between FCT and AMA;
- **March 2018:** launching of a “FCT’s Mobilizing programme to foster AI in public administration”, through a competitive call for R&D projects promoted by FCT;
- **April 2018:** Portugal signs the “European AI declaration”, during the 2<sup>nd</sup> EU digital Day, Brussels;
- **October 2018:** presentation of 19 R&D projects funded by FCT, under the “FCT’s Mobilizing program to foster AI in public administration”;
- **October 2018:** kick-off for a specialized team to prepare an **AI Portugal 2030 strategy** within the scope of INCoDe.2030;
- **November 2018:** preparatory meetings and consultations for **AI Portugal 2030 strategy**;
- **12 December 2018:** presentation and public discussion of a draft version of **AI Portugal 2030 strategy** in the 2nd National Forum on Digital Skills - INCoDe.2030;
- **January – February 2019:** consultations with different entities and business enterprises;
- **14 January:** launching of a call within the System to Support the Modernization and Capacitation of Public Administration (SAMA2020) to finance Data Science and Artificial Intelligence projects within Public Administration;
- **1 February 2019:** presentation and expert discussion of the **AI Portugal 2030 strategy** at Carnegie Mellon University, Pittsburg, in the context of the Carnegie Mellon-Portugal Program;
- **12 February 2019:** presentation and public discussion of the **AI Portugal 2030 strategy** at INL, Braga, with EC’s Deputy DG Connect;
- **25 February 2019:** presentation and public discussion of the **AI Portugal 2030 strategy** in Porto, together with the presentation of OECD 2018 S&T Outlook;
- **1 March 2019:** “FCT’s Mobilizing program to foster AI in public administration”, through a competitive call for R&D projects promoted by FCT – second edition.

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DRAFT

# 1 Introduction

Artificial Intelligence (AI) is becoming a powerful transformative technology driving all sorts of changes and with a wide-ranging effect in different life settings from health to education, from work and organizations' cultures to environment. Its promises and potential may be harnessed for the social common good and for all<sup>1</sup> but may also enable complex risks to the society.

Under the context of INCoDe.2030, a Portuguese initiative to foster digital skills, a large and diversified set of key stakeholders in Portugal have raised the necessary concerns about the need to foster strong investment in AI at national and European terms, as well as to identify key areas for development.

Europe needs to strengthen European R&D&I in AI in order to face accelerated competition in the global market. With that in mind, the development of a coordinated Action Plan on Artificial Intelligence in Europe has been discussed in April 2018 and formally accepted by the Council in December 2018<sup>2</sup>. Recognizing that AI is transforming our world and represents challenges and opportunities that need to be faced with ambition and by joining forces, the Action Plan calls for a coordinated approach at European level, encouraging the use of this powerful technology to help solve the world's biggest challenges, from health to climate, from transport to agriculture, from cybersecurity to industry in general.

Portugal has joined these efforts since the first preparatory meetings, so that Europe comes to the forefront in investing and developing AI and in exploring the opportunities offered by AI. It is essential to scale up public and private investments and to mobilise all actors concerned around common strategic interests, from research and innovation, to bringing state-of-the art AI applications into the market and uptake of AI in the economy and by the public sector. In line with the Declaration signed by EU Member States in April 2018<sup>3</sup>, Portugal wants to raise to the expectation of this ambitious European approach.

AI needs an interdisciplinary and collaborative approach. The opacity often seen around the implications of AI may be an obstacle for the wider society to make sense of it and take part of the dialogue. AI needs to integrate cognitive diversity to foster social inclusion and transformation. Therefore, we need a diversity of specialists that will foster different perspectives to better solve complex problems. But we also need the whole population to take part in the debate and to get involved in designing AI by voicing priorities of what AI should address, in a human-centric approach. Championing diversity, a source of

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<sup>1</sup> *Communication from the Commission to the European Parliament, The European Council, the Council, the European Economic and Social Committee and the Committee of the Regions – Artificial Intelligence for Europe - COM(2018) 237 final, 25.04.2018.*

<sup>2</sup> *Communication from the Commission to the European Parliament, The European Council, the Council, the European Economic and Social Committee and the Committee of the Regions – Coordinated Plan on Artificial Intelligence - COM(2018) 795 final, 7.12.2018.*

<sup>3</sup> <https://ec.europa.eu/digital-single-market/en/news/eu-member-states-sign-cooperate-artificial-intelligence>

innovation, in AI brings together different forms of collective and distributed intelligence to solve problems<sup>4</sup>.

Therefore, we believe that the value of AI also relies in its ability to become democratically distributed. To achieve this, we need to invest in the creation of mechanisms to store, make available and distribute data and information and in the development of digital (formal and non-formal) education to provide citizens, from different cultural, economic and social backgrounds, with skills and competencies to critically benefit from it, raising skills levels and anticipating future skills needs.

The aim of this document is to set the basis of a national strategy for the development of the Portuguese economy and society through the use of Artificial Intelligence (AI) in public and private activities. This strategy is fully aligned with the Coordinated Action plan of the EU and their Member States. We know that AI will have, and is already having, a strong positive impact in Portugal and Europe. Albeit this technology is becoming a driver for economic growth, transforming the labour market, industry and society as a whole, we also know it carries risks that have to be identified and mitigated, so that the opportunities it brings can be fully reaped. With this in mind, Portugal's AI Strategy will be based in the fundamental principle of not compromising the dignity of the citizens, strongly anchored in the promotion of wellbeing, fairness and quality of life.

Portugal is already active in many research, innovation and deployment projects in the area of AI, especially related to remote sensing, robotics, advanced analytics, augmented reality, intelligent systems, monitoring and simulation, to name a few, applied to areas such as energy efficiency, precision agriculture, oceans, transport and health. Other relevant areas include autonomous manufacturing, big data, business intelligence and machine learning.

Ultimately, we want to foster the impact of AI in transport, agriculture, energy and sustainable energy systems, aeronautics and space, security and industry in general. Other areas of utmost importance are the blue economy, urban development and mobility, Earth Observation and biodiversity.

In industry, AI will change completely the paradigm of human machine interface and the decision processes, based on several developments, including robots to adapt to new working environments with little to none reprogramming needed and systems with real time control capabilities.

Ensuring adequate digital competences, including digital up-skilling and re-skilling will be a must, generalising digital access, stimulating employability and providing the conditions for the production and dissemination of new knowledge.

People will continue to be at the centre of the development of AI, encouraging the use of AI to help solving the biggest challenges Europe is facing.

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<sup>4</sup> Levy, P. (1997) *Collective Intelligence: mankind's emerging world in cyberspace*. Cambridge, UK: Perseus.

## 2 Portugal in technology and AI now

Although Portugal is showing good results in some innovation indicators (including but not limited to AI), in most of them we have been typically placed below the mean of the European Union<sup>5</sup>. Portuguese institutions are particularly well positioned in terms of research international collaborations, broadband penetration and product/process innovations in SME. Portugal has been relatively successful as an innovation-friendly environment and has an attractive research system.

**Human Resources:** Numbers from 2017 show that Portugal has a shortage of qualified human resources in advanced technological areas, mostly in terms of higher education (67% of EU mean in 2017), but also in lifelong learning (88.8%) and new PhDs (94%). Employment in knowledge intensive activities is low (57% of EU), but is slightly above mean in fast-growing enterprises (103.2%).

**Research:** Portuguese research has a high level of international collaboration (185% of the EU mean in 2017), participating in the 10% most cited works (82.6%) and in the attraction of foreign PhD students (98.3%).

**Innovation:** The slice of employment of fast-growing companies in the most innovative sectors has been improving. The R&D expenditure of the business sector has considerably improved since 2015 and represents about 52% of the gross expenditure in R&D. SMEs are doing quite well in innovations in the product or the process (158.8%) and in marketing/organization levels (112%).

**Infrastructure:** The best indicator of Portugal in the European Innovation Scorecard 2018 is the broadband penetration (200%). Despite that we have a low level of Internet usage (below 60% of the households in 2017)<sup>6</sup> including e-commerce and internet banking with a better performance in the use of social networks.

### 2.1 The Portuguese AI ecosystem in a glance

Portuguese universities and polytechnical institutes offer a broad range of first, second and third cycle degrees in Information Technology. The offer of MSc and PhD degrees in AI related topics is also visible and growing steadily. However, companies in Portugal feel a lack of human resources in these areas. The offer in post-graduate conversion courses and focused specializations is limited but growing, mostly done in cooperation with companies.

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<sup>5</sup> European **Innovation** Scoreboard 2018 and <https://ec.europa.eu/info/sites/info/files/2018-european-semester-country-report-portugal-en.pdf>

<sup>6</sup> Digital economy and digital society statistics at regional level, <https://ec.europa.eu/eurostat/statistics-explained/>

Academia hosts a good number of research centers that have been devoted to AI (including robotics) for some decades. The Portuguese AI Society (APPIA), the Portuguese Robotics Society (SPR) and the Pattern Recognition one (SPRP) are the most active in the field.

The increase of the number of new technological companies involved with AI has been impressive. Young scale-ups and delegations of European multi-nationals have become important in hiring (hundreds of IT and AI specialists) and development (innovation, collaboration with universities, knowledge-intensive exports). However, a recent study conducted by Microsoft<sup>7</sup> reports that only 4% of the universe of 277 larger companies consulted consider themselves to be in a mature stage of AI usage. 61% are still planning or in pilot phase. The numbers of the whole universe are certainly much lower. 57% of the companies expect AI to have a high impact on new business areas.

Collaboration between companies and academia is becoming increasingly common, both in terms of collaborative R&D but also in the recruitment flow. However, top companies working in Portugal on AI recognize they have to improve their competence in forging partnerships with Academia.

The Portuguese Public Sector (PPS) comprehends a very large number of entities. In 2018 the scientific funding agency (FCT) launched 19 new projects focused on the application of AI in the PPS. Other initiatives in the same line prepared for 2019 will tend to increase the innovation indicators within the PPS.

Collaborative Laboratories (CoLABs) are a new form of partnership with industry and society for market-driven innovation and skilled jobs creation. CoLABs' main goal is to create qualified and scientific employment in Portugal through the implementation of R&I agendas oriented towards the creation of economic and social value, eliminating the gap between research and innovation activities; reinforce the collaboration between different institutions, public and private in co-responsibility of knowledge based strategies; combining public based, competitive and private funding. There are currently 21 CoLABs<sup>8</sup>, some with activities related with AI. These joint ventures gather academia, companies and other important stakeholders.

### 3 Main Questions framing the *AI Portugal 2030* Strategy

The general questions the AI4Portugal strategy should seek to answer are as follows.

- How can AI be used to foster job creation and improve economic and social development in Portugal?
  - How can the private sector use it? How is the private sector currently using AI?
  - How can the public sector use it? How is the public sector currently using AI?

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<sup>7</sup> Artificial Intelligence in Europe: Portugal, Outlook for 2019 and Beyond. Report by Microsoft

<sup>8</sup> [https://www.fct.pt/apoios/CoLAB/docs/lista\\_homologada\\_titulo\\_de\\_colab\\_lote2.pdf](https://www.fct.pt/apoios/CoLAB/docs/lista_homologada_titulo_de_colab_lote2.pdf)

[https://www.fct.pt/apoios/CoLAB/docs/Lista\\_homologada\\_titulo\\_de\\_CoLAB.pdf](https://www.fct.pt/apoios/CoLAB/docs/Lista_homologada_titulo_de_CoLAB.pdf)



- How should public and private entities act in order to promote the use and the development of AI by companies and the public sector?
  - How can the private sector be encouraged to invest more in AI? How much is being invested now? What are the plans and strategies of the big companies using AI in Portugal? Which are these companies?
  - How can the education system evolve in order to form the wide range of professionals needed? Which are the profiles of these professionals? Which are the important skills of technical and non-technical professionals? How can research feed the cognitive computing revolution while being inspired by it as well? How much should be invested in fundamental research in the area of AI and other areas related to AI?
- How can we measure the impact of AI application?
  - In the Portuguese economy?
  - In the private sector?
  - In the quality of life of the citizens in Portugal?
- Which domains of application should Portugal invest on more heavily?
  - Health, Sea, Air and Space, Industry, Agriculture, Services, Tourism, Education, Government, Media, Culture, Sustainability?
  - Which companies and institutions are better positioned to further the application of AI in these domains?
- Which are the important future skills and technologies in AI?
  - Should we concentrate on the application of existing technologies, including standards machine learning techniques, like neural networks (deep and otherwise), decision trees, Bayesian methods and SVMs, among others, or should we invest in the development of new methods?
  - Which computing technologies will play an important role in AI in the future: special purpose architectures, supercomputers, quantum computing or simply new generation general purpose processors?
  - What is the role that Artificial General Intelligence will play in the future of the society?
- Which are the associated technologies that are important to support AI? Internet of Things, HPC, HCI, Machine Learning, Programming, Computer Graphics, Signal Processing, Telecommunications, Quantum Computing?
- Which are the risks of the AI-driven revolution?
  - For citizens.
    - Impacts in employment, attacks to privacy, security threats, extreme automation, dramatic reduction of human driven decisions.
  - For democracy.
    - Lack of transparency in decisions, Profusion of information not curated by humans, minimization of democratic citizens representation, insufficient regulation
  - For economy
    - competition, unfulfilled promises, globalization
  - For peace.
    - Machine controlled weapons, intelligent cyber-attacks, machine driven espionage

- Last but foremost, where we are in terms of AI in Portugal and where we want to be in 10 to 20 years' time.

The answers to these and other questions should be thought in four dimensions:

1. **Societal robustness**, with a clear vision of the impacts of AI in democracy, privacy, security, fairness, the labor market, governmental and commercial transparency and equity. Although AI is highly disruptive in all these dimensions it also provides, if properly designed, a set of powerful tools to actually improve society and democracy.
2. **Job creation, promoting Economic development and growth**, using AI to improve products, processes and business models in all sectors, fostering productivity and also transforming public services in order to deliver better outputs to the citizens, hence contributing for an improved quality of life.
3. **Human development**, with Portuguese universities, the school system and continuous education instruments satisfying the growing and dynamic competence needs for a wide range of professionals at different education levels, while promoting inclusion of every worker impacted by the introduction of AI.
4. **Scientific and Technological development**, with Portuguese universities and research institutions maintaining and further developing a front-line position in AI research; and, with companies and public sector, increasing awareness of AI capabilities and how it can be used to boost business and overall quality of services. The establishment of Digital Innovation Hubs will support and promote the interaction between AI consumers and AI producing organizations.

## 4 Vision

**Promoting a better society:** AI will improve the quality of services and the efficiency of processes, while guarantying the human dignity as well as wellbeing and quality of life. The economy will grow at a faster pace due to the adoption of AI. Important societal problems such as sustainability, resources management, and unemployment will be successfully approached using AI and data science technologies. Adopting strong ethical guidelines will protect the fundamental rights of citizens.

**Fostering AI skills and “digital minds” for all:** Portugal will be in the forefront of AI Education for all, producing AI general skills, as well as promoting specialists and attracting AI talent from Portugal and from abroad. The education of AI skills and related skills will spread to earlier stages of education and to life-long learning.

**Promoting new jobs and developing an economy of AI services:** All companies and public services will consume AI. A supply chain of AI services will bring AI from the research labs to society. Services will be accessible to SME's through the adoption of AI as a service (AI-on-demand). Specialized companies will be able to develop and adapt AI algorithms and put them in the national and international markets. A data market and a model market will flourish, as well as other AI-related direct and indirect markets. If

necessary, Portugal will adopt AI technologies at a fast pace, modernizing industry and the public sector, competing in the global market.

**Fostering Portugal as a living lab for experimentation of new developments:** Portuguese innovative sectors should be promoted as “living labs” for new experimentation at a global level, including in: i) AI for urban transformation through sustainable cities; ii) AI for sustainable energy networks; iii) AI for biodiversity, from forests and green economy to marine species and blue economy; iv) AI for autonomous driving; v) AI for cybersecurity; and vi) Quantum materials for AI; vii) adaptive learning curricula for students.

**Securing AI niche markets through key specialized services in Portugal:** specific areas should be considered, namely: i) Natural Language Processing, with application to automatic translation and other automatisable services; ii) Real time AI, with application in secure business and financial transactions; iii) AI for software development; iv) AI for edge-computing.

**Contributing to new knowledge and developments through AI research and innovation:** AI knowledge will keep evolving rapidly in the next decade. The research community will strengthen their presence in the world through the development of edge-cutting research of the cooperation with the best international research teams. The growing application of AI by Portuguese companies will motivate the development of innovative algorithms and methodologies, but the Portuguese AI community must have the ambition to participate in the development of future AI.

**Provide better public services for citizens and businesses, and adopt evidence-based approaches on public policies and decision-making processes:** AI and data science should become an important tool to pursue the vision laid out in the ICT Strategy 2020, changing from a reactive paradigm to an anticipatory service provision paradigm. At the same time, public policies and decision-making processes should be increasingly supported by evidence and not by intuition, making use of the vast amount of administrative data already collected for operational purposes.

## 5 Action Plan

### 5.1 Inclusion and Education: disseminating generalist knowledge on AI

Digital inclusion and education for all is an essential component in AI development. More extensive knowledge and skills will facilitate adaptation to changes in professions. Opportunities for expanding qualification contents will be integrated in education programmes. The aim is to avoid highly specialised competence in an excessively narrow field.

Digital inclusion and education are two main axes of the INCoDe.2030, a Portuguese initiative that aims to improve the country position and competitiveness, working towards securing a prominent place in terms of digital skills until the end of the next decade.

### 5.1.1 Digital inclusion (DI):

General features for DI actions and projects may consider the following:

- a) Development of “**Creative Communities for Digital Inclusion**” (CCIDs) considering the experience in progress in some Portuguese regions within the context of INCoDe.2030. Each project needs to serve specific purposes in terms of local and institutional requirements;
- b) DI projects should consider: i) the mix of "ICT competences" currently on the ground and ii) the "mix" of "ICT skills" to be achieved. The survey of current competencies requires identification of the current situation in each specific case, which will help design a programme aiming to improve the current state. The "mix" of ICT skills should include a set of capabilities aligned with the challenges of the "information society" such as how to work with word processors, spreadsheets, email, social networks, multimedia applications, access to public administration services, knowing how to interact with banks and pay bills online, whilst securing privacy and the theft of important personal information;
- c) DI projects should also plan to align the timing of training activities on the ground, either for training the trainers or for directly training the citizens, in accordance with the following steps: i) personalization: establish a mapping of "ICT skills" to be delivered throughout the country; ii) optimization: scheduling training activities optimally based on the mapping, thus benefiting from economies of scale at the national level, i.e. doing more with the same level of funding and therefore significantly increasing the overall process efficiency and the inherent performance indicators.
- d) DI projects must commit to ongoing monitoring activities, including direct surveys of beneficiaries and by instrumentation of devices (laptops, tablets, etc.) used in the accomplished actions. Collected data should be immediately available in intelligent dashboards, allowing real-time tracking of project progress, thus facilitating the role of project managers.

### 5.1.2 Education

General features for education actions and projects may consider the following:

- a) **teaching machine learning and data science**: teaching the fundamentals of machine learning to young students, replicating actions already under way (e.g., in some Ciência Viva schools, among others) in schools and in “Science Clubs” (forming trainers that replicate the work in progress). To design examples of challenges (e.g. biodiversity or pollution studies, etc.) replicated in several schools by gathering the data collected by each school in a national database, thus enabling students to learn one of the main fundamentals of machine learning: more (and better) data lead to better forecasting models;
- b) **development of creative / collaborative multimedia content on science**: one of the fundamental axes of digital inclusion (pillar 3 of the EU's DigComp 2.1 framework) focuses on the active ability to

create digital content. The organization of networking actions bringing together schools and several Science Clubs for collaborative video creation: a) on key themes of STEM (Science, Technology, Engineering and Mathematics) (e.g. studying the human body, each club focuses on body; study the energy system, each club focuses on a type of energy, etc.); b) on Portugal, its regions and history (e.g. each club presents the history of its region, each club characterizes the population of its region and the challenges of public policies, etc.). The videos will be available on an open and intelligent network content organization platform (e.g., Kooledge.com) thus enabling the open and competent dissemination of this content.

c) **development of programming/coding capabilities:** joining the idea of content creation and programming, involving teams of academia to develop a platform in which schools and Science Clubs can launch their own CODINGFESTs, allowing to hold more events during the year. The idea, which already seems to be in the minds of the CODINGFEST organizers, is to structure the process of launching code challenges so that, with the support of teams of students and teaching staff at each school (or groups of schools in partnerships) challenges can be defined and launched such that all schools in the country are competing to solve. Students will be able to learn not only how to solve problems, but also how to create and define problems, drawing on their creative capability.

## 5.2 Qualification and specialization

Qualification and specialization are key to the development of AI driven innovation and economy in Portugal. They are also axes of the INCoDE 2030 initiative, alongside education, inclusion and research. To qualify human resources at different levels (professional courses, bachelors, masters, post-graduate specializations, PhD and post-doc) is a challenge for a number of different reasons, despite the excellent quality of both our institutions and students. Most important, skills are related to ICT in general and AI skills in particular, including data science. However, other supporting skills will be important as well.

Portugal is increasingly chosen as a setup point by international technological companies, while national IT firms show a tremendous growth in size and number (new ICT companies per year doubled from 2007 to 2017). Moreover, non IT companies hire more and more staff with ICT skills.

Even though Portugal is close to the European median in terms of digital competences (15th in the DESI 2017 Index, Digital Economy and Society Index of the European Commission), it needs to reinforce Information and Communication Technologies (ICT) competences. This applies to specialists, who need to be able to make the most of the growing availability of jobs in the digital market, but also to the whole of human capital, increasing for example internet usage levels, which are currently still worryingly low.

Portugal offers a training infrastructure as well as the human potential capable of being (re)qualified to meet the demands of employment opportunities typical of modern societies such as Portugal. However, this (re)qualification is a demanding task that requires mobilisation and a combination of efforts from different areas of governance and civil society.

Digital competences are also intrinsically linked to employability - increasing digitalisation in the labour market requires new competences but offers a wider range of opportunities. A more skilled active population generates more new jobs, as well as innovative markets and products, generating more competitive and robust economic activities.

At the same time, the country itself must be an active agent in the global effort to produce new scientific computing knowledge and develop the capacity to manage and use large amounts of information. This will help to ensure a better position in Europe and in the world. We cannot wait to find out what the new technologies will be; we have to create them and work with them.

Qualification in exploiting AI is, for example, the cornerstone of Industry 4.0. Both specialization and research have to deal with advanced AI techniques and solutions, mastering it at the theoretical and technological level, developing and implementing new solutions in many different areas, such as health, space, maritime, industry, agriculture, cities, services and mobility (to name a few).

### **Specific objectives**

- Increase the overall number of human resources qualified, in ICT in general and in AI in particular, at the different levels of education, including short cycles for initial training and adult training, as well as graduate education/specialization of adults.
- Enable the development of transferable skills in academia to industry, through their effective acquisition by learners in the former, in close cooperation with companies and the public administration.
- Increase the participation of women in technological areas, namely in ICT in general and AI in particular, and thus augment the potential of the human capital.
- Promote the attractiveness of Portugal to foreign talent, including students, researchers and experienced professionals, and reduce border obstacles when justified.
- Promote the experimentation of new ideas and concepts of AI in Portugal, including forms of cooperation among national and international higher education institutions and firms or the public administration.

### **Specific Actions**

- Develop qualification at the regional level, including higher education institutions and local, public and private, actors, in the form of “Regional/local Networks for Digital Qualification”, following the on-going experience in the development of short cycles in Polytechnics, but further promoting adult training for reskilling and upskilling actions. It should consider the development of focused intensive courses for reskilling, in close cooperation with companies and the private and public sectors;
- Further promote the development of graduate specialization programs, including executive education for adults, in close cooperation with firms and the public administration.
- Foster foreign enrollment to both studies and/or work of AI and ICT talents, including on-going

actions through the initiative “Study and research in Portugal”.

### **5.3 Thematic areas for research and innovation in European and international networks**

In the area of AI there is relevant investment of European companies in Portugal in a variety of areas such as automotive, car multimedia and intermodal transports; information systems; components and services for 5G networks; smart cities and security; banking; bioeconomy and biorefineries. Some outstanding examples are referred hereafter.

#### **Specific Objectives**

- Make AI have an economic and social impact in all the referred areas, with emphasis in the themes mentioned below.
- Have a strong ecosystem of companies, academia, public sector and society, including start-ups, scale-ups and established companies.
- Guarantee that AI is safely and ethically applied to the various domains.
- Help companies and regulators find appropriate legal frameworks.
- Identify strategic lines of research that can foster Future AI.

#### **Specific Actions**

- Further promote the participation in the European effort for developing regulation and protocols for an Ethical and Secure AI.
- Develop regulatory sandboxes articulated with European Union.
- Foster the collaboration between companies in Portugal and European industrial giants through the participation in European Networks.

#### **5.3.1 AI for urban transformation through sustainable Cities**

Smart cities will more and more rely on AI. Be it in the use of big data, software application in all aspects of life in the city, e.g. traffic control and public safety, to energy efficiency and autonomous vehicles and logistics, the city will embed AI in order to optimize and adapt this technologies to the inherent rapid changing environment in a complex ecosystem as a city.

The development of smart cities relies on research, on education and skills, on innovation, on the market uptake of new technologies. AI is fundamental to urban transformation and many leading projects in Portugal are already pursuing these challenges from car multimedia to cyber security.

#### **5.3.2 AI for sustainable energy networks**

Current debates and trends in energy, both within Portugal and the EU, highlight some significant

energy systems challenges. The first of these is the need to reverse the energy consumption and emissions trends most nations have seen over the past 15 years. Meeting greenhouse gas emissions targets is a challenge that calls for new ideas, tools, technologies, and policies.

It is essential to devise strategies to cost-effectively meet these challenges, requiring intelligent energy management systems as well as new energy systems methodologies that capture the dynamics and drivers demand – including consumer behaviour, energy resources (especially renewable resources) and the networks that connect the two. It is also of prime importance to engage industry and governments in innovative research programmes to develop standard approaches, methods, and policies for improving the long-term performance of the energy sector while addressing climate change and energy security concerns.

Digital transformation is reshaping the energy industry, with the increased use of renewables, resiliency issues and sustainability concerns, to name a few, where digitisation and AI is an enabler of that change, e.g. real time data analytics to improve efficiency; distributed generation; sensors. Digital transformation, combined with IoT offers both a short and long-term solution to coping with varying regulatory and pricing demands of the energy market and managing costs, uptime and service more predictably.

### **5.3.3 AI for biodiversity: from forests and green economy to marine species and blue economy**

AI applied to biodiversity has also an enormous potential in Portugal, from marine species and healthy oceans in a blue economy to forests for a green economy for Europe, this is a cutting-edge area where we want to make the difference.

Intelligent data-driven systems applied to precision agriculture to remote sensing and Earth Observation are showing its added value in new relevant projects.

In many of these fields, the *Atlantic International Research Centre (AIR Centre)* can play a role. The AIR Centre is a knowledge&data driven long term multilateral platform for scientific and technology cooperation in the Atlantic towards a holistic, integrative and systemic approach to knowledge on space, oceans, climate change impacts, energy and data science. The AIR Centre is meant to become a knowledge and data driven network organization, enabling innovative work through bottom-up initiatives that will face new and greater challenges and R&D gaps and Innovation. The AIR\_DataNet, a cross-cutting initiative, is a supercomputing network of facilities and expertise supporting advanced and complex simulation models of the ocean and atmosphere and large sets of data including the Atlantic Data Cube and Atlantic GEOSS, two complementary data access tools focused on the Atlantic Ocean.

In addition, a new Fraunhofer Portugal Research Centre on precision agriculture will soon be operational and will conduct research in this field.

### **5.3.4 AI for mobility and autonomous driving**

Intelligent transport will also open enormous possibilities in AI expertise. The ultimate goal is to foster



the impact of AI in industry and transportation sector, by creating new jobs through introducing real-time itinerary mapping based on traffic conditions and autonomous driving capabilities. The combination of AI with the increasing communication capabilities of vehicles to interchange information with other vehicles and road and Internet infrastructure systems, combined with vehicle surroundings perception, will allow to have a fully Intelligent Transport System (ITS) able to improve safety, reduce traffic congestions, enhance drivers' experience and achieve the sustainability of transportation.

### **5.3.5 AI for cybersecurity**

Cybersecurity has an increasing importance in a society with growing prevalence of information systems, many of which with AI. Many of these systems will be in control of critical facilities and infrastructures, which provide essential services to all citizens, such as hospitals, power plants, water purification and provisioning systems, transports and integrated urban management systems. Others will be ubiquitous in smaller units such as cars and other vehicles, industrial robots and mobile robotic assistants. Cybersecurity algorithms will require the ability to adapt to new kinds of attacks and responding accordingly and autonomously in real time. Moreover, AI will minimize the elapsed time between the detection of an attack and the system's corresponding reaction. Nevertheless, AI systems themselves be subject of security attacks, giving rise to a higher level autonomous cybersecurity management.

### **5.3.6 AI for health**

Ambient Assisted Healthcare can benefit enormously from AI and AI applications are prevalent in healthcare. Big data and data sharing are essential tools and there is a significant potential for AI to deliver benefits in this sector, such as by discovering new drugs, reducing costs, diagnosing diseases, improving patient care, personal medicine and public health.

An ongoing pilot project relates for example to the analysis of antibiotic prescription patterns in a partnership between the Ministry of Health and the Gulbenkian Institute of Science. This project aims to avoid excessive and inappropriate prescription of antibiotics, which poses a threat and a public health problem. Based on the digital transformation that is occurring in the prescription of medicines and health products, namely through Paperless Prescription, it is intended to deepen the analysis of the prescription patterns of antibiotics using data from the electronic medical prescription.

Ambient Assisted Living (AAL) is another area where AI can play an essential role, in particular in the support of aging. AAL Fraunhofer Portugal, <https://www.fraunhofer.pt>, currently materialises itself through the Fraunhofer Portugal Research Centre for Assistive Information and Communication Solutions (AICOS), with consolidated competences in Human-Centred Design, AI and Cyber-Physical Systems.

## **5.4 Public administration and its modernization**

The programme aims to support R&D activities that contribute to strengthen scientific and technological competencies to deal with the vast amounts of data generated in Public Administration. The goal is to use and combined this administrative data with data from other sources, to better inform our public

policies and decision-making processes, which should be increasingly supported by evidence and not by intuition. And, ultimately, to change public service provision from a reactive paradigm to an anticipatory paradigm.

It will contribute to the appropriation and incorporation of scientific knowledge to support operational decision systems and to enable the production of new knowledge with the goal of finding solutions for particular and real problems in public entities, in order to address relevant issues for the citizens, in any area of governance.

Currently 19 R&D projects are being funded through the "FCT's Mobilizing programme to foster AI in public administration": 4 initial pilot projects aim to support already established and mature partnerships between the R&D community and public administration; 15 additional projects were selected by an independent scientific panel under a specific call aiming to identify and foster new partnerships. A second call promoted by the FCT and a dedicated call promoted within the System to Support the Modernization and Capacitation of Public Administration (SAMA2020) will fund more projects in 2019.

These 19 ongoing projects result from the cooperation between scientific institutions and entities of the public administration and are being developed under the innovation axis of INCoDe.2030 (National Digital Competencies Initiative). They cover several governance areas such as health, education, transportation and urban mobility, economic activity and land use planning. Details of these 19 projects currently funded by FCT are listed in Annex 3.

### **Specific Objectives**

- Make administrative data more easily accessible for research units, public and private organizations, providing a secure access and respecting personal privacy issues;
- Continue to foster collaboration between public sector entities, businesses and research units concerning the use of AI;
- Promote new and innovative solutions for administrative simplification, namely under the SIMPLEX programme;
- Reinforce public sector skills and capabilities with respect to AI and data science;
- Assure the ethical use of AI in public administration;

### **Specific Actions**

- Develop a National Data Infrastructure, managed by the National Statistics Office (Instituto Nacional de Estatística), which will constitute a centralized repository of administrative data;
- Continue to fund collaborative projects between the public sector and research units to develop administrative modernization innovative solutions;
- Create a Collaborative Laboratory (CoLab) for AI in Public Administration led by a public sector organization;
- Reinforce already existing AI and data science skills qualification programs within the public sector in collaboration with Higher Education Institutions;

- Include public sector organizations in the ethics committee for AI;

## **5.5 Specific areas of specialization in Portugal with international impact**

Portugal has currently strong players in some areas that may serve as inspiring examples and help drive innovation and research. The following list identifies some of these areas where Portugal can lead in european terms.

### **Specific Objectives**

- Affirm international leadership in a few key areas, as listed below, by joint actions of companies and academia leading to innovation, edge-cutting research and involvement in international networks.
- Increase the impact of these areas in the Portuguese economy.
- Drive the development other research/innovation lines of AI and related technologies.

### **Specific Actions**

- Foster access to new and sophisticated markets worldwide;
- Enable data sharing for promoting research development and collaboration between academia and companies.
- Enable platforms for sharing of best practices between companies and academia.
- Promote the availability of computing infrastructure.

### **5.5.1 Natural Language Processing**

Portugal has developed an active research community in the area of computational linguistics / natural language processing, as well as successful companies (e.g., Unbabel, Priberam, among others). Language independent resources that can be used by the diversity of European and world languages and Portuguese in particular should be further promoted. Textual data is ubiquitous and improving its processing will have significant impacts in all domains of application.

### **5.5.2 Real Time decision making with AI**

In many applications AI algorithms need to respond in real time and autonomously, as well as be able to absorb new data and adjust learned models. Data comes in volume and velocity from trading or business transactions, from sensors in automobiles or in industrial pipelines, from electrical and telecommunications networks, from interactions with the ambient, from smart cities installations, from robots moving in challenging environments, from cybersecurity installations, from highly intensive game or simulation interactions. Data has to be processed fast, models have to adapt fast, algorithms have to decide fast and accurately. Portugal has a strong research community in data stream learning and many

companies deal with this kind of scenario (e.g., Feedzai, Bosch, Ren, Altran, Farfetch, Veniam, Wedo).

### **5.5.3 AI for Software Development**

The effort of software development can itself be aided by AI. Coding can be easier. Development can be faster. This can also be central for dissemination of skills. Portugal has a strong offer in rapid software development (e.g., Outsystems, Altran).

### **5.5.4 AI for Edge-computing**

Portugal can play an important role in the area of IoT and edge computing. Industrial units produce hardware devices for different industries such as the automotive, agricultural and industrial machines and environments (e.g., for cities, factories, vehicles, and including current major firms, such as Bosch, Continental, Altran among many others).

## **5.6 New developments and supporting areas in European and international networks**

### **5.6.1 Advanced computing: supercomputing**

Portugal is actively engaged in contributing for an effective European strategy on advanced computing. We wish to be an active contributor to the EuroHPC future ecosystem in parallel to our activities in grid and distributed computing. For this purpose, we are currently conducting the installation of a new supercomputer facility optimized to support a large spectrum of relevant critical areas such as artificial intelligence, deep learning, digital modelling and data science, either in close association with the development of frontier research areas, or the development of new applications and markets in a range of sectors, including Atlantic Interactions, Energy systems and services, Earth Observation and new space, precision agriculture and smart farming, health systems, and public administration and services, among others. These would be the driving objectives of the new system. As such, we envisage that a multi-platform system may be the best option, in order to accommodate a broad range of applications.

Central to this strategy is the establishment of the Minho Advanced Computing Center (MACC) that will be centered on advanced computing activities.

### **5.6.2 Quantum materials and quantum computing**

Quantum computing and quantum materials are another challenge we want to embrace.

The International Iberian Nanotechnology Laboratory (INL), located in Braga, hosts the Quanta Lab and the Academic Hub of the IBM Q Network. INL is the only Intergovernmental Research Organisation in the world within the field of Nanotechnology, with a modern and well-equipped laboratory encompassing possibilities to study and fabricate everything from DNA-chips to electronics and sensors in a complete and true interdisciplinary way with capacity to make pilot production of proof-of-concepts. Their strong interdisciplinary research integrates most scientific fields such as physics, electronics, biology, maths, pharma and medicine. AI is a cornerstone of the INL R&D Strategy.

## 5.7 Facing societal challenges brought by AI: Ethics and safety

AI systems will take important and critical decisions autonomously. Society will demand transparency (the ability to explain the decisions) and auditability (the ability to trace the flow of decisions and actions from human to algorithm) in order to promote safety and ethical principles, including privacy protection and fairness. We will need best practices to assess AI projects in terms of risks to safety and ethics and mechanisms to detect and prevent misuse of advanced AI techniques. The legal framework will have to be adjusted to determine liability in conflicts having the involvement of AI decision making.

## 6 Implementation: Short to medium-term objectives

- Participate in the European endeavour to develop a network of centres of excellence for AI R&D, in close cooperation with a wider spread of digital innovation hubs to ensure AI take-up;
- Integrate a strategy of closer cooperation between European AI excellence centres around agendas fixed together with industry and based on common knowledge and common challenges for the deployment of AI-based solutions in the areas where Europe faces major challenges;
- Strengthen the participation in the ongoing partnerships between the Member States and the EU through joint undertakings such as ECSEL (for electronic components and systems), EuroHPC (high-performing computing) as well as the Quantum Flagship under the Research and Innovation Programme Horizon 2020, key to processing big data and sustain further developments in AI;
- Continue to foster a strategy of promoting digital skills, not only focused on high-level skills but also on very focused digital competences, with a special emphasis on AI;
- Fully exploit the potential of AI in the economy and society, across all sectors to foster adoption of AI, including for SMEs and the public sector;
- Continue the path of applying AI solutions in public administration based on the outcome of the ongoing pilot projects in partnership between the public administration and scientific institutions, funded by the Science and Technology Foundation and the System to Support the Modernization and Capacitation of Public Administration (SAMA2020), in the context of the INCOoDe 2030 initiative.
- Create new funding opportunities, including for venture capital;
- Engage with international partners in order to align positions and benefit from international cooperation in AI, including with Africa, in a variety of areas not forgetting themes such as standards, ethics and cybersecurity. Informed and concerted actions in AI are required and international cooperation is essential in all activities for a responsible and concerted development of AI.
- In areas of public interest continue the already forward-looking policy of openness, reuse and

interoperability of public data, in areas related to AI, e.g. Earth Observation data.

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## 7 ANNEXES:

1. Recommended actions aligned with the EU Coordinated Plan
2. List of sample initiatives in Portugal
3. Foreseen EU call for the creation of a network of AI excellence centers
4. Foreseen calls for “Mobilizing programmes” - National Innovation Agency, ANI

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## Annex 1: Recommended actions aligned with the EU Coordinated Plan *(for discussion)*

The recommended actions are aligned with the European Union AI Coordinated Plan. Area identifiers (A to G) refer to the structure of the European AI Coordinated Action Plan.

Area	Aim	Action	When
A: Strategic actions and coordination	Identify investment parameters	Identify which KPI for AI investment evaluation in Portugal	Mar 2019
B: Maximizing investments through partnerships	Define common research and innovation agenda	It will be established a group of stakeholders from industry and academia that will set up a Research and Innovation Agenda until mid 2019. The first meeting will be in Jan-Feb 2019.	Jan-Feb 2019
	Promote innovation	Revise innovation vouchers and other instruments that facilitate industry-academia cooperation	2019
	Awareness raising	Organize a yearly AI Fest. The aim is to bring together researchers, industry and community in an informal event that can be territorially distributed. The event features demonstrators, hands-on sessions, advanced workshops	July 2019
	Promote innovation	Promote / participate in the equity investment funds for the launching of start-ups and the consolidation of larger AI companies and installations.	July 2019
C: From the lab to the market: building up research excellence; establishing world-reference testing facilities; accelerating take-up	Promote scientific excellence	Organize a Network of AI research excellence centers through APPIA, in collaboration with other scientific societies (SPRobotica, Associação Portuguesa de Reconhecimento de Padrões). Define grand challenges to be approached with the collaboration of the centres.	By mid 2019
	Promote innovation	Set up an AI-on-demand platform, linked to other similar efforts in Europe. The platform is fed by academia, community and industry and makes available a set of AI tools that can be used as a service (API) or by easy-to-use download (containers) by academia, community	May 2019



and industry. The effort can be coordinated by the Network of AI centers and made available through the digital innovation hubs as an important tool to enable AI use by SMEs.

	Promote innovation	Launch a Digital Innovation Hub on AI with two branches and other smaller delegations (NUTS 2).	2019
	Increased success in European projects applications	Reinforce the national structure for funding management.	2019
	Boost research through testing facilities	Launch specific project calls for national and European AI labs and SMEs to work with larger companies from the automotive, space, ocean, agriculture and other strategic sectors, taking advantage of cross-border testing facilities installed.	2020
D: Skills and life-long learning	Promote skills	Increase offer in Higher Education for Computing and AI disciplines in all three levels; the number of first degree students should increase by at around 50% (including international students); the number of MSc courses should increase to cover more areas and have a better territorial distribution. PhD programs should go international and attract a much larger number of students by offering grants to national and international students on a merits base	2019
E: Data-a cornerstone for AI – creating a Common European Data Space	Make data available	Identify public data sets to make available for the research community and the society [( <i>explorar projeto INE</i> ); <i>lançar Colab na área de IA para AP.</i> ]	2019
	Make data available	Identify industrial data sets that can be shared to make available for the research community and the society. The data repositories can be organized by sector: Health, Education, Manufacturing, Retail, Tourism, Media, Sea/Geo, AgroFood, Energy. Work with INE to provide/organize the repositories.	2020
	Make data available	Setup a collection of data resources and tools for the Portuguese language to be used by	Nov 2019

academia and by industry.

F: Ethics by design and regulatory framework	Make AI Good	Set up an ethics committee for AI.	Mid 2019
G: AI for the Public Sector	Make AI Good	Launch project calls on AI for the Public Sector	Early 2019
	Make AI Good	Promote an annual meeting where Public Sector organizations present their problems and researchers present potential solutions. Joint presentations of ongoing experiences of AI for the public sector.	Oct 2019
H: International cooperation	International Cooperation	Lead and participate in proposals for European cross-border Projects of Common Interest (energy area).	2019
	International Cooperation	Call of AI projects for Social Good for the benefit of third-party nations (ecology, health, water supply, peace, education, etc.)	2021
	International Cooperation	Develop the AI axis in cooperation with CMU / UT Austin / MIT by defining specific sub-topics in the calls.	2019

## Annex 2: List of sample initiatives in Portugal

In Portugal, there are already official initiatives **promoting the use of artificial intelligence** techniques, with a strong focus on data science, skills and robotics. Our initiatives have been distributed within at least three ministries: Science and Technology, Economy and Presidency and Administrative Modernization, this one in charge of public administration.

The initiatives briefly described below will be integrated and consolidated within the same vision.

### AI in public administration

Early 2018 the Portuguese government launched 4 pilot projects that promote the use of AI techniques in public administration: fighting long term unemployment; preventing misuse of antibiotics; food safety and chatbots for entrepreneurs. Each project has at least one partner from the public administration and one research institution. On March 2018 an FCT call for more projects in this area was launched, and 15 projects were selected among 52 submissions. A new round of projects shall soon follow (March 2019), as well as others devoted to industry-academia cooperation.

The projects currently funded by FCT are listed below:

<b>Derm.AI – Usage of Artificial Intelligence to power Teledermatological Screening</b> Fraunhofer Portugal Research (Fraunhofer)   Shared Services of the Ministry of Health (SPMS)	299.156,25 €
<b>Water Intelligence System Data (WISDom)</b> Polytechnic Institute of Setúbal (IPSetúbal)   Water and Sanitation Municipal Company of Beja	288.450,00 €
<b>AI-based neuroimaging biomarkers for the diagnosis of neuropsychiatric illnesses</b> FCiências.ID - Association for Science Research and Development   Shared Services of the Ministry of Health (SPMS)	299.925,00 €
<b>Identifying and predicting emergency admissions</b> Calouste Gulbenkian Foundation (FCG)   Shared Services of the Ministry of Health (SPMS)	283.103,75 €
<b>Data2Help: Data Science for Optimization of Emergency Medical Services</b> Institute of Systems and Computer Engineering, Research and Development in Lisbon (INESC ID/INESC/IST/ULisboa)   National Institute of Medical Emergency (INEM)	294.036,25 €
<b>FailStopper Early Failure Detection application in Public Transport Vehicles in Operational Context</b> Inesc Tec - Institute of Systems and Computer Engineering, Technology and Science (INESC TEC)   "Metro" of Porto	95.147,50 €
<b>Modeling and prediction of road traffic accidents in the district of Setúbal</b> University of Évora (UE)   Republican National Guard	299.986,25 €
<b>IPSentinel Terrestria Enhanced Recognition System (IPSTERS)</b>	124.600,00 €

Institute of Development of New Technologies (UNINOVA/FCTUNL/UNL) | Directorate-General of the Territory

**ModEst Student flow modelling in the Portuguese education system** 246.950,00 €  
FCiências.ID - Association for Science Research and Development (FCiências.ID) | Directorate-General of Education and Science Statistics

**Understanding the drivers of academic achievement: Evidence for Portugal's high school system** 157.737,50 €  
NOVA Information Management School (NOVA IMS) (NOVA IMS/UNL) | Directorate-General of Education and Science Statistics

**iLU: Integrative Learning from Urban Data and Situational Context for City Mobility Optimization** 299.725,00 €  
Institute of Systems and Computer Engineering, Research and Development in Lisbon (INESC ID/INESC/IST/ULisboa) | Lisbon City Council

**EPISA—Entity and Property Inference for Semantic Archives** 299.237,50 €  
Inesc Tec - Institute of Systems and Computer Engineering, Technology and Science (INESC TEC) | Directorate-General for Books, Archives and Libraries

**Online Gambling Addiction Detection** 295.291,00 €  
NOVA Information Management School (NOVA IMS) (NOVA IMS/UNL) | Tourism of Portugal

**ICDS4IM - Intelligent Clinical Decision Support for Intensive Medicine** 264.888,75 €  
University of Minho (UM) University Hospital Center of Porto

**IPOscore - Predicting the risk of surgical complications and defining the prognosis of cancer patients through the integration of clinical and biopathological data** 247.056,25 €  
Institute of Mechanical Engineering (IDMEC) | Portuguese Oncology Institute of Porto

**Intelligent Agent(s) for Assistance in the Entrepreneur Desk (AIA)** Pilot / 106.568,00 €  
Faculty of Sciences and Technology of the University of Coimbra (FCT UC) | Agência para a Modernização Administrativa

**Identifying and Reducing Antibiotic Under and Over Prescription** Pilot / 123.860,00 €  
Nova School of Business and Economics (NOVA SBE) | Shared Services of the Ministry of Health (SPMS)

**Predicting long-term unemployment: an applied approach for intelligent unemployment management** Pilot / 122.556,00 €  
Nova School of Business and Economics (NOVA SBE) | Institute for Employment and Professional Training

**IA.SAE – Artificial Intelligence in Food and Economic Security** Pilot / 125.000,00 €  
Faculty of Engineering of the University of Porto (FE UC) | Economic and Food Safety Authority (ASAE)

## Digital skills

Digitization is essential to data collection and to the development of AI solutions. We are also promoting digital skills with the INCoDe 2030 initiative. This program is not only focused on high-level skills but also on very focused digital competences.

INCoDe.2030 is a Portuguese initiative that aims to improve the country position and competitiveness, working towards securing a prominent place in terms of digital skills until the end of the next decade. Towards that goal, the programme has a broad scope developing along 5 action lines: inclusion, education, qualification, specialisation and research.

Several ICT areas are key to the development of a digitized world, but artificial intelligence (AI) has already a special place in our daily lives and is an inescapable area that spans across all action lines of INCoDe.2030. From inclusion, where AI can have a strong role on social and human transformation, to education through which students can be introduced to simple examples of AI in robotics and other motivating areas, qualification exploiting AI as the cornerstone of Industry 4.0, and both specialization and research that have to deal with advanced AI techniques and solutions, mastering it at the theoretical and application level developing and implementing new solutions in many different areas.

Specifically concerning Axis 1, Inclusion, INCoDe.2030 is aligned with an EU vision that understands AI as being human-centred<sup>9</sup>, fostering an equitable society by addressing substantive issues related to societal challenges. In this perspective, AI needs to be socially and culturally situated, acknowledging that it is embedded in non-neutral values and may contribute to reproduce biased visions of reality and increase gaps in recognition and representation<sup>10</sup>.

## High Performance Computing

We are also firmly committed to improving our High Performance Computing facilities, with a new Centre already - Minho Advanced Computing Centre - under construction and a planned strong participation in EUROHPC that will devote a large share of its resources to support the use of AI in specific industries, acting as Digital Hub at national level.

## Industry 4.0 +

Ongoing initiatives related to industry are:

- The promotion of the 'industry 4.0' program by the Ministry of Economy (IAPMEI)

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<sup>9</sup> Carriço, G. (2018) The EU and artificial intelligence: a human-centered perspective, *European View*, Vol. 17(1), 29-36.

<sup>10</sup> Fraser, N. (2008). Reframing justice in a globalizing world. In N. Fraser (Ed.) *Scales of Justice* (pp. 12-29). Cambridge: Polity Press

<https://www.iapmei.pt/Paginas/Industria-4-0.aspx>), with a strong focus on technological cooperation and digitization;

- The launch, before the end of 2018, of an EIT KIC Digital hub in Braga (European Institute of Technology and Innovation) involving universities and big companies (automotive, manufacturing);
- The launching of co-labs (joint ventures of companies, research institutes and public and non-governmental organisms – the organization of these structures is very similar to Hubs or Testbeds, but at national level). Co-labs promote innovation and the productization of innovation. Most of the approved 20 Co-labs are not specifically focused on AI yet, but they are already part of an important trend in the use of AI and data science techniques in almost all of them.

## Digital Innovation Hubs

Portugal has three Digital Innovation Hubs (DIHs) already established and aims to enlarge the network of DIHs. These one-stop-shops help companies to become more competitive with regard to their business/production processes, products or services using digital technologies. DIH are one of the more important pillars of the Digitise European Industry effort, as they are composed of the most relevant business groups in the respective areas, as well as startups, SME and the academia, in order to ensure the broad dissemination and transfer of know-how by and to the business community.

Portugal established DIH were, as of October 2018, the following:

- **Produtech**, linked to the Production Technologies Cluster, gathers a comprehensive set of services, from visioning, strategy development and road mapping to the deployment of large-scale initiatives in R&D and Innovation, from awareness actions to matchmaking (e.g. for maturity assessment, access to specialist expertise and infrastructures, solution deployment, advanced training, mentoring...), from visibility actions (national and international) to priority definition, exploitation of opportunities (innovation, integrated offers, solutions take-up, deployment and diffusion, cross-fertilization and business) and access to funding and financing.
- **i-MAN** was established to foster the digital transformation of manufacturing companies of the Northern Region of Portugal (Norte) and to nurture the respective innovation ecosystem. It focuses on the main industrial sectors of the region: footwear, textile and clothing, agro-food, forestry, metalworking and machinery, and automotive parts. This DIH was originated from the BEinCPPS project, financed by FP7, in a consortium of 23 beneficiaries belonging to 8 different countries (Italy, Germany, Spain, France, Portugal, Austria, Serbia, and Switzerland).
- **HUB4AGRI**, a Hub for Agriculture, that aims the promotion of the competitiveness of companies in the agricultural sector, via the digitalization and the use of digital tools supporting the decision (Decision Support Tools - DST), based on a multisectoral cooperation network.

## Collaborative Laboratories

Collaborative Laboratories (CoLABs) are a new form of partnership with industry and society for market-

driven innovation and skilled jobs creation. CoLABs' main goal is to create qualified and scientific employment in Portugal through the implementation of R&I agendas oriented towards the creation of economic and social value, eliminating the gap between research and innovation activities; reinforce the collaboration between different institutions, public and private in co-responsibility of knowledge based strategies; combining public based, competitive and private funding.

There are currently 21 CoLABs, some with activities in AI, e.g.:

- DTx Digital Transformation in Industry
- SFCoLAB Smart Farm CoLAB
- Vortex CoLAB on Cyber-physical Systems and Cyber Security

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## Annex 3: Foreseen creation of a EU network of AI excellence centers

The Horizon 2020 work programme for LEIT-ICT is under discussion. It foresees the possibility of opening up a topic in July 2019 for the creation of a network of AI excellence centers. Not prejudging the ongoing discussions, we see this as a critical initiative to reinforce and build on Europe's assets in AI, including in terms of R&D. The European Commission action plan states clearly that: "Member States and the Commission aim to scale up national research capacities and reach critical mass through **tighter networks of European AI research excellence centres**. The objective is to foster cooperation among the best research teams in Europe, so that by joining forces they can tackle major scientific and technological challenges in AI more efficiently.

Bringing state-of-the-art AI applications to the market requires experimenting and testing in real-world environments. As part of the implementation of the Digitising European Industry strategy<sup>11</sup> adopted in 2016, the Commission is already supporting large-scale pilots and experiments in areas such as smart farming, smart cities and connected and autonomous vehicles.

Lessons will be drawn from these pilots and experiments. To optimise investment and avoid duplication of efforts, the Commission proposes that **several large-scale reference test sites, open to all actors across Europe, will be developed using up to EUR 1.5 billion** from the AI strand of the proposed Digital Europe programme, building on the strong base of existing centres of excellence in Member States. Examples of testing facilities that Member States are putting in place include the cross-border testing of connected and autonomous driving<sup>12</sup> and real scale experimentation of smart hospitals. In the case of connected and autonomous mobility, the identification of such testing facilities and the tests themselves will be coordinated, first, by the single EU-wide platform referred to in the EU strategy for mobility of the future<sup>13</sup> and, subsequently, by the corresponding partnership to be established under Horizon Europe.

It is equally important to foster the broadest possible uptake of AI in the economy, in particular by start-ups and small and medium-sized enterprises. By raising public awareness and sharing the latest scientific advances and tried and tested state-of-the-art technologies developed in Europe, we can ensure that every company, small or large, high-tech or not, as well as the public sector, can grasp these digital opportunities. The proposed new Digital Europe programme provides for co-investment by Member States and the Commission in **digital innovation hubs** across Europe, including via the Cohesion Policy funds. The programme will further facilitate the diffusion of AI capacity in each Member State and will link to an AI on-demand-platform<sup>14</sup>. To this end, in 2019 Member States will identify AI digital innovation hubs in their territory."

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<sup>11</sup> COM(2016) 180

<sup>12</sup> <https://ec.europa.eu/digital-single-market/en/cross-border-corridors-connected-and-automated-mobility-cam>

<sup>13</sup> COM(2018) 283

<sup>14</sup> <http://ai4eu.org/>



## Annex 4: Mobilizing programme in the remit of the National Innovation Agency

Within the regular calls for projects funded by the National and regional structural funds, ANI shall launch a call for “mobilizing projects” in February 2019, as well as a call for smaller “collaborative projects” in May 2019. Mobilizing projects are large scale (<10 M€) initiatives, led by industry, in partnership with R&D institutions, aiming at significant impacts. In 2019, they shall be open to the following thematic areas, addressing AI as appropriate:

- Aeronautics, space and defense, climatology and earth observation;
- Agro food, wine, forests and biodiversity;
- Footwear and textiles;
- Science and culture;
- Sustainable construction, urban science, cities and cars of the future;
- Circular economy;
- Industry, manufacturing and production technologies;
- Oceans;
- Cyber physical systems, ICT and electronics;
- Health.

The "Mobilizing Programmes" are "projects that stimulate scientific and technological skills and competences, with high technological content and innovation and with significant impacts at the multi-sectoral, regional, cluster and other forms of partnership and cooperation, aiming at an effective transfer of knowledge and valorization of R&D results with companies, carried out in an effective collaboration between companies and non-corporate entities of the R&I system. "

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