ARTIFICIAL INTELLIGENCE AS A DRIVER OF CHANGE: A REVIEW OF BARRIERS, OPPORTUNITIES, AND EU REGULATORY FRAMEWORKS WITH IMPLICATIONS FOR CROATIA

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ABSTRACT

This research aims to analyze the barriers, perspectives, and regulatory reactions to the use of artificial intelligence (AI). Sudden technological advancements and extensive application of AI are initiating profound change, but also pose questions, especially in the labor market. Workers are concerned about losing their jobs, while consumers have been inquiring about the responsibility of an AI system when it makes an incorrect decision. Small firms are uncertain about how to utilize AI in their businesses, whereas startups in the AI sector often struggle to secure the necessary resources and skilled professionals. Simultaneously, rising international competition is compelling organizations to adapt rapidly to remain competitive in the market. In parallel, technology has profoundly transformed the economy and society, optimizing business processes, reducing operational costs, and significantly enhancing organizational productivity and efficiency. Besides these arguments, AI implementation also presents additional challenges to privacy, ethics, regulation, and security. In this context, the risks associated with the AI Act, as a potential global legal standard, have been analyzed. Its practical effectiveness will ultimately depend on accurate risk assessments and the capacity to adapt to future technological innovations. Despite the challenges, AI represents an extraordinary opportunity to redefine human potential and fundamentally transform the way we live and work. With appropriate regulation and responsible implementation, AI can become a pivotal tool in building a more sustainable and innovation-driven society – one in which technology is not merely an instrument but a partner in shaping a better future.

KEY WORDS

artificial intelligence, legal norms, technological change, labor impact

CLASSIFICATION

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INTRODUCTION

The concept of computer-based artificial intelligence dates back to 1950, when Alan Turing proposed what became known as the "Turing Test": can a computer communicate well enough to convince a human that it is also human? The term "artificial intelligence" emerged in 1955 to describe the first academic conference on the subject. In the same year, researchers at the Carnegie Institute of Technology developed the first AI program, "Logic Theorist". The practical application of artificial intelligence began in the 1980s when university researchers developed "expert systems" – software programs that assess a set of facts using a knowledge base and then offer solutions to problems [1].

Fears that automation, along with mechanization, computing, robotics, and more recently AI, will lead to job losses and irreparably harm the labor market are greater than ever [2, 3]. Keynes [4] described technological unemployment as "unemployment caused by our discovery of ways to use labor more efficiently than the pace at which we can find new ways to use labor". Similarly, Leontief [5], during his observation, saw tremendous improvements in computer chip processing and was worried that machines would replace humans. In the past, automation often temporarily replaced human labor, but in the long run, it led to the creation of complementary jobs. For these reasons, this article will examine the barriers, perspectives, and regulations (frameworks) regarding artificial intelligence and its implementation in business. According to recent studies, it appears that society has entered a new era driven by the application of artificial intelligence (AI), where changes are occurring at a rate faster than humanity can process them. At times, it can be said that the world is "losing control" in tracking this technological giant, and despite many examples of good practices, people still express fear and concern when AI is mentioned. This raises the question of what kind of perception people have of artificial intelligence and whether they view this technology more positively or negatively. The research titled "Perception of Artificial Intelligence in the Republic of Croatia", published in the Effectus [6], showed interesting results. The majority of respondents reported that they had been exposed to information about AI (in the past 6 months), and they associate it more with negative connotations, such as uncertainty (27% of respondents) and concern (33% of respondents), while only 30% mentioned the usefulness of AI.

When it comes to barriers related to AI, they are emerging daily, and perhaps the biggest is the lack of experts in the field of machine learning, deep learning, and general knowledge about artificial intelligence. Despite numerous initiatives, measures, and lifelong learning programs, it is challenging to keep pace with this wave and stay current with all the new developments in the market. Indeed, numerous studies have demonstrated that a significant proportion of business leaders are uncertain about the potential benefits of AI, where to source AI-powered applications, how to integrate them into their organizations, and how to assess the return on investment in technology [1, 7]. Today, AI-powered machines can perform tasks such as pattern recognition, information synthesis, and drawing conclusions, which, until recently, required human cognition. As AI capabilities have expanded, so has their application in various fields. In all sectors, larger companies (with more than 500 employees) are at least 10% more likely to adopt AI technologies in their core operations compared to smaller companies [8]. Due to the lack of research on the application of artificial intelligence in small businesses, Anwar et al. [9] investigated how AI can enhance business strategy and competitive advantage in small businesses, with a particular focus on the challenges and opportunities that this technology presents to small companies.

How are businesses adapting to hiring and seeking employees who use AI technology, and are they keeping up with market changes? From all of the aforementioned, the following research question emerges:

RQ₁: Can various barriers in the implementation/use of AI pose a significant risk to the market and hinder its integration into different sectors?

According to the World Economic Forum (WEF), in 2022, 26% of existing jobs in China and India were impacted by AI technologies, while in the United Kingdom, this proportion was 20%. Despite the previously mentioned concerns, AI technologies are expected to drive innovation and economic growth, creating 133 million new jobs globally by 2022 and contributing 20% to China's GDP by 2030 [10]. Global superpowers China and the United States are currently engaged in a competition to gain technological dominance in the field of AI. China is currently in the lead with 25% of the global production of AI-related technologies and has increased its number of AI patents by 200% [11]. Furman et al. [12] reported that the economy of developed countries had slower productivity growth from 2006 to 2016 compared to the period from 1996 to 2006 in 36 out of 37 developed economies. Growth slowed from an average annual rate of 2,7% in the previous decade to 1,0% in the past decade. To stimulate productivity growth, it is essential to ensure laws and policies support the efficient development and use of AI, both by existing businesses and public administrations, as well as emerging companies (startups).

It is well known that a significant barrier to implementing AI systems into existing business processes is the need for specialized knowledge, which can be financially demanding [13, 14]. Furthermore, the application of AI also raises several ethical and social concerns. One of the key issues is the potential for bias, as AI systems can adopt and magnify unfair patterns in the data they are trained on, leading to wrong decisions that could harm users' trust [15, 16]. All of the previously mentioned barriers could lead to disruptions in the integration of AI into business processes. The main concerns revolve around security and transparency – who will be held responsible for decisions made by artificial intelligence? Will AI completely reform the life we have known so far, or will it help us step toward a better tomorrow?

However, despite these barriers, there are numerous advantages to artificial intelligence. The very fact that its adoption in many sectors of the global economy leads to greater efficiency, productivity, and reliability underscores the importance of further research and the integration of AI into various contexts to explore its potential fully. That brings the following research question:

RQ₂: What are the prospects for implementing artificial intelligence, despite the prevailing belief that AI replaces human labor?

AI will undoubtedly have profound effects on our lives, and its use is linked to numerous prospects and challenges. Nevertheless, it is essential to consider the regulatory frameworks, legal regulations, security, and ethics surrounding it. Every country needs to regulate policies and frameworks within its borders, coordinate international policies, and establish clear guidelines for addressing the political, ethical, economic, and cultural impacts of AI [17, 18]. Although there is fear of job loss due to the application of artificial intelligence, it can lead to the creation of new opportunities through the phenomenon known as the "re-employment effect", which enhances human capabilities with the help of technology [19]. For example, in healthcare, general practitioners recognize AI's potential for improving diagnostics and risk assessment, but they also have concerns about accuracy, workload, and the need for detailed evaluation [20].

Uncontrolled development would inevitably lead to significant damage and unauthorized actions, as this type of technology has unrestricted access to various data. If stored improperly, it could be used for illicit purposes. Questions arise regarding the security of nuclear, chemical, biotechnology, nanotechnology, and similar high-risk technologies. Particularly sensitive are programs involving robots that assist immobile individuals, armed drones, and technologies

for regulating urban traffic, among others [21]. Smiljanić [22] notes that competition in the development and application of AI technologies can shape international politics, as both companies and states are involved in this field.

AI systems must be designed to be ethical, controllable, sustainable, and desirable, with a balance between their efficiency and ease of explainability [23]. Deshpande [24], and Kumar and Dadhich [25] emphasize that clearly defined responsibilities and governance frameworks are essential for the responsible introduction of AI, especially in sensitive sectors such as finance and law. Furthermore, AI can effectively enhance compliance with regulations by automating data analysis and monitoring, enabling organizations to identify potential violations promptly [26, 27]. From these facts, the following research question arises:

> **RQ3**: What frameworks are necessary for the successful integration of AI while adhering to all essential processes and regulations?

While the review takes a comparative, cross-sector perspective, we also use Croatia as an illustrative national case study. As a recent EU member, Croatia, an open economy with a growing research capacity but uneven enterprise adoption and mixed public sentiment toward AI, offers a valuable lens on how high-level European rules align with country-level institutional realities. By examining national readiness initiatives, skills supply, uptake among SMEs and startups, and the alignment between regulatory obligations and available support mechanisms, we aim to identify practical levers for accelerating the diffusion of responsible AI. This country focus motivates a fourth research question: to what extent is Croatia prepared to operationalize EU-driven AI governance, and what targeted actions could close the implementation gap? This leads to the fourth research question:

> **RQ4**: How is Croatia positioned to implement and govern AI under the emerging EU regulatory architecture, and which capability, policy, and ecosystem gaps must be closed to translate regulatory intent into broad-based adoption and innovation?

Guided by established methodological recommendations for conducting and reporting scoping reviews [28], the article pursues four interrelated objectives: (1) to synthesize cross-sector evidence on the technological, organizational, and social barriers that condition the adoption and scaling of artificial intelligence (AI); (2) to assess the opportunities and performance consequences of AI implementation – including productivity, cost, revenue, and labor-market effects – and to identify when experimentation tips into transformative impact; (3) to examine how emerging, risk-based governance and legal frameworks in the European Union, highlighted by the AI Act, may enable or constrain responsible uptake across industries and firm sizes; and (4) to use Croatia as an illustrative national case for understanding how supranational rules are operationalized in practice, with attention to capability gaps, skills supply, public trust, and ecosystem development. These aims are organized around the four guiding research questions defined previously.

Given the scope of the AI-related topic, this article consists of three interconnected parts. The first part describes all the barriers related to the implementation of AI from a broader perspective, focusing on societal acceptance and the technical challenges organizations face. The second part discusses the prospects, also from a broader aspect, considering the ongoing market competition between global superpowers. The final part reviews governance frameworks and legal regulations with a primary focus on the European Union's emerging AI regulatory architecture (GDPR, Coordinated Plans, AI Act) and its implications for implementation.

The article follows a logical flow. It starts by combining data from several sectors regarding the organizational, social, ethical, and technical obstacles that influence the adoption of AI.

Performance improvements, changes in company models, and the impacts on cost and productivity, as well as labor-market ramifications that encompass both replacement threats and re-employment dynamics, are covered in the following topics. The article then examines how European legislation has evolved, from data protection tools to the EU AI Act's risk-based approach, emphasizing the implications for standardization, compliance, and transparency. Building on that background, the evaluation assesses Croatia's current standing in terms of research capacity, business adoption trends (with a focus on SMEs and startups), national readiness activities, and compliance with EU guidelines. To answer the three study questions, relate the findings to well-known adoption frameworks (such as TOE/TAM) and the productivity paradox, and distill managerial and policy insights, a synthetic discussion combines these threads. Key findings, the limitations of the current body of evidence, and priority recommendations for upcoming longitudinal, sector-specific, and policy evaluation research are included in the article's conclusion.

REASONS TO AI IMPLEMENTATION, RQ$_1$

The implementation of AI represents a significant challenge, particularly in the fast-paced world of modern businesses where numerous organizations face risks associated with the unintentional or excessive use of AI. These risks may also arise from the intentional misuse of AI technologies, driven by factors such as greed, malicious intent, conflicts of interest, or geopolitical rivalries. From phishing scams to comprehensive cyber warfare, the malicious use of AI technologies can accelerate or intensify digital threats [29]. However, a wide range of scientific literature highlights social and technical barriers directly linked to the integration of AI into organizations [15, 30].

Cubric [31] provides a detailed overview of AI adoption barriers in various sectors, including energy, healthcare, engineering, tourism, agriculture, information technology, transportation, and the clothing industry, based on a review of 30 scientific articles published between 2005 and 2019. The identified barriers include technical issues, such as data availability, as well as social barriers related to a lack of knowledge, job security concerns, and increased dependence on automation. Also, there is a lack of trust, security, and data availability from multiple stakeholder perspectives.

As cited by the authors, barriers arise across different industries and sectors, and the reasons for these barriers are pretty similar. For instance, Chomutare et al. [32], He et al. [33], Joshi et al. [34], Strohm et al. [35], and Tachkov et al. [36] highlight AI adoption barriers in **healthcare** that align closely with those in other industries. These include challenges related to the human factor, such as variations in acceptability and trust among direct users, inconsistent technical performance of AI systems, unstructured implementation methods, along with legal, political, and technological obstacles. Xu et al. [37] discuss communication issues between healthcare workers and AI technologies, notably in patient care, as well as the importance of patient education in reducing technology-related anxieties among various demographic groups.

Barriers also occur in tasks involving **operational efficiency** in business and management. A literature analysis spanning the period from 2015 to 2020 [38] highlighted cultural limitations, primarily including a lack of personnel skills, the development of AI adoption techniques, and a fear of the unknown. Challenges also include unstructured and disconnected data within enterprises, rigid legacy systems with limited flexibility for AI integration, as well as a shortage of data science and engineering personnel skills [39]. Rane et al. [40] and Oriekhova and Harchenko [41] also highlight the challenges of integrating AI systems into outdated systems, which can be complex and time-consuming.

Drmac [42] outlines implementation barriers in **traditional industries** related to business and management. The study identifies four main barriers across the pre-implementation, implementation, and post-implementation stages: a lack of defined use cases, low AI knowledge, inadequate data, and misalignment with end-users. In **supply chain management**, barriers include the large volume of diverse data sources, the need for collaboration among various stakeholders, and their reluctance to adopt AI. This area also lacks an adequate framework for managing AI as a solution to rapidly evolving changes [43]. In **education**, while teachers highlight the positive impact of AI tools on learning outcomes, they face implementation challenges that require additional support from all relevant stakeholders [44].

The challenges of implementing AI present a significant social issue, involving unrealistic expectations about AI technologies, a lack of understanding of their real value and benefits, and fears of job loss due to the application of AI technologies [45]. **Scientists** also face significant barriers when it comes to measuring the impact of AI and automation on the future of work. Key questions shaping the future of the labor market and the strategies needed for education and employment include: to what extent skills must be upgraded or redefined to align with evolving occupations, what is the degree of complementarity between humans and machines, how to monitor the geographical redistribution resulting from worker migration, and how to align local and international policies [46]. These are crucial issues in shaping the future of both the labor market and the strategies required for education and employment.

Bérubé et al. [47] conducted a study with 18 specialists. They discovered three primary categories: 1) the absence of organizational data-related capabilities, 2) the absence of individual competence in AI, and 3) general barriers to the adoption of AI that had previously been identified in earlier studies. The same obstacles were observed in another scientific research. Grünbichler [48] emphasizes the importance of persuading management of the advantages of AI, providing employee training, and establishing proper infrastructure to ensure access to quality and secure information. External issues, such as deficiencies in qualified staff, technical infrastructure, and a limited understanding of current software packages, all contribute significantly to the stricter implementation of AI.

Kar et al. [49] noted that the most critical barriers to AI adoption plans are the lack of AI experts and leadership awareness. Merhi [50] conducted interviews with seven experts and employed the TOE framework, along with an analytical hierarchy, to assess the importance of barriers in 11 segments divided into three groups. The findings revealed that technology is the most crucial area, with data quality posing the most significant challenge to successful implementation.

Figure 1. Visualization of barriers to AI implementation across Technology, Organization, and Environment categories, based on the TOE framework and insights from Merhi [50].

Even with technological advancements and the growing use of artificial intelligence, the majority of companies are still confronted by the productivity dilemma. Although AI has numerous advantages, such as reduced operational costs, enhanced decision-making, and increased competitiveness, its full potential is not entirely realized without organizational changes and capital expenditure. To achieve successful deployment, staff skills must be developed, as well as integration with existing company processes and alignment with strategy. Successful organizations, such as Amazon and Netflix, demonstrate how artificial intelligence can provide significant operational and financial benefits. However, without a clear business model and due to numerous obstacles, such as skill shortages, the widespread adoption of this technology remains challenging. Therefore, it is essential to approach AI implementation in a structured and strategic manner to ensure the long-term growth and sustainability of business models.

PERSPECTIVES ON AI IMPLEMENTATION, RQ$_2$

Despite massive technological advances over the past few years, the productivity slowdown remains an enigma that has a profound impact on many technology and productivity experts. The "productivity paradox" has generated various arguments as to why technologies such as AI and others have failed to deliver the anticipated increase in business process efficiency. Many researchers aim to identify factors that may lead to beneficial long-term outcomes. They're trying to provide a comprehensive picture of how AI can be a source of productivity growth, as well as why realizing its full potential can be challenging without the right organizational reforms and strategy. Based on Kar et al. [49], the decision-making ability and precision of AI solutions are the most critical drivers that impact other influencing factors.

Positive instances of AI applications are on the rise, indicating that this technology is poised to transform the world. The emergence of new technology processes has a favorable impact on operational strategies, management, and big data-driven decision-making. Many small businesses seek to minimize operating expenses while increasing revenue, with automated manufacturing and operational systematization as potential solutions. When it comes to competition, AI applications enable better business decision-making, resulting in increased operational efficiency. AI technologies have enabled small firms to minimize operational costs while increasing revenue [38]. Furthermore, AI significantly enhances business operations by optimizing supply chains and automating customer service, leading to cost savings and increased productivity [51, 52].

Organizations employ AI-powered technology, which includes machine learning, deep learning, and natural language processing. The use of these technologies, in the long run, will give firms a competitive advantage [53]. Additionally, organizations that implement AI-powered technology can develop personalized marketing strategies, thereby enhancing customer engagement and satisfaction [51, 54]. Organizations have begun investing in AI implementation to manage large amounts of data, understand the complexity of strategic data needs, enhance decision-making processes, and enable automated systems within organizations. Therefore, the goal of every AI innovation is not to replace labor, but rather to enhance productivity and efficiency. AI applications are focused on cost savings, such as reducing energy consumption or improving capital efficiency, while also enhancing product offerings. Properly trained employees will then recognize the usefulness of this technology and see its easy usage.

According to a study of 300 small and medium-sized enterprises and startups, a company's revenue typically increases only after sufficient investment in AI. The benefits of adopting AI are greater in companies that also invest in complementary technologies and follow an internal research and development strategy. Specifically, AI adoption at low levels does not indicate

significant revenue growth; however, as the intensity of AI adoption increases, revenue growth becomes more pronounced [55].

Amazon achieved remarkable results by purchasing Kiva, a robotics company that automates picking and packing, worth $775 million. The "Click to ship" cycle time, which ranged from 60 to 75 minutes with humans, dropped to 15 minutes with Kiva, while inventory capacity increased by 50%. Operational costs decreased by an estimated 20%, resulting in a return of nearly 40% on the original investment [56]. Netflix also achieved impressive results using an algorithm to personalize recommendations for its 100 million subscribers worldwide. Helping users quickly find desired content is crucial - customers tend to drop off if it takes them more than 90 seconds to find a movie or TV show they want to watch. Through improved search results, Netflix estimates that it avoids canceled subscriptions, resulting in a $1 billion annual revenue increase. Yuan [57] explored the success of Netflix (which is primarily supported by artificial intelligence) in a case study. He also concluded that AI is used explicitly to improve the user experience through a recommendation system that analyzes viewing history and user preferences.

The development of AI-based (service) business models by manufacturing small and medium-sized enterprises is a complex process in which the interaction between physical products and services is significantly changing [58]. In this context, it is not enough to merely open new technological possibilities through artificial intelligence; they must become sustainable and economically viable within (service) business models based on artificial intelligence [59]. This fact can lead to fundamental changes in the business model, which could challenge the rationale underlying the existing business model. Therefore, it is essential to approach the development of new business models in a targeted and structured way [60-62].

Chen and Decary [63] note that artificial intelligence in healthcare is developing exceptionally fast, with various AI applications being developed to address some of the most pressing challenges faced by healthcare organizations. According to them, healthcare system leaders must understand how AI can be effectively integrated with existing technologies to enhance efficiency, improve access to healthcare services, and ensure patient safety. According to Jiang et al. [64], AI can assist doctors in making more informed clinical decisions or even augment human judgment in specific areas of healthcare. Ultimately, AI can assist medical staff in efficiently sorting and diagnosing data.

Tariq et al. [38] proposed an AI implementation cycle as a strategic framework for successful strategy execution. It consists of four groups with eight interconnected business areas: understanding, strategic alignment, change management, management, opportunities, skill development, integration, and implementation. Key aspects include understanding AI's potential and limitations, aligning AI initiatives with business strategy, managing organizational changes, developing employee skills through training, and integrating AI into existing solutions. Effective implementation ensures competitive positioning in response to market globalization.

With everything mentioned above, the integrated Technology Acceptance Model-Technology Organization Environment (TAM-TOE) model has achieved widespread application in explaining the implementation of various technologies.
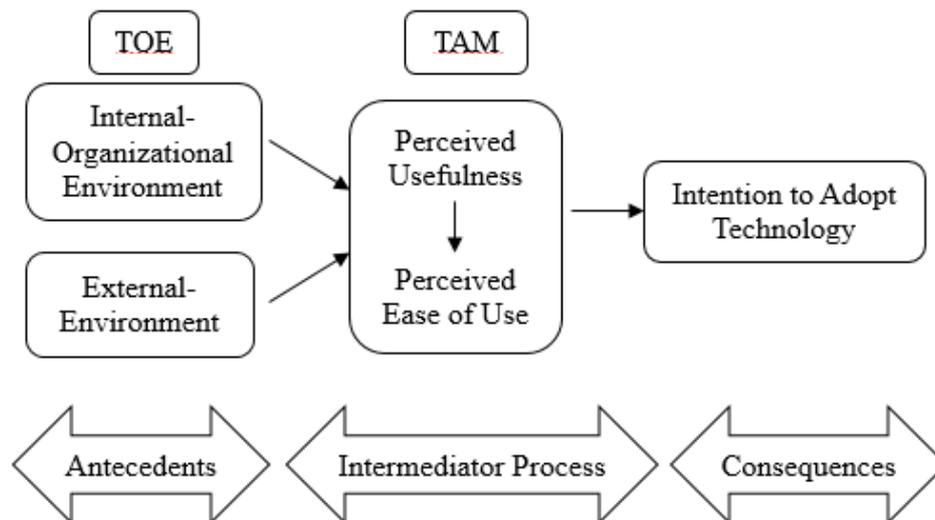
Figure 2. Conceptual visualization of the integrated TAM-TOE model, demonstrating how organizational and environmental factors (TOE) influence perceived usefulness and ease of use (TAM), ultimately affecting the intention to adopt technology. Adapted based on the conceptual model from [65].

Chatterjee et al. [65] developed a model based on SEM analysis of questionnaires from 340 employees across small- to large-scale organizations. Compatibility (alignment of AI with processes and infrastructure), competence (the ability of the workforce), readiness (financial resources for AI deployment), and complexity (the difficulty in using and comprehending the system) are the four organizational and internal environment-based variables in the model. Two technology variables were also employed: competitive advantage and partner support, as well as perceived ease of use and usefulness. Results indicated that competence had a positive impact on readiness, while complexity had a negative impact, with most variables being significant in terms of ease of use.

Similarly, Alsheibani et al. [66] used the TOE framework in their research. They sent a survey to 207 Australian small, medium, and large IT organization managers regarding their level of AI adoption and the barriers they face. The study identified two key factors: vague business cases and a lack of support from top management. The findings showed that the lack of ability to assess, build, and implement AI solutions was the most frequent obstacle (33,8%), followed by an unclear or not well-enunciated business case (16,9%), and thirdly, insufficient top management support (14,4%).

In conclusion, the adoption of artificial intelligence faces various technical and social challenges. Key problems include a lack of quality data, ineffective adoption methods, a shortage of a competent workforce, and inadequate infrastructure. Furthermore, enterprises must overcome employee resistance, regulatory constraints, and challenges when integrating AI technologies into existing business processes. Moreover, AI implementation must handle ethical issues such as data privacy and system security to prevent future exploitation of AI. Many firms can improve their performance by partnering with external partners, such as technology professionals and academic institutions. Despite these limitations, successful AI deployment can provide enormous benefits, but it requires a strategic approach, significant investment in education, and modifications to the organizational structure to realize the potential of this technology fully.

EU REGULATIONS ON AI INTEGRATION, RQ₃

AI is increasingly becoming an integral part of daily life, ranging from communication and self-driving cars to business predictive analysis. With all this, various challenges, such as privacy, data breaches, and ethics, are being raised. Failing to address these ethical concerns through proper AI regulation will result in the erosion of brand trust and harm the company's market position. Hence, as a complex entity, it requires additional rules to ensure safety, transparency, ethics, and respect for human rights in this process. The European Union (EU) also recognizes the need to establish laws and regulations and is working diligently to create more informed rules for this rapidly evolving technology. The aim is to ensure that AI is implemented in a manner that aligns with European values and norms [67].

The AI regulations in the EU are well-rounded. They include aspects such as algorithm transparency, different ethical criteria, accountability for judgments made by AI, mandatory data protection, and others. These policies aim to ensure that this AI technology benefits society while also safeguarding the fundamental rights and security of individuals [68]. However, AI regulation also has its own set of issues. It should not be too tight or too loose. On the one hand, they should not deter innovation and competition, while on the other, they should protect the residents' safety and rights. AI is an infinitely interesting subject that raises numerous controversies and sparks extensive research, thereby increasing public awareness and understanding.

Over the coming decades, those who can create artificial intelligence are likely to control both the economy and geopolitics, which is expected to increase international tensions. On the one hand, various challenges in the development and implementation of AI may lead to fragmentation among global regions, potentially jeopardizing technological progress and cooperation. On the other hand, a certain level of differentiation could enrich the global AI ecosystem, fostering innovation and creating competitive balancing mechanisms through decentralization. Intergovernmental and non-governmental organizations, the private sector, and academia have contributed to benefiting society and mitigating undesirable consequences in other technological areas [68].

Table 1 presents the key regulations and directives in the field of AI in a chronological and systematic manner, serving as a valuable tool for understanding the legal environment and its impact on organizations, research institutions, and the industry as a whole. In addition to the regulation names, the table also includes the year the regulation was passed and a brief description of its content. This overview offers a deeper insight into the legal framework governing the development and application of artificial intelligence, highlighting key aspects such as ethical guidelines, data protection, security standards, and accountability.

In summary, artificial intelligence is primarily considered a product, similar to EU regulations on product safety. These laws laid the groundwork for the ultimate goal, which is the AI Act. The AI Act [69] will be the first comprehensive law on AI, as no other country or region has such a detailed legal framework. The goal is to influence global tech companies operating in the EU to comply with these rules.

The European Commission has reached a provisional agreement on the AI Act, the first comprehensive legal framework that regulates this technology in detail. The process of adopting it is complex, involving several phases of negotiation and harmonization between key EU institutions. The European Parliament adopted its negotiating position with 499 votes in favor, 28 against, and 93 abstentions. These will be the first global rules on artificial intelligence. Members of the European Parliament have addressed several topics, including the ban on biometric surveillance, emotion recognition, the use of predictive police AI systems, issues related to generative models such as GPT, and the right to appeal decisions made by AI systems [70-78].

Table 1. EU Regulations on the Use of AI.

Regulation	Year	Content
General Data Protection Regulation (GDPR)	2016	This regulation ensures the protection of personal data and the fundamental freedoms of individuals, including the freedom of thought, belief, conscience, and information, as well as respect for private and family life. It mandates strict controls for the protection of personal data [70].
Coordinated Plan on Artificial Intelligence	2018	This plan is a strategic framework for national artificial intelligence strategies. It encourages member states to develop their strategies and provides support through AI Watch, the knowledge center of the Commission's Joint Research Centre [71].
WHITE PAPER on AI	2020	This document reflects the European approach to excellence and trust in AI. It provides legal certainty for AI-based innovations and mobilizes resources to establish an "ecosystem of excellence" [72].
Proposal for a new Artificial Intelligence Act (AI Act)	2021	With this proposal, members of the European Parliament aim to ensure that AI systems are human-supervised, safe, and transparent. The rules follow a risk-based approach [73].
Coordinated Plan on Artificial Intelligence	2021	Extension of the 2018 plan, aimed at turning the strategy into action, accelerating investment in AI technologies, and aligning AI policies to address global challenges [74].
General Approach to the Artificial Intelligence Act	2021	A human-centered declaration narrows the definition of AI systems, expands the ban on using AI for social scoring, clarifies the requirements for high-risk AI systems, and adds new provisions to increase transparency [75].
European Declaration on Digital Rights and Principles	2022	Proposed rights and principles include placing people and their rights at the center of the digital transformation, supporting solidarity and inclusion, ensuring freedom of choice online, and promoting the sustainability of the digital future [76].
AI Act: A step closer to the first Artificial Intelligence Regulation	2023	The European Commission has reached a provisional agreement that the European Parliament and the co-legislators must further approve. This will be the world's first AI regulation [77].
AI Act	2024	The European Artificial Intelligence Act (AI Act) will take effect on 1 August 2024. This document aims to promote the responsible development and application of artificial intelligence in the EU [78].

The AI Act categorizes risks into four categories, based on their technological features and broad application areas. These are: unacceptable risk (banned systems), high risk (strict rules and oversight), limited risk (transparency), and minimal risk (mild regulation). We can conclude that the AI Act lays the foundation for the safe and ethical use of artificial intelligence, ensuring a balance between innovation and the protection of fundamental citizens' rights [77].

Focusing on known functionalities and safety risks, the Act directs attention to problems that have already been discovered or anticipated. This could foster confidence that a general-purpose AI system is safe if it meets all the criteria outlined in the law. Given the mixed record of predictions regarding technological development, this confidence may be unjustified.

The AI Act may misjudge the size of the AI risk – i.e., the probability of harm and the severity of consequences on values such as health, safety, privacy, and others, rendering the general legal framework ineffective. The root of this problem is that the AI Act has not yet advanced to the standardization phase, which is critical for developing detailed guidelines. To address this challenge, the document proposes a risk assessment methodology designed to enhance the accuracy and relevance of the AI Act provisions. This methodology is not only applicable to improving the AI Act but could also be helpful for any other legal framework based on risk that regulates AI [79].

In the AI4People model, the authors [80] presented a synthesis of five ethical principles and offered 20 concrete recommendations for assessing, developing, promoting, and supporting the responsible use of artificial intelligence.
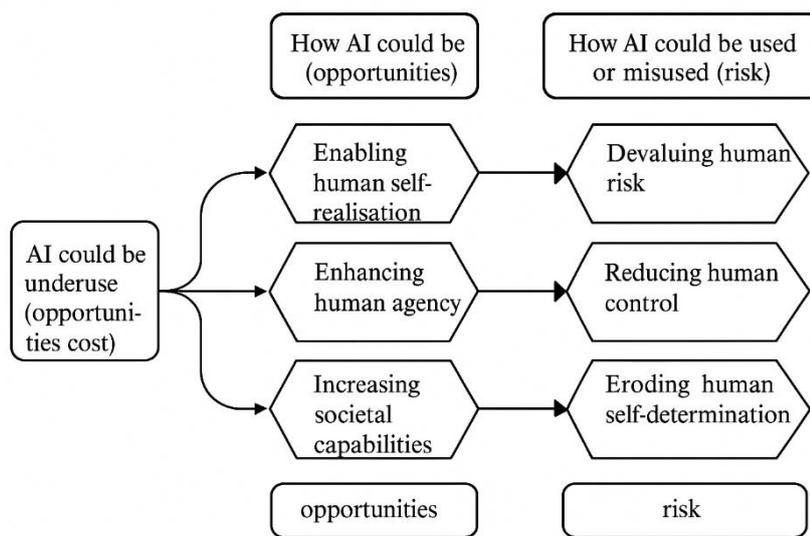

Figure 3. Opportunities, Risks, Principles, and Recommendations, as outlined in [80].

Companies' perceptions of European Union rules vary according to industry, firm size, and individual regulations. Some businesses regard EU regulation as a barrier due to increased administrative hassles and compliance costs, while others see it as a motivator for innovation and long-term success. The European Green Deal sets ambitious goals for reducing emissions and promoting sustainable behaviors. Some businesses view these aims as a challenge due to the necessary expenditures on new technologies and changes to their business models. On the other hand, many businesses recognize the potential for innovation and the development of new products and services that are aligned with sustainable practices, which can facilitate access to new markets and enhance competitiveness [81, 82].

Small and medium-sized enterprises (SMEs) often struggle to keep up with the complexity of EU regulations due to limited resources and expertise. However, the EU offers various support and funding programs to help SMEs comply with regulations and encourage their growth and innovation. For example, programs that develop green skills in young people can help address the shortage of a qualified workforce in SMEs [83]. Overall, companies that proactively approach regulatory compliance and see it as an opportunity to improve their operations and reputation tend to reap long-term benefits. Conversely, companies that view regulation solely as a burden may face challenges in adapting and staying competitive in the market.

Global healthcare systems face numerous challenges, such as limited access, high costs, and an aging population. The situation is further intensified by pandemics like COVID-19, which lead to shortages of protective equipment, inadequate or inaccurate diagnostic tests, doctor burnout, information exchange issues, and so on [83, 84]. Research and publications on AI in

healthcare continue to grow at an exponential rate. These studies not only explore the potential applications of AI in healthcare but also include "mature" real-world testing and the implementation of FDA-approved AI solutions in the healthcare system [34, 85].

Awasthi et al. [86] searched PubMed using the terms "machine learning" or "artificial intelligence" and "2023", with the restriction to English-language research and human subjects. The search resulted in 23 206 articles, of which 1612 were classified as mature, and 1226 articles were selected for final analysis. The most researched areas were medical imaging, followed by gastroenterology and ophthalmology. The conclusion was that the medical specialties dominating AI research are precisely those that are image-based, such as radiology, gastroenterology, and cardiology.
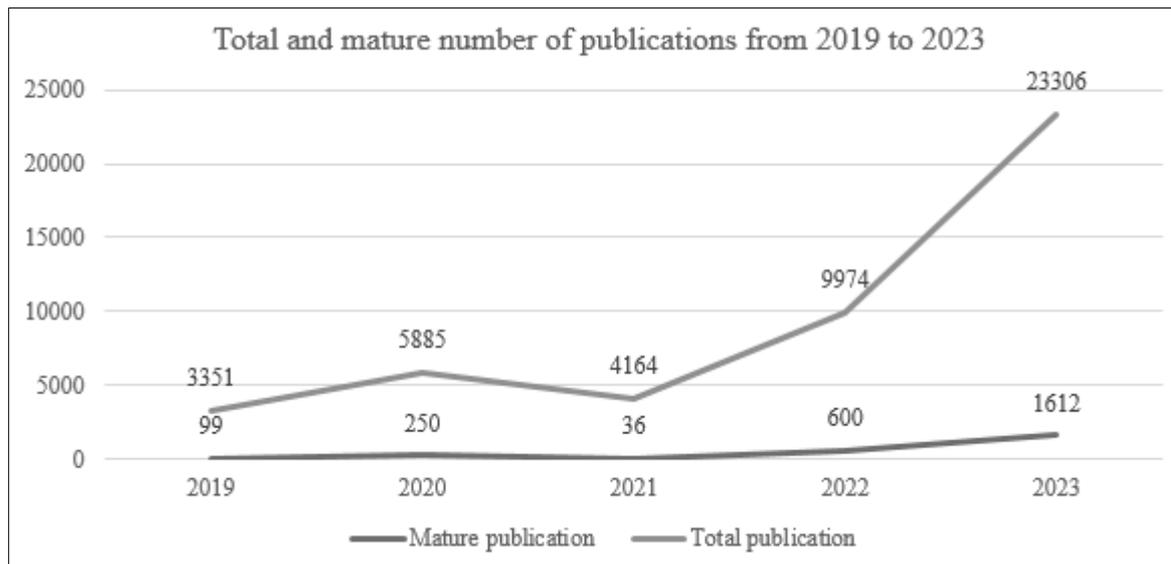

Figure 4. Visualization based on [86], illustrating total and mature AI-related medical publications indexed in PubMed from 2019 to 2023.

According to Panch et al. [87], artificial intelligence has brought revolutionary changes to healthcare (disruptive innovation). Various researchers emphasize that thanks to its sophisticated algorithms and broad application, AI has supported doctors and medical professionals in different areas, including health information systems, geocoding health data, predictive modeling, epidemic surveillance, decision support, and medical imaging [64, 88-90].

It is clear that although the AI Act provides a legal framework that could become a global standard, its effectiveness in practice will depend on accurate risk assessment and adaptability to future technological innovations. The lack of detailed standardization and potential misjudgment of risks could lead to rules that are either too restrictive or too lenient, which may hinder their application across various sectors. AI has already demonstrated significant potential in the healthcare sector for enhancing diagnostics, predicting medicine, and resource management. However, significant issues persist regarding ethics, transparency, and safety when deploying AI solutions. According to research, AI in healthcare is most widely utilized in domains that require medical imaging; however, extending its application would necessitate additional legal requirements and changes to existing regulations.

To summarize, the AI Act is a significant step toward ensuring the responsible use of artificial intelligence; however, its actual effectiveness will be determined by further standardization, alignment with technological developments, and adaptation to the unique needs of individual sectors, such as healthcare and industry. Furthermore, cooperation among government authorities, regulators, and the corporate sector will be critical in establishing a consistent approach to integrating AI technologies. Continuous monitoring and evaluation of legal

frameworks will also be necessary to promptly address new challenges and ethical issues that may arise as AI continues to advance.

CROATIA'S POSITION IN THE DEVELOPMENT AND REGULATION OF ARTIFICIAL INTELLIGENCE, RQ₄

Croatia is currently navigating a transformative period in adopting and regulating AI, characterized by dynamic developments across multiple domains. It is witnessing significant progress in scientific research, where universities and research institutions are increasingly exploring AI-driven methodologies, particularly in data analysis, automation, and interdisciplinary studies. At the same time, Croatian entrepreneurs and technology startups are actively integrating AI solutions into their business models, enhancing productivity, personalization, and innovation across various industries, including healthcare, agriculture, and marketing [91-93].

From a regulatory perspective, Croatia is aligning its national policies and strategic goals with the European Union's guidelines on trustworthy and ethical AI. This includes the development of "The National AI Development Plan" that the Croatian government is currently working on [94]. These efforts aim to foster responsible AI development while ensuring data protection, transparency, and accountability.

In the entrepreneurial sector, 62% of young entrepreneurs do not use AI tools in their business operations. Only 14% use AI regularly, 11% use it occasionally, and 13% have tried it but do not use it actively. The most commonly used AI tools are ChatGPT (21,8%) and Grammarly (10,6%), while tools such as Tableau with AI and Salesforce Einstein are used by fewer than 1% of respondents [95]. This suggests that while AI adoption is underway, its transformative potential is not yet fully realized in the Croatian business landscape.

Furthermore, Croatian interest groups, such as CroAI, are actively involved in expanding knowledge and accessibility of AI in Croatia. Through the Elements of AI course, which has already educated over 1% of the population, CroAI actively contributes to digital literacy and the development of AI competencies in society [96]. The Ministry of Science and Education has reported an increase in scientific publications on AI, from 180 in 2012 to over 500 annually by 2022, with the most significant contributions in the fields of machine learning and computer vision [97]. This upward trend remains evident today, as research activity in AI continues to grow, driven by increasing institutional support, expanding research infrastructure, and the strategic prioritization of AI across scientific and technological domains.

Additionally, the quality of Croatian AI researchers was assessed based on their publications, citations, and participation in projects. Under the EU's FP7, 10 AI-related projects were funded. Within Horizon 2020, 406 AI project proposals were submitted, with 42 approved (10,3% success rate), including three coordinated by Croatian institutions. These projects involved 27 public sector and 24 private sector partners. Under Horizon Europe, 18 AI-related projects were funded, two coordinated by Croatian partners. Nationally, the Croatian Science Foundation funded 115 AI-related projects, including approximately 40 that supported PhD students and research initiatives [97].

A national survey conducted in 2024 ($N = 2\,200$) revealed that 59% of Croatian citizens associate AI with harmful threats, while 31% view it as a positive aspect [98]. Despite an increase in AI usage among the general population, from 14% in 2023 to 25% in 2024, 75% of the population still does not use AI and are somewhat apprehensive about this new technological giant [98]. This highlights the importance of transparent and responsible AI governance in fostering public trust and confidence.

Lastly, Figure 5 displays the migration of AI skills per 10,000 LinkedIn members across various European countries from 2019 to 2024, indicating whether a country is experiencing a net gain or loss of AI professionals. Croatia stands out with a value of 0.0, indicating no significant net inflow or outflow of AI-skilled professionals. This balanced position suggests that the number of AI professionals entering the country is roughly equal to those leaving. In contrast, countries like Luxembourg (+8,9) and Cyprus (+4,7) are attracting substantial AI talent, while others, such as Hungary (–1,1) and Türkiye (–0,5), are experiencing a "brain drain" in this field 0. Croatia's neutral standing may reflect a relatively stable or limited AI sector, with neither strong push nor pull factors influencing migration. To increase its attractiveness for AI talent, Croatia should consider enhancing its tech infrastructure, research investment, and international collaboration opportunities.
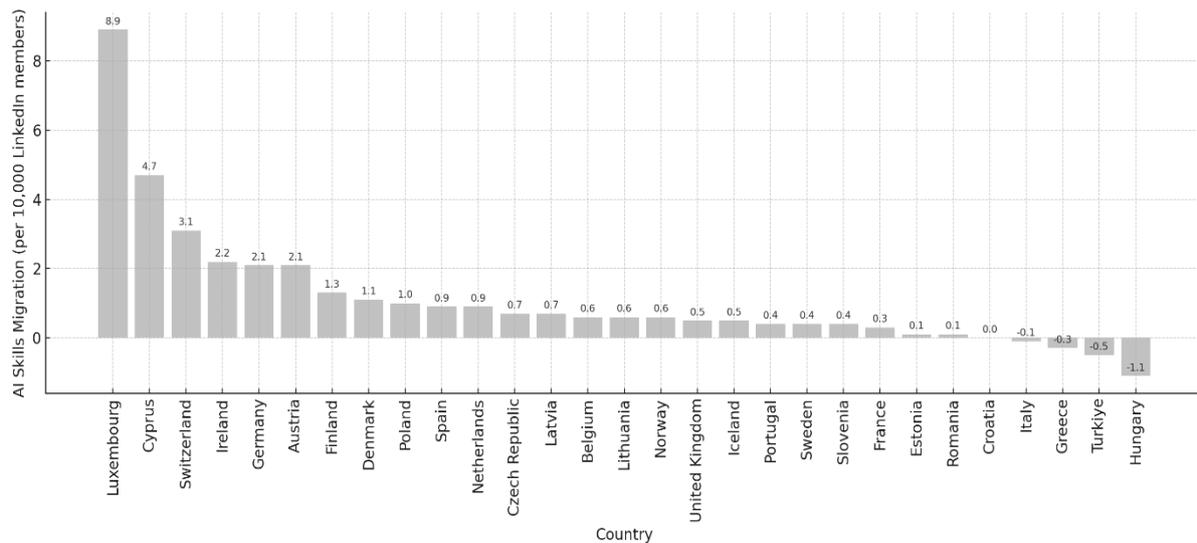

Figure 5. AI skills migration by country 0.

In conclusion, Croatia's position in the AI landscape is characterized by growing scientific output, increasing entrepreneurial interest, and proactive engagement with EU regulatory processes. However, challenges persist in terms of resource allocation, public perception, and the full realization of AI's transformative potential. Addressing these issues through targeted policies and collaborative initiatives will be crucial for Croatia to harness AI as a valid driver of change.

DISCUSSION

The examination of the first research question RQ_1 confirms that technological, organizational, and social obstacles to the adoption of artificial intelligence reinforce one another rather than appearing in isolation. Fragmented and poor-quality data, along with the challenge of integrating new algorithms into legacy information systems, remain the primary technical bottlenecks. However, their impact is multiplied whenever managers cannot articulate a persuasive business case for AI or, equally important, when employees fear that automation will cost them their livelihoods. The evidence collected by Cubric [31] and Tariq et al. [38] resonates with our findings, while Merhi's [50] notion of "competence" emerges as a pivotal moderator: organizations in which technical know-how and managerial vision combine are demonstrably more willing – and more able – to move from pilot tests to full-scale deployment.

Turning to the second research question, RQ_2, the study reveals that economic benefits emerge only after the implementation surpasses a critical threshold. Sporadic experiments seldom translate into measurable revenue growth. Still, once the technology is underpinned by concomitant investment in infrastructure, research and development, and workforce reskilling, the return on investment can be dramatic. Lee et al. [55] capture this tipping-point logic

empirically, and the trajectory of firms such as Amazon and Netflix illustrates it concretely. Both companies realized the bulk of their savings and new income only when AI was embedded at the very heart of their business models. In other words, artificial intelligence generates the most outstanding value when it becomes a constituent element of the organizational DNA rather than an ornamental add-on.

The third question, **RQ₃**, foregrounds regulation as a double-edged sword. The forthcoming EU Artificial Intelligence Act aims to reduce legal uncertainty and protect citizens from unacceptable risks. Yet, it may also impose compliance burdens that disproportionately fall on small and medium-sized enterprises. Ebers et al. [79] caution that a rigid, static risk taxonomy could either overstate or understate genuine dangers, leaving innovators pinned between excessive paperwork and insufficient guidance. Our analysis supports this concern: without a mechanism for periodic recalibration, the law could drift out of alignment with the fast-evolving technical landscape it seeks to govern.

Regarding the fourth question, **RQ₄**, Croatia's experience highlights that regulatory alignment alone does not guarantee effective AI adoption: a formal movement toward an EU-consistent strategic framework coexists alongside uneven enterprise adoption, constrained capabilities, and a cautious public mood. National policy work on an AI strategy signals intent but remains in a formative stage, and its translation into operational guidance for firms – especially SMEs – appears to be incomplete [94]. Low and irregular use of AI tools among young entrepreneurs suggests capability and awareness gaps that could blunt the innovation pull created by EU-level mandates [95]. Capacity-building efforts, such as CroAI's broad-reach education programs, help seed foundational literacy but must scale further to shift adoption curves beyond early enthusiasts [96]. Research system indicators – rising publication output, participation in EU framework projects, and targeted national funding – show a strengthening knowledge base that could be leveraged into applied partnerships if better connected to industry demand [97]. Yet public opinion data reveal persistent risk perceptions that may translate into political caution and slower diffusion unless addressed through trust-building governance and demonstrable value cases [98]. Talent mobility data reinforce the urgency: Croatia's neutral net flow of AI skills implies a limited gravitational pull compared to European talent magnets, raising the stakes for creating attractive research–industry ecosystems under the EU regulatory umbrella [69-78, 99].

These empirical results make four principal theoretical contributions. First, they knit together the long-standing "productivity paradox" with the TOE and TAM adoption frameworks, showing how technical constraints cascade into broader socio-economic consequences. Second, they corroborate the so-called re-employment effect described by Lanamäki et al. [19], demonstrating that employees' perceived risk is substantially mitigated when leaders frame AI as a complementary rather than substitutive force. Third, they recast statutory rules not merely as costs to be borne, but as strategic variables: sufficiently predictable laws can create the stability firms require to commit capital to long-term, AI-enabled projects. Fourth, using Croatia as an EU member state microcosm, we show that national capability, skills uptake, public trust, and talent dynamics mediate how supranational AI rules are translated into firm-level adoption and governance practice.

The practical implications flow directly from these insights. Managers need to cultivate dual readiness – technological and human – by cleansing and integrating data assets while simultaneously offering ongoing learning opportunities that involve workers in co-designing new processes. For start-ups and small firms, clustering into shared regulatory sandboxes can spread the expense of compliance and provide real-time feedback to policymakers. Legislators, for their part, should resist "one-size-fits-all" prescriptions: dynamic, sector-specific standards

inside the AI Act would alleviate regulatory drag in highly supervised industries such as healthcare without sacrificing public safety or ethical oversight.

CONCLUSION

The so-called productivity paradox prevails because, despite significant technical advancement, productivity does not increase at the predicted rate. The application of AI to boost efficiency and reduce costs comes with multiple technological and societal challenges that may complicate its successful integration into companies. Some of the key issues include poor-quality data, technical problems, regulatory issues, cultural barriers, and concerns about job security. AI can enhance business processes, reduce costs, and improve decision-making, but its effectiveness is only guaranteed when a well-thought-out plan is in place. Without a deliberate strategy, the entire potential of AI technologies goes unfulfilled. AI deployment also has implications for privacy, ethics, regulation, and security in addition to these perspectives and obstacles. The European Union has recognized the need to regulate this new technology, and the AI Act is the first comprehensive document that governs the use of such technology while also protecting the rights of citizens. A problem, however, is that the rule may be too strict, stifling innovation, or too lenient, threatening the user.

Future work should focus on establishing governance structures for AI across various sectors. Future papers should investigate the long-term impacts of AI on employment and explore strategies for implementing new technologies, such as AI. Additionally, there should be studies on how the integration of human capital and AI can lead to more effective business models. More work is still required to explore how organizational culture, legal systems, and ethical concerns influence the adoption of AI, as well as to develop methods for quantifying the economic impacts of AI applications across various industries. Moreover, the impact of AI on employment in society and the need to reform the education system to match the new requirements will be very valuable to scientific knowledge.

The main drawbacks of existing research are the lack of longitudinal studies that track AI's impact on businesses over time and the limited number of empirical studies conducted in specific industries. Furthermore, the majority of research is conducted from the perspective of developed markets, leaving the impact of AI in underdeveloped countries unexplored. Another significant drawback is the focus on large firms while overlooking small and medium-sized organizations (SMEs), as well as the insufficient investigation into the long-term consequences of AI implementation. The heterogeneity of AI applications across businesses and countries hampers the generalization of findings.

Although this study identifies various obstacles in deploying artificial intelligence, it is evident that AI has enormous potential for both large organizations and small and micro-enterprises. The key to its effective development is to align technology with organizational needs, ethical norms, and regulatory frameworks, while also providing continuous staff education and adaptation. Given the rapid pace of technological change, timely research and adaptation are crucial for fully realizing the potential of this rapidly evolving technology in the future.

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