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Research Results
Резултати от научни изследвания

STRATEGIES AND POLICIES TO SUPPORT THE DEVELOPMENT OF AI TECHNOLOGIES IN EUROPE

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Abstract. The starting point for this particular research is to uncover the relationship between the establishment of the regulatory framework, the implementation of various European digitisation development programmes and other types of enabling environment (financial instruments and programmes) with the demonstrated performance of business and science in the form of registered patents in the field of AI. The scope of the study is limited to the specific legal documents in the field of artificial intelligence, the financial mechanisms that Europe applies to stimulate research in this field, as well as to the applications filed and patents granted for technologies in the field of artificial intelligence, namely: machine understanding technologies. The study's main results show that technology companies follow their own technology policies to meet market demands and trends, and support mechanisms (in the form of policies, programmes, and financial incentives) are more the result of technological developments than the other way around.

Keywords: Artificial Intelligence; legal Frame for AI development in Europe; patents

Introduction

The dynamics of the environment show the increasing need for the introduction of Artificial Intelligence (AI) tools in every business area. The large-scale penetration of various technologies for big data processing, machine learning, neural networks, contain the potential for significant progress in the economy and society. AI has the potential to significantly advance technology and create new business models in many sectors of the digital economy (EU Directive 496/2022). At the same time, there are a number of unknowns related to its rational and seamless use. New risks and/or negative consequences for individuals or societies are emerging. The accelerated pace of the uptake of AI is causing a number of stressful situations. This determines the need for a balanced approach to implementing the transition. The EU is striving to increase the guarantees that Europeans can benefit from new

technologies developed and functioning in accordance with the values, fundamental rights and principles of the Union (EU Regulation 206/2021). Such guarantees are essential to minimise risk and create the right environment for digital transformation and a sustainable entry into Industry 4.0. In recent years, the efforts of the EU have been focused on creating a framework that ensures a safe and enabling environment for the development of artificial intelligence. The European approach implies that the use of AI should be built in a way that guarantees the security and rights of citizens, the use of high-quality data and equal access to the benefits of the technology. The European objectives aim at global leadership in trustworthy AI, underpinned by high ethical standards, no harm to citizens and public trust (EU Regulation 206/2021). The aim of this paper is to analyse the regulatory and financial framework in Europe for the development of AI and to find out what effect it has had on the development of various innovations based on AI tools (machine learning, neural networks, Internet of Things, computer vision, etc.). Technological development is examined through the lens of patenting AI-related technologies, insofar as this process ensures that technologies are globally novel, a significant step ahead of the existing state of the art and industrially applicable.

Methodology

The research question that the authors ask is whether there is a link (and what is it) between the establishment of the regulatory framework, the implementation of various programmes for the development of digitisation in Europe and other types of incentive environment (financial instruments and programmes) with the demonstrated results of business and science in the form of registered patents in the field of artificial intelligence. The study used qualitative research methods (literature review and document analysis, observation and tracking of trends in AI development) to identify the factors and mechanisms of influence in the development of AI technologies in general, as well as quantitative research methods - primary data collection, secondary data analysis from different sources and researchers, statistical analysis. In order to achieve the objective and answer the research question, the following structure of the paper is adopted: an overview and analysis of the regulatory framework and the incentive policies and instruments that Europe is applying for the development of AI and registered patents in the field of AI in the period 2010 – 2022. The data on European patents in the field of AI is extracted using the World Intellectual Property Organization categorization in the 2019 Technology Trends Report (WIPO 2019) as well as the identification of the codes of the International Patent Classification given by Kim, Juhwan & Jun, Sunghae & Jang, Dongsik & Park, Sangsung (Kim at al. 2018), for the importance, of each type of technology classified in the corresponding index for the development of AI-related follow-on technologies (Kim at al. 2018). In this categorization, the AI-related technologies are as follows:

– Artificial intelligence techniques: advanced forms of statistical and mathematical models, such as machine learning, fuzzy logic and expert systems, enabling the computation of tasks that are typically performed by humans; various AI techniques can be used as a means to implement different AI functions.

– Functional applications of AI: functions such as speech or computer vision that can be implemented using one or more AI techniques.

– Application areas of AI: different areas, fields or disciplines where AI technologies can find application, such as transport, agriculture or life and medical sciences.

And the fifteen most commonly used International Patent Classification codes related to AI technologies are:

– G06F Electrical digital data processing

– G06K Data recognition, data representation; recording media; processing of recording media

– H04N Pictorial communication; television

– G10L Speech analysis or synthesis; speech or voice processing; speech or sound coding or decoding

– G06T Image data processing or generation

– A61B Diagnosis; surgery; identification

– H04M Telephone communication

– G01N Study or analysis of materials by determination of their chemical or physical properties

– H04R Loudspeakers; microphones; phonograph pixels or similar acoustic electromechanical transducers; public address systems

– G06N Computer systems based on specific computational models

– G01S Radio navigation; determination of distance or speed by radio waves; determination of location or presence by use of reflection or re-emission of radio waves; similar devices using other waves

– H04L Transmission of digital information, e.g. telegraphic communication

– G06Q Data processing systems or methods specially adapted for administrative, commercial, financial, managerial, control or forecasting purposes; systems or methods specially adapted for administrative, commercial, financial, managerial, control or forecasting purposes, not elsewhere specified or included

– H04B Transmission

– H04W Wireless communication networks

Timeline of the study: the study was conducted for 2010 – 2022.

AI environment

According to the roadmap for making Europe a world leader (EU Resolution, 2020/2266(INI)) the transformation should encompass key activities reorganising entirely the public. It focuses on key areas such as A supportive regulatory

environment; Completing the digital single market; Digital green infrastructure; Ecosystem of excellence; Ecosystem of trust; Industrial strategy; Security (EU Resolution, 2020/2266(INI)).

To achieve its goals, Europe is focusing its efforts on various initiatives and investments related to the penetration of AI in the community. It is putting in place a comprehensive mechanism including investment in human capital, i.e. the development of education and lifelong learning; research from the lab to knowledge transfer to business; regulation including ethics, legislation and standardisation; and infrastructure for AI development (Roy 2020). Its efforts are focused on obtaining results that ensure a high degree of reliability of systems using various AI tools, protecting the interests of users, developers and implementers alike. Priority is given to building a robust European legal framework for AI. It addresses the fundamental rights and risks specific to AI systems. It provides AI developers, implementers and users with clear requirements and obligations regarding specific uses of AI. It also ensures the safety and fundamental rights of

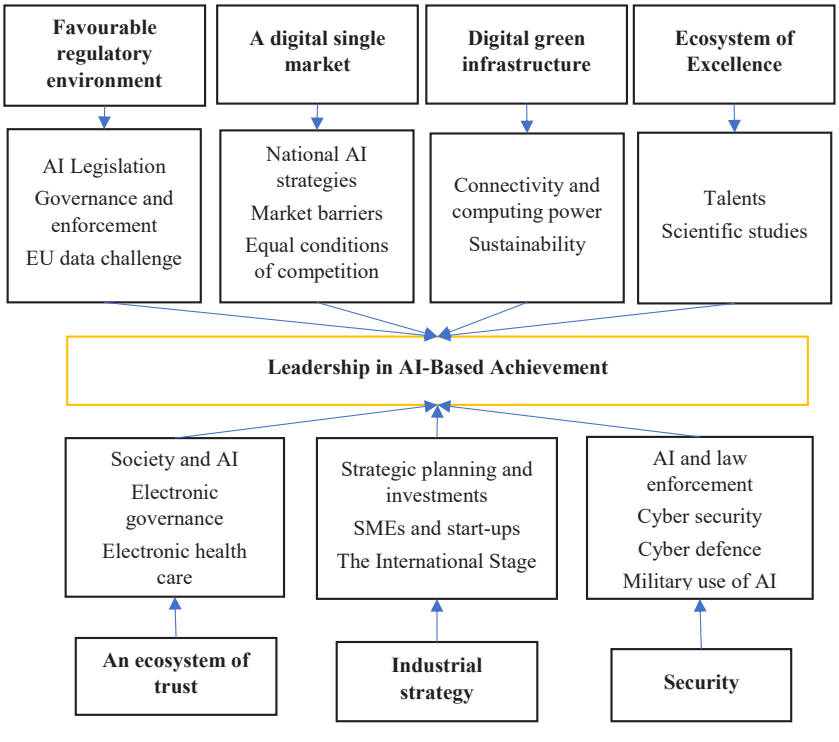

Figure 1. Key components for making Europe a world leader
Source: Report on Artificial Intelligence in a Digital Age 2020/2266(INI)

individuals and businesses; and reduces the administrative and financial burden on business (Regulatory framework proposal on artificial intelligence). The legislation harmonises the civil liability framework with the specificities of AI and also sectoral safety legislation (A European approach to artificial intelligence). In this context, the EU is adopting a number of resolutions in 2020 related to AI, including on ethics (EU Resolution2020/2012(INL)), liability (EU Resolution2020/2014(INL) and intellectual property rights (EU Resolution2020/2014(INL). In the same year, the Charter of Fundamental Rights was signed in the context of AI and digital change (Charter of Fundamental Rights in the Context of Artificial Intelligence and Digital Change, 11481/2020).

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Artificial Intelligence in Criminal Law, 2020/2016(INI)) and in education, culture and audio-vision (Report on Artificial Intelligence in Education, Culture and the Audio-Visual Sector, 2020/2017(INI). In 2021, the Regulation on harmonised rules on artificial intelligence is also adopted (Regulation on harmonized rules on artificial intelligence, com (2021) 206). It ensures that AI systems in the EU must be safe and reliable so as to define legal certainty and facilitate investment and innovation in AI (Regulation on harmonized rules on artificial intelligence, COM (2021) 206). In 2022, another piece of legislation in the field is adopted - the Directive on adapting the rules on non-contractual civil liability to AI (Directive COM(2022) 496). Its aim is to improve the functioning of the internal market by setting uniform requirements in different aspects of non-contractual civil liability for damage caused by AI systems (Directive COM(2022) 496). It helps to protect fundamental rights such as: the right to life, the right to physical and mental integrity and the right to property ((Directive COM(2022) 496). The Directive ensures that all individuals who are harmed in any way by AI will receive protection equivalent to that received by victims who are harmed by products in general (Directive COM(2022) 496). At the same time, the legal uncertainty for businesses developing or using AI as to their potential risk of liability is reduced (Directive COM(2022) 496).

In its drive to build a comprehensive ecosystem of excellence, the EU is building common European data spaces (EU data exchange), unveiling programmes such as Digital Europe, whose objectives are linked to the digital transformation of Europe, its public administration, business and society. The main policies of the programme are focused on: high-performance computing; artificial intelligence; cyber security and trust; advanced digital skills; interoperability and digital transformation (Digital Europe Programme). Another programme is the "Digital Decade", which provides guidance for digital transformation and drives the index for the uptake of digital technologies in the economy and society (Europe's digital decade). Dozens of high-tech laboratories and centres for artificial intelligence have been built, with the Bosch Centre for AI, the UCL Centre for Artificial Intelligence, the European Laboratory for Learning and Intelligent Systems, the Max Planck Institute for Informatics among the leading ones (Top Ten European AI Research Labs for 2022). There are also world-class AI Reference Testing and Experimentation Facilities.

While this is only part of the environment for developing AI-based innovation, it is clear that the EU is working hard to achieve a high degree of public trust, ensuring long-term sustainable interest and ensuring a risk-free transition to a smart economy. Making the reliability of AI-enabled systems a top priority contributes significantly to stimulating investment (Regulatory framework proposal on artificial intelligence) in smart innovation. This will both facilitate their uptake and enhance Europe's competitive position (Kontseptsia za Razvitieto na Izkustvenia Intelekt v Bulgaria do 2030) in AI.

European patents in the field of AI

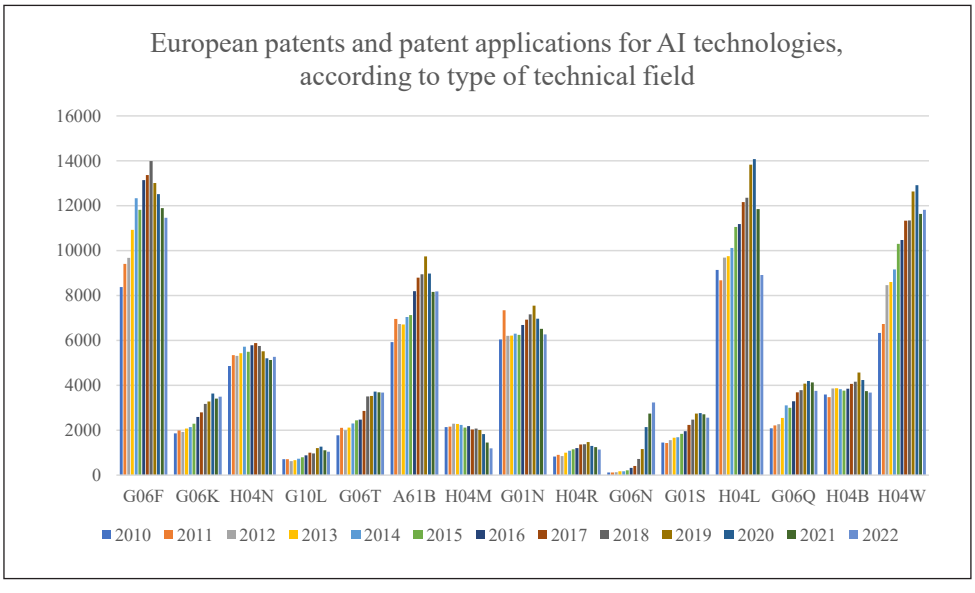

Figure 2. Technologies in the field of artificial intelligence applied for and protected by a European patent in the period 2010 – 2022

Source: European Patent Office

Since 2010, the growth in AI applications and patents has increased sharply on an annual basis, reflecting the increasing spread of AI technology across sectors. However, despite the impressive patent activity, European companies are lagging behind in technological development. For the period 2010 – 2022, the only European companies in the top 5 or top 10 technology applicants and patent holders in the field of AI are typically US or Asian companies (originating from China, Korea, and Japan). This data is confirmed by the joint report published by the European Investment Bank (EIB) and the European Patent Office (EPO) entitled "Deep technology innovation in smart connected technologies" (EIB 2022). The report finds that global patenting activity in the technologies of the 4th Industrial Revolution, which mainly concern smart connected devices from small and medium-sized enterprises (SMEs), remains strong in Europe: between 2010 and 2018 (the reference period of the study), the EU-27 accounted for around 15% of international patent families (patent applications filed in at least two countries or in a regional patent office) and is the third largest contributor to international patent families after the US and Japan. Patent activity in these technologies by SMEs in the EU grew rapidly during this period, with an average annual growth rate of nearly

20%. But in absolute terms, Europe also lags behind the US in terms of the number of SMEs developing such technologies. While 6517 small enterprises patent smart and connected devices, processes and technologies in the United States, less than half – 2634 – do so in the European Union.

In addition, Europe has a highly well-organized financing environment for fostering innovation and research. Yet, despite this policy's emphasis on R&D and an innovation-led economy, Europe has not yet performed well in terms of innovation. Nearly all EU countries increased their innovation performance between 2015 and 2022, according to the European Innovation Scoreboard created by the European Commission (European Innovation Scoreboard 2022). In 2015, performance improved highest in Cyprus, Estonia, Greece, Lithuania, and the Czech Republic as compared to the EU. Performance in terms of innovation improved more quickly than the EU average for two new innovators, Croatia and Poland. The EU still has an innovation divide. Geographical concentration of innovation activities still rests mostly in countries from Northern and Western Europe, while Southern and Eastern Europe are still considered emerging innovators.

The main obstacles facing small businesses in developing advanced digital technologies in the European Union are two main ones: access to finance and lack of skilled staff. This is understandable insofar as these enterprises have an above-average investment intensity, higher development costs, and also need time to bring their innovations to market. The technological development lag clearly shows that the difficulty of access to such programmes, the conservatism of financial institutions and investors, the difficulty of administering such projects, and the increased requirements for participation in programmes to encourage the development of technological innovations to reduce the possibilities of supporting such enterprises and therefore the opportunities for development. Start-ups in this field invest heavily in research and development (R&D), while their projects involve greater risks. Low cash flows, few tangible assets to serve as collateral and the uncertainty associated with innovation mean that more traditional investors are hesitant to get involved. Although there are many high-performing companies in Europe, European companies generally underperform compared to those in other major regions: they grow more slowly, generate lower returns and invest less in R&D than their US counterparts. This largely reflects the fact that Europe has missed the opportunity to lead and participate adequately in the latest technological revolution, lagging behind in terms of value and growth in ICT and other disruptive innovations.

Conclusion

If we compare the timeline of patent applications and granted protection documents in Europe in the field of AI and the introduction of specific strategies and policies in this area, we can clearly see that technology companies follow their own technology policies to meet market demands and trends in support

mechanisms are more the result of technological developments than the other way around. At this stage of the analysis, when there are still too many unknowns as to whether and which interventions are effective for which countries with respect to AI technologies, it is advisable to engage the attention of researchers and decision-makers in careful monitoring of emerging innovative markets. This will help to determine whether the right mix of policy instruments is available in the European Union and individual countries and whether this mix is effective in ensuring the smooth development of businesses in new markets. Policies that prove ineffective in specific markets can be adapted or abandoned altogether. Monitoring should include a strong prospective aspect that can identify new emerging markets well in advance so that a proactive set of policies can be identified for the earliest phases of development when the risk of market failure for technology start-ups is highest.

In order to enhance the effect of the adopted normative measures, it is advisable to pay attention to the collaboration with business and high-tech companies. The legislative body has developed the main areas of increasing security in the use of AI. From here, flexible policies should be drawn up to adapt to the changing conditions of the market environment. From this point of view, it is appropriate to develop exemplary rules and policies for working in a business environment, on the basis of which high-tech companies can adapt and apply EU requirements. It will also help to balance the needs of technology companies in terms of data privacy and security and protect the rights of citizens, guarantee them a high quality of AI work. Future steps towards research in the field are directed in this direction. The authors aim to direct their scientific efforts to help AI project managers make informed and sufficiently safe decisions.

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