Chapter 6
Artificial Intelligence: Technologies, Applications, and Policy Perspectives. Insights from Portugal

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6.1 Introduction

Today, technology profusion and innovation are enormous [1] and fast, able to change the global scenario including businesses and how they operate, how they manufacture and communicate with the consumer, generating new business models [2, 3]. The most critical contemporary technologies incorporate artificial intelligence (AI) [4–7].

Lately, there has been an increasing interest in AI from both academics and practitioners [8, 9]. AI is connected to machines' capacity to imagine and process like real people, which means having the ability to read, interpret, and determine in a logical and intelligent way [10]. Some of the technologies associated with AI are deep learning (DL), machine learning (ML), and natural language processing (NLP).

DL is intended when computers use complex algorithms to emulate the human brain's neural network and practically learn an area of information without supervision [11].

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ML includes computers that learn from, often with a minimum of programming, the data and knowledge that are applied to them [12], reaching the results autonomously (for instance, the recommendations on Amazon). ML allows a mathematical model to be built from data, including a large number of unknown variables. With training data sets, the parameters are configured during the learning process. The various methods of ML are divided into three categories: human-supervised learning, unsupervised learning, and reinforcement-unsupervised learning. Such groups include various techniques, among others deep learning and neural networks.

NLP refers to ML methods employed to track down patterns in extensive data sets that recognize the natural language [13]. The study of feelings, where algorithms will search for social networking trends to investigate the consumers' feelings and attitude towards particular products, brands, or goods, is an example.

New advanced analytical tools have the potential to automatically classify market behaviors and predictions, incorporating analytical frameworks into operations affecting key decision-making capabilities, with a relevant effect on the architecture of organizations where new functions arise [14]. AI profoundly affects the way firms make their business strategies, as it impacts both the organization's internal resources and the way the business environment shapes its forces. While AI can be considered part of a company's structural capital [15], it can represent a way for organizations to boost their capabilities and competitive advantage [16]. AI follows automation, cloud computing, and the Internet of Things (IoT), to empower advanced machines, more intelligent factories, more innovative ecosystems, leading to the creation of new business models [17–20].

AI is driven by the convergence of virtually unlimited cloud computing capacity, digitization, and breakthroughs on how machines can use such data to understand and reason as well as humans do. Organizations are more and more willing to adopt modern AI technology such as ML. Among the goals, companies aim to speed production, boost their operating efficiencies, maximize equipment efficiency, eliminate garbage, and keep maintenance fees under control [17].

AI innovations are now opening up a mixed workforce in which humans and computers operate together. The aim is to find the perfect combination of human and machine cooperating to allow workers to benefit from technology's power [21]. According to the global market intelligence firm IDC, by the end of 2020, 60 per cent of plant floor workers at G2000 manufacturers will collaborate with technologies that empower automation, such as additive manufacturing, simulation, AI, robotics, and augmented and virtual reality. Still, there is an open debate about if and how much AI can replace human intelligence. The dialogue involves, in particular, all the sectors in which AI technologies are being adopted fast, disrupting the business processes and the outcomes. While most of the literature highlights how AI cannot replace human intelligence, almost all studies agree that it can support and enhance several strategic processes, including decision-making [22–24].

As said, AI is a technology which has been disrupting and boosting the performance and outcomes of the manufacturing and services sectors, and more is about to happen in the next few years [25]. This study carries an inclusive and general AI analysis, underlining the main theoretical frameworks and experiences in practice, providing a comprehensive review of AI from an industrial perspective. In trying to achieve this aim, the chapter provides first a systematic literature review to define the trends and applications of AI, followed by a reflection about the potential policy implications. The case of Portugal is taken as an example of what is going on in the field, and which challenges come next. This study has been conducted together with the Portuguese Ministry of Economic to analyze the technologies, applications, and policy perspectives of AI, focusing on Portugal.

6.2 Methodology

In trying to map the phenomenon and its main characteristics, a systematic literature review has been conducted starting from a search on the scientific databases Web of Science and Scopus [26]. This methodology was chosen based on Edmondson and McManus [27] studies and ideas about the best methods to analyses the problem of the technologies and application of AI in the industrial and service scenario.

The chapter addresses three main research questions (RQs), namely: RQ1: What are the main AI technologies applied to industry and services?; RQ2: Which the main applications of AI to the industry and services?; and RQ3: Which are the main public policies issues regarding AI in the European Union and Portugal?

The selected keywords were "artificial intelligence" and "technologies" and "applications." The search was limited to the timeframe 2015-(mid) 2020 since the interest towards the topic has been growing in the last 5 years, as well as the level reached by the technology and its applications in the industry. The first search was based only on "artificial intelligence" keyword, and the result was 125,957 articles. It was then necessary to restrict the search key to make it more aligned to the study's goals. Therefore, several exclusion criteria were included: the other keywords considered "technologies" and "applications," a restriction of the time frame to the last 5 years; only articles published in academic reviews; articles written in English, and full access. The final results lead to 314 research articles, which were analyzed.

6.3 AI: Themes, Sectors, and Applications

In addressing RQ1: What are the main AI technologies applied to industry and services?, the analysis of the 314 selected scientific articles allowed identifying the main research areas on AI and also the main sectors where it is applied. The trends of AI are based on a profusion of platforms, applications, and tools. Furthermore, from the analysis of the scientific studies about AI, the main themes and technologies under investigation are ML, predictive analytics, artificial neural network, DL, robotics, and AI. Table 6.1 summarizes the main results.

Table 6.1 Main themes in artificial intelligence studies

Keywords	Number of publications
Artificial Intelligence	134
Artificial neural network	24
Big data	9
Blockchain	2
Data science	3
Deep learning	22
Machine learning	61
Predictive analytics	37
Robotics	19
Smart cities	3
Total	314

Source: The Authors' analysis on Web of Science and Scopus, 2020

Table 6.2 Sectors being studied in artificial intelligence studies

Research areas	Number of publications
Business and management	8
Citizen privacy and law	5
Computers and engineering	79
Emergent technologies	32
Energy	30
Health	100
Industry	13
Public sector	3
Safety and environmental	39
Smart cities	4
Tourism	1
Total	314

Source: The Authors' analysis on Web of Science and Scopus, 2020

AI makes it possible to build algorithms known as artificial neural networks, inspired by the human brain's role. ML and DL's fields are more used are areas of AI technology such as machine vision, autonomous vehicles, automated text generation, face recognition (i.e. the use of mobile or personal computer facial recognition to access devices), and so on. AI makes software to be used in machine vision, voice recognition, and NLP cases even more straightforward.

AI innovations have many consequences for the internet business, computing and engineering, and many other areas, such as manufacturing, healthcare (which appears the most investigated sector), agriculture and automotive. Table 6.2 summarizes the main results.

More in detail, AI and ML are already showing a massive impact on healthcare and surgery [28]. The AI-based applications can support clinical and surgical decision-making, understand and interpret medical data, formulating a diagnosis without direct human intervention [29]. These applications are applied not only in the diagnosis phases but also in the treatment definition, image-guided surgery, drug development, personalized medicine, and patient monitoring and care [30]. Several clinical disciplines are involved in the AI revolution. Still, disruptive impacts are expected in radiation diagnosis [31, 32], eye-testing apparatus [33], ultrasonic diagnosis [34], diagnostics [35], computer-aided surgery [29], surgery [36], X-ray, and radiation therapy [37].

AI and ML also significantly impact the banking industry [38, 39]. The use of these new technologies simplifies banking operations. As an example, many banks and financial institutions have started to employ intelligent virtual assistants to enhance post-sales and customer support. Moreover, AI systems are used to prevent fraud and check possible dangers to clients while shopping in online stores.

Concerning the e-commerce industry as a retail market, the use of AI has included chatbots, helpers designed on AI technologies, smart logistics, and algorithms to monitor, assess, forecast, and interpret the actions of consumers [40, 41].

Many businesses often use operational automation to reach higher productivity standards and reduce transportation costs [42]. ML assists businesses in market forecasts, product search rating, product and deal suggestions, detect fraud, translations, and many more practices [43].

Regarding our RQ2: Which the main applications of AI to the industry and services?, predictive analytics stands as the number one AI use. It employs statistical methods and calculation to identify if and when events and outcomes are likely to happen and which counteractions can be taken. Practical examples include the ability to forecast if and when a wagon or pick-up is expected to crash or tear down and when it may be stuck in traffic or delayed because of unfavorable weather conditions [42]. The second most popular application involves real-time operations management, used to improve internal efficiencies within the company [44]. The possibility to enhance and monitor customer services [45] and customer insight and experience comes next, with dedicated new marketing operations by analyzing the outcomes of purchases. Companies are then able to map and understand the new habits, trends, behaviors of the customers [46]. Additional uses include risks management [47], research and development [25], supply chain, logistics, and procurement [48], human resource management [49], fraud prevention and detection through cybersecurity [50], knowledge creation, pricing, and social engagement [51].

AI also affects education [9]. The literature focuses on the contributions of AI mainly to improve learning opportunities for students and the management of the learning process [52–55]. AI solutions prove to contribute to equitable and inclusive access to education, providing opportunities, e.g., for people with disabilities and those living in isolated communities to access appropriate learning paths, through holograms and robotics. AI's contribution to education can support students who are not physically in the same location, allowing teachers and mentors to monitor asynchronous discussion groups, boosting engagement and outcomes. A secondary output allows better management of the flows, including grading.

All in all, AI improves strategic decision-making in various fields. Business decision-making requires analytical and intuitive thinking. AI solutions proved to integrate, but not to substitute, human explicit and tacit knowledge, supporting strategic decision-making [56]. Practical examples include healthcare and surgery [57, 58]. According to the literature, surgical decision-making is affected by time constraints (especially in trauma and emergency surgery), bias, uncertainty, complexity, decision fatigue, and hypothetical-deductive reasoning, leading to disservice and potential mistakes. In the hypothetical-deductive framework that characterizes surgical decision-making, the surgeon or surgical team should assess the initial patient condition by developing a possible diagnosis list. Such a list should then lead to a series of tests or therapies. In the traditional surgical scenario, it is the surgeon's ability or guesswork to create a comprehensive list of all likely or unlikely diagnoses and life-threatening factors [59], also taking into consideration the strengths and weaknesses of available trials or therapies. Once the best-fitting diagnosis is identified, the surgeon must use good judgment to formulate a surgical or treatment plan. All the phases along the road pose variability and possibilities for errors or biases [60]. Traditional clinical decision aid systems and tools are often compromised by time-consuming manual data entry and suboptimal accuracy. AI has the power to address these weaknesses. AI-based tools and technology that are correctly implemented can facilitate surgical decision-making by endorsing the decision to run the procedure, the informed consent process, the recognition and mitigation of eventual risk factors, the mapping and care of potential side effects, and shared decisions on the available resource [57, 61]. Still, AI solutions and technologies can support and improve, rather than replace, human decision-making [62] recalling the need to consider and train AI as a means for augmentation (boosting human's capabilities) rather than automation (replacing them).

6.4 Policy Reflections About Fostering Artificial Intelligence

The findings reveal that research on AI has advanced rapidly over the past years, and it is increasing again. In addressing our RQ3: Which are the main public policies issues regarding AI, with a major focus on the European Union and Portugal, we should highlight how while the technological applications and their outcomes on a variety of industries and sectors are undoubtedly impressive and measurable, concerns from the society have arisen [63, 64]. Simultaneously, two opposing views about these impacts have emerged. A more optimistic view focuses on the fact that AI could dramatically enhance productivity and outcomes in various fields, impacting people's lives positively. Applications like those on healthcare could lead to better patients' outcomes, like more precise diagnosis and safer surgeries and treatments. Fraud prevention could save people's money, and personalized customers' services may enhance the users' experience. On the contrary, a more pessimistic view stresses that the fast developments and applications in AI could impact society for the worse, reducing jobs and invading people's privacy, raising thus ethical concerns and legal issues.

Policy choices are likely to play a critical role, regardless of whether one takes a more negative or positive view on the topic. Second, regulatory policies will definitely impact the pace of technological diffusion and the shape in which technology takes. Third, some measures serve as protections for AI's future detrimental impacts on labor markets and competition issues [65].

As for policies that will impact the propagation of AI, one might point to ML's example. This technology is vulnerable to using vast quantities of data to make predictions feasible. In specific environments, the main limitation of AI is the right to collect valuable data, much of which is subject to privacy issues. In this way, the privacy policy has a significant effect on organizations' abilities to develop and enforce AI [66]. Very little security of privacy ensures that customers will not be inclined to engage in business purchases where they are exposed to their data and information. Too much regulation of privacy provides that businesses cannot use data to innovate. Although the latest analytical study does not directly concentrate on AI, the evidence to date shows that most government-mandated legislation on privacy is likely to slow down the adoption and advancement of technology, indicating a trade-off between the right to privacy and the pace of innovation [67]. This implies that any AI-focused government policy should weigh data producers and consumers' potentially competing interests, particularly concerning privacy, primarily to support a local AI industry. Perhaps more than any other legislation, privacy laws are likely to impact the pace and course of AI implementation in operation.

Liability and accountability rules may also affect the implementation of AI [68]. Companies would be less likely to invest in producing AI products without strict and transparent liability laws. The recent development of autonomous cars offers a helpful example. In the production of a self-driving vehicle, a variety of different firms would be interested. Without explicit cut rules on responsibility, however, anyone can hesitate to invest. Suppose autonomous cars can save lives, allowing a more secure driving. Should non-autonomous vehicle manufacturers be kept to higher standards than what is mandated under current law? The dissemination of safer technology will intensify this. In contrast, if the rise in accountability was mainly on emerging technologies, then diffusion would slow down. As for all other technology, more scientific funding, well-balanced intellectual property legislation, and the freedom to innovate in a protected manner would make development quicker.

The same liability issue concerns the evolution and adoption of AI-based surgical robots. Such robots can already independently carry out parts of surgical operations like, for instance, performing intestinal anastomoses more precisely and faster than experienced surgeons [69]. The benefits of such robots have already been stated and measured, such as a more precise visualization of the operating field, better movements thanks to the articulating tools, the elimination of vibrations and fewer medical errors [29], leading to better outcomes both for the surgical patients as well as the hospital or institution adopting such a technology [70]. However, today, the entire decision-making process is the full responsibility of the surgeon in charge [71]. This is the main reason limiting the spread of AI-based surgical robots [72], and this issue will remain until further regulations.

As for policies that address AI outcomes, one could point to the most common concerns, the impact on jobs [62]. Although an argument can be made about the fact that technology is often put into place to substitute human activity in tedious and dangerous undertakings, increasing safety and productivity [45, 62], some have raised concerns about the need to find alternate sources of meaning. Moreover, the widespread use of AI may further strengthen current wealth distribution trends. In other words, the development of AI may come at the cost of further inequality. It is likely to be skill-biased if AI is like other forms of information technology. Skilled people who are still doing reasonably well would be those who profit most from AI [73]. Such persons are also more likely to own computers and technology. The social safety net is linked to measures to counter the effects of AI for inequalities. The AI background is not unusual in weighing the risks and advantages of social services, from egalitarian taxes to healthcare coverage. However, others have floated relatively ambitious proposals to deal with the possible rise in inequalities, such as a levy on machines and a universal basic income.

In the shorter term, the change could mean temporary redundancy for many employees if AI diffuses broadly. Some authors emphasize a short-to-medium-term disparity between skills and technologies. This suggests that policy planning should consider both economic cycles and education policy in advance of the dissemination of AI. Technology-driven dismissals based on place and time are not unique to AI. They became a feature of the modernization of factories and farm mechanization. There are also unanswered questions concerning school reform. If computers can execute technology-related prediction functions, can education programs concentrate on cognitive skills and the humanities? Should school programs evolve to rely more on adults? How do the skills available as AI spreads vary from the skills currently offered by the education system? It is essential to answer all these unanswered questions through effective policies and services.

Another policy question relates to whether AI will lead to monopolization in some industries. The leading AI companies are prominent in revenue, profits, and market capitalization [74]. This has contributed to a rise in antitrust scrutiny by governments of leading technology companies (especially the European Commission). These organizations' position as forums, not their use of AI per se, is the object of much of this antitrust scrutiny. The meaning of data is the function that makes AI different. Companies can develop better AI with more info. If this leads to economies of scale and the opportunity for monopolization depends on whether a slight lead provides a positive feedback loop and a long-run benefit early in the growth cycle.

While AI is like other technology in many ways, it looks unique in a few crucial dimensions. In specific, AI is both a general-purpose application and an invention' approach. The consequences concern returns on expenditures like AI regulation. The cost of suboptimal policy design is likely to be considerably higher than for other innovations due to the scope of implementations or the advantages of optimal policy are more important.

6.5 EU Artificial Intelligence Strategy 2030

The EU Artificial Intelligence Strategy 2030 has been validated, and it is running. It foresees that AI will be included in educational materials for pupils and grown-ups, either embedded into the public administration services or as SMEs technologies. The aim is to investigate AI's various economic and societal potentials, as well as its application in areas such as renewable energy networks, cities, metropolis, and communities, forests, and oceans, connectivity, self-driving vehicles, and healthcare services. Its growing popularity will help to advance scientific research in the future.

This Strategy's plan clarifies that AI's investment brings more opportunities and jobs, guaranteeing all workers' inclusion impacted by this new reality. While creating a new world of possibilities, AI will not replace human beings. Promoting a better environment, encouraging AI talents and digital brains, generating new jobs and building an AI service economy stand as the main pillars of the AI strategy. The aim is to secure AI niche markets through key specialized services, leading to further innovations through AI science, delivering better public services to people and businesses.

In this context, Portugal has been selected as a living lab for the experimentation of new AI developments, implementing the National Strategy for Artificial Intelligence, based on the InCoDe2030 program, under the Government of Portugal strategy and policies and operationalized by these organizations: Portuguese Science and Technology Foundation (FCT), Ciência Viva, the Portuguese Innovation Agency (ANI), the Portuguese Agency for Administrative Modernisation (AMA). The Action Plan includes seven action lines, concerning inclusion and education by disseminating generalist knowledge, qualification, and specialization, the definition of thematic areas for research and innovation in European and international networks, the development of the public administration and its modernization, the identification of specific areas of specialization with global impact, the development and support of regions in European and international networks, and addressing the challenges in terms of ethics and safety.

6.6 Portugal Artificial Intelligence Overview

Notwithstanding the increasing significance of AI, there are substantial holes in the Portuguese case's quantitative knowledge. Most of the current experience, in particular, refers to studies focused on the collection of data from different stakeholders in the form of surveys. CIONET Portugal researched the effect of AI on Portuguese firms belonging to various industries. One of the most critical pieces of evidence from the research shows that 34.6% of participants would use an AI approach in less than 12 months. As of now, 39% of participants state their company is employing AI in everyday activities. Following this report, participants suggest that ML and chatbots will be the AI technologies that will gain more success in the industry and service sectors. ML stands as the most accepted AI tool. 94% of organizations say they will likely implement this approach. Still, participants claim as AI may impact their organizations by, for example, supporting the automation of facilities, IoT, or even hospital diagnostic tools.

The uncertainty that employment will shrink increases with the growth of AI. Thus, a positive impact on Portuguese employability can be expected, with potential growth of 15.1%, despite the number of jobs lost because of AI applications.

A different piece of research on a sample of Portuguese firms (namely, Artificial Intelligence in Europe: How Leading Companies Benefit from AI - Perspectives 2019 and Beyond) highlights how ML and Smart Robotics technologies can represent significant opportunities for Portuguese companies.

Portuguese companies appear to be late adopters of AI compared to other European countries and, considering a ratio of AI maturity, Portuguese organizations stand behind the European average. While 82% of Portuguese firms declare they would soon try or employ some AI-based applications, the remaining 18% are not yet thinking to introduce AI into their plants. Therefore, results show that the maturity level is still far away, and policies and actions are needed to reach it.

In certain companies/functions, the diffusion of AI among Portuguese entities is depleted. However, all company activities are protected by AI software. Nevertheless, the investigation resulted in some surprising findings, as 36% of firms do not employ AI-based applications in the management or operations. In line with European trends, the involvement of Portuguese companies which apply AI in their fields appears in this way: Technology and Digital (45%), Client Support (36%) and Research, Development, and Product Creation (32%).

The problem with sector delimitation is one of the fundamental issues concerning the AI phenomena' mediation component. In this sense, the Techno-Economic Section (TES) methodology was used in a recent piece of research carried on by the European Union. The methodology's first move was to describe the TES (AI, in this case) boundaries, defining players who rely on AI as a primary or secondary operation. Such relevant actors are classified as R&D centers, academic entities, and firms engaged in one or more of the following activities: research processes, manufacturing and marketing industries, and relevant services relating to AI. In the EU background, the United Kingdom, Germany, Spain, Italy, France, and the Netherlands have the most significant amount of organizations. In exchange, the emphasis is on nations such as Cyprus, Bulgaria, Estonia, and Malta, considering the investments as a percentage of their recorded GDP. Portugal holds an intermediate position when considering the quantity of parties and its portrayal compared to the GDP.

On the other side, the same European Commission report mapped the foremost players by country in the 2009–2018 period, who engaged in FP7 and H2020 AI-related research projects. We may observe an equitable distribution among the biggest and highly successful researching Nations. In Portugal, only two of the listed AI organizations got a sponsorship successfully.

6.7 Portuguese AI Case Studies

In recent years, there has been a growing number of research projects and several AI start-ups in Portugal. These include companies such as Feedzai, James, Heptasense, Jungle.ai and Unabel. Among these, Feedzai is undoubtedly one of the most recognized Portuguese start-ups. This firm, which was born in Coimbra, put AI to work on prevention and fraud. Currently, the Feedzai team is working with some of the largest banks in the world. Feedzai has successfully developed an intelligent platform that absorbs and transforms various data streams and fraud information into any channel. The platform enriches data to create hyper-granular risk profiles, while ML processes events and transactions in milliseconds. They then provide explainable AI by adding a human-readable semantic layer to the underlying machine logic.

6.8 Artificial Intelligence Policy Ramifications

AI research has progressed steadily over the past years. Two perspectives can be found in the literature. A more cynical view emphasizes how rapid developments in AI can change society with substantial job losses, arising complex ethical concerns related to the implementation and usage of these technologies. In contrast, a more optimistic perspective focuses on the fact that AI can lead to a better quality of life.

Policy decisions on the implementation of AI in industry and society are likely to play an important role, namely: (a) regulatory policies that can lead to increasing the pace of technology dissemination; (b) privacy policies have a direct effect on organizations' ability to develop and introduce AI. However, a high degree of privacy regulation suggests that companies would have trouble using data to innovate and potentially slow the acceptance and innovation of technology.

This study offers information to policy-makers to help them decide to establish an ethical structure for a more trustworthy, ethical, open, and impartial use of AI. There will also be a strengthening of trust with efforts to consider new standards and norms. It will also be essential to establish policies on ownership of intellectual property rights in outputs generated by AI, liability, and data privacy. Future liability decisions will also impact the distribution of AI in this regard [68], as it affects organizations' faith in investing in AI technologies production.

The decision to develop inequality policies is also nuclear, as AI is likely to be ability biased. People need to adapt to the digital economy's challenges, and policy-makers also need to consider AI in both business cycles and education policy. Policy choices should help corporations explore innovations and upskilling/reskilling the workforce. The digital and data-driven environment pushes forward all aspects of the economy, and policy decisions will speed up adoption, making AI more available and affordable.

6.9 Conclusion

Because of new advances in AI, the effects of sudden and large-scale automation have been the focus of interest lately. In tandem with computers' growing computing power, modern algorithms have made it possible for robots to take care of tasks that only humans can perform until now.

While there are many opportunities in terms of applications covering several different areas, many issues exist, notably data protection, work losses, and deficiencies in the skills required. Looking ahead, the capacity to implement more advanced technology will be missing in less efficient businesses. In turn, from a competitive advantage point of view, the more efficient firms can result, the more value they can get, particularly in a digital world where intangible firm-specific assets look crucial. This feature seeks to disrupt the dynamism and competition in the industry and may potentially impact productivity. In this regard, mounting signs of rising markups and market concentration and decreasing business entries and exits, notably in digitally intensive industries, are alarming, highlighting the possible effect of AI-related technology on organizations' strategic management and strategy-making processes.

Big data on job qualifications and job conditions can be elaborated and analyzed by AI. To direct individuals and employees to make well-informed job decisions, local labor market knowledge and skills, anticipation programs would be necessary. Jobs and training programs, both at the national and local level, will adapt to the next frontiers on employment by identifying demands more efficiently and educating people with valuable expertise. Thus, strategic choices regarding AI involve organizations or industries and countries and policy-makers, who are responsible for creating ad-hoc policies to shape the future of the economy, the business environment, and society to benefit from new technologies.

In all, while AI-based technologies have undoubtedly the power to bring benefits for both companies and society, a need for dedicated policies emerges, both from a national and an international level. While practitioners concentrate on the use and possible applications of such a disruptive technology, scholars should investigate the major outcomes and concerns. Academic studies and professional reports should guide decision-makers in ruling such a challenging phenomenon. Several paradoxes emerge, like the request for privacy in contrast with data collection to foster innovation.

Like all pieces of research, our study has limitations. The continuous and rich production of scientific documents and practitioners' sources on an emerging and actual topic like AI may limit the validity of our findings and considerations in the future. Still, while our research is mainly based on scientific sources, a professional perspective should be added, enriching the phenomenon's view and the considerations on policy implications. Comparing more countries to Portugal may then add valuable insights to the whole topic.

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