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ARTIFICIAL INTELLIGENCE AS A CORE OF THE NEW INDUSTRIAL REVOLUTION: PROSPECTS AND LIMITATIONS

The purpose of the article is to define prospects and limitations of artificial intelligence as a core of the new industrial revolution.

The definition of the AI concept in the scientific community remains the subject of heated debate. At the same time, in the regulatory and legal plane, a trend is being formed towards unification of the AI concept.

Based on the analysis and literary sources, the following prospects for AI can be identified on theoretical and practical levels. On theoretical level: (1) alienation of tacit knowledge from the individual (employee and entrepreneur); (2) optimization of the planning system; (3) revision of the socialist-calculation debate; (4) decreasing information asymmetry. On practical level: (1) formation of new products and markets; (2) increasing labor and capital productivity; (3) massive creation of new jobs; (4) optimization of business processes; (5) opportunity for rapid growth for small businesses and startups.

Limitations: (1) long-term structural unemployment; (2) inflated expectations from AI and, as a consequence, the possible formation of a speculative bubble in the global stock market; (3) AI's high energy consumption; (4) outdated pre-AI corporate culture and regulatory environment.

Further improvement of AI (including the transition from AI to AGI) and the expansion of its use can make a significant contribution to solving problems related to economic calcu-

lation and minimizing information asymmetry, and therefore optimizing transaction costs in the economy.

AI, certainly acting as a locally useful tool at the level of individual enterprises and organizations, causes the acceleration of attracting funds to the stock market, which can lead to the formation of a bubble on global level. If this bubble bursts, expectations about the economic efficiency of AI will be revised, and some AI-related companies will experience significant margin reductions (perhaps losses and bankruptcies). But this, in turn, will initiate the next stage of AI development, will accelerate its transition from the current narrow specialization to the creation of full-fledged general artificial intelligence (artificial general intelligence), which has a greater potential to change the economy at all levels. As a result, AI will become established as the core of the new industrial revolution.

Keywords: AI, artificial intelligence, industrial revolution, socialist-calculation debate, reducing information asymmetry.

JEL: O4, O33, B53

Actuality

The ongoing deepening of the economy digitalization is closely related to the use of artificial intelligence (hereinafter AI), which is gradually penetrating all spheres of economic activity. AI is one of the key technologies of the Fourth Industrial Revolution. The use of AI helps businesses increase productivity, automate routine tasks, improve customer service, and create personalized approaches to them. The use of AI tools allows to reduce risks and make more informed strategic decisions.

In recent years, AI has turned from an object of discussion by scientists, visionaries and futurists into a significant economic factor. Today, AI technologies are actively used in civil and military spheres, and also affect investment flows. For example, Nvidia developed Turing and Ampere graphics processors (GPUs), which are optimized for machine and deep learning tasks. Thanks to this it has become a leader in the field of processors for AI and its capitalization tripled in 1 year (exceeded $3 trillion in summer 2024).

Despite the fact that the essence of the AI concept remains the subject of debates, in 2023 there was an increase in the number of Fortune 500 companies mentioning AI in their earnings reports compared to 2022. The number of such companies increased from 266 to 394 (that is, by 1.5 times), which ultimately made up almost 80% of the entire list (Artificial Intelligence Index Report, 2024, p. 277).

Leading international consulting companies give very optimistic forecasts. According to the calculations of McKinsey, only "generative AI could add the equivalent of $2.6 trillion to $4.4 trillion annually" (McKinsey, web).

However, previous studies have shown that at the macro level there is no statistically significant confirmation of the positive impact of digitalization (including Industry 4.0 and AI) on the industry and the economy as a whole (Vyshnevskyi et al., 2020; Vyshnevskyi, Amosha, Liashenko, 2019). Largely, this issue has remained relevant. Thus, the “2024 Artificial Intelligence Index Report” notes that “over the last five years, the growing integration of AI into the economy has sparked hopes of boosted productivity. However, finding reliable data confirming AI’s impact on productivity has been difficult because AI integration has historically been low" (Artificial Intelligence Index Report, 2024, p. 272).

Analysis of the latest research

The problems of industrial development, smart industry and Industry 4.0 technologies are constantly receiving great attention from the scientific and expert community. This is evidenced by a significant number of scientific and analytical publications.

According to many researchers, the role of AI is not just growing, but has already achieved a fundamental impact. Thus, in the work (Zhao et al., 2024) when analyzing the factors influencing the level of development of renewable energy, AI and GDP, direct foreign investments, trade volume, population and industrial development were put on one level. So that, AI is considered as a significant macroeconomic factor.

Nobel laureates in economics A. Banerjee and E. Duflo note that "unfortunately, notwithstanding the grandiose talk about singularities, the bulk of R&D resources these days is directed toward machine learning and other big data methods designed to automate existing tasks, rather than the invention of new products that would create new roles for workers, and hence new jobs" (Banerjee and Duflo, p. 233). Therefore, the situation when "excessive automation reduces GDP instead of contributing to it" (Banerjee and Duflo, p. 232) is quite natural.

The problem of reconciling the risks and opportunities of using AI remains relevant. "Modernizing product liability rules for AI requires bridging the gap between the abstract risks that are more prominent in AI and the concrete legal requirements and definitions that should apply. In product liability law, establishing a clear concept of AI defects becomes essential in assessing the responsibility of AI manufacturers and operators for any harm or injury caused by these systems. However, determining liability in AI-related defects can be complex due to the involvement of multiple stakeholders. Assigning responsibility becomes particularly challenging when defects arise from various sources, such as flawed training data, algorithmic biases, or inadequate system design." (Buiten, 2024, p. 268) However, when these negative consequences might occur, there may no longer be an individual or legal entity that developed, launched or operated it.

Investigators of "The interlocks between smart product platforming (SPP) powered by Artificial Intelligence (AI) and Generative AI, big data analytics, and machine learning" (Akhtar et al., 2024, p. 1) conclude that "the use of SPP with inherited flexibility and advanced technology – such as AI, GAI, big data analytics, and machine learning – plays a major role in effective and creative product design, consequently facilitating the related manufacturing processes" (Akhtar et al, 2024, p. 9). However, the assessment of the real economic effect remains outside this study.

Baldwin and Okubo are analyzing the relationship between remote work and the use of AI, and justify the scenario according to which "the workers who retain their jobs will be both teleworking more and using more AI, but the number of workers falls as AI raises the productivity of remaining workers. But ... occupations that are the «most teleworkable are also those that are most susceptible to automation»" (Baldwin and Okubo, 2023, p. 1550). They confirm the growing role of AI in enabling remote work and reformatting the labor market.

"Like the steam engine, electricity, computers, or the internet, which have greatly transformed both the economy and society at large, AI is not bound to a single specific application but is foundational, opening up wide arrays of uses." (Davidson, 2024, p. 13). Thus, AI itself is considered as a key element of the new industrial revolution, becoming its symbol.

Based on the analysis of previous studies, the problem of the prospects and limitations of using AI as the core of the new industrial revolution remains unresolved. Therefore, ***the purpose of the article*** is to define prospects and limitations of artificial intelligence as a core of the new industrial revolution.

Definition of artificial intelligence

The problem of defining the concept of "artificial intelligence", despite its wide application, remains relevant to this day. Thus, S. Davidson in his recent work notes that "The term 'Artificial Intelligence' (AI) – introduced by John McCarthy in 1956 – is surprisingly

poorly defined" (Davidson, 2024, p. 1). There are dozens of different definitions of the AI concept. For instance, S. Russell and P. Norvig highlight “eight definitions of AI, laid out along two dimensions. The definitions … are concerned with thought processes and reasoning, … address behavior. The definitions … measure success in terms of fidelity to human performance” (Russell and Norvig, 2010, p. 1-2). But «AI – smart machines – only ‘know’ data that can be programmed into, or read, by a machine» (Davidson, 2024, p. 7). In this definition, AI intelligence is limited by the input data, but AI can be programmed to independently search for and extract new data.

H. Sheikh, C. Prins and E. Schrijvers highlight well the following problem. “It is not surprising that AI is so difficult to define clearly. It is, after all, an imitation or simulation of something we do not yet fully understand ourselves: human intelligence`” (Sheikh, Prins, Schrijvers, 2023, p. 16). They say that “a common definition of AI is that it is a technology that enables machines to imitate various complex human skills” (Sheikh, Prins, Schrijvers, 2023, p. 15) and give the broadest and the strictest definitions. “In its broadest definition, AI is equated with algorithms.” (Sheikh, Prins, Schrijvers, 2023, p. 15). It is difficult to agree with this approach to defining AI, since it is impossible to move from it to a definition of ordinary (human) intelligence. But “in its strictest definition, AI stands for the imitation by computers of the intelligence inherent in humans. (Sheikh, Prins, Schrijvers, 2023, p. 15). This definition looks more relevant to define the intelligence.

Given the existence of many approaches to defining AI, we try to use the most general and consistent one, which involves a combination of the concepts of "artificial" and "intelligence". "Artificial" is defined as "made by people, often as a copy of something natural”[1]. "Intelligence" is defined as “the ability to learn, understand, and make judgments or have opinions that are based on reason”[2]. So that, AI is intelligence made by people. The carrier of ordinary intelligence is a human. The carrier of AI is usually something artificial. Based on this, AI exists in an artificial body brain.

Let us try to compare “ordinary intelligence” and “AI” using approach, which was offer by Aristotele more than two thousand years ago and includes consideration of the object of study from four positions: material cause, formal cause, efficient cause, final cause (tab. 1).

Table 1 – **Comparison of Human and Artificial Intelligence from the Perspective of Aristotle's Four Causes**

Cause	Human intelligence	Artificial intelligence
Material cause	Brain	Hardware (physical components of a computer system) and software.
Formal cause	Structure of the mind	Design or architecture (for instance, sets of data and algorithms), which unites hardware, software and datasets into a uniform system (AI system).
Efficient cause	Society, genetics, environment	Human intelligence (for instance, engineers), environment (datasets).
Final cause	Set goals and solve tasks/problems	Solve tasks/problems (very often, more efficiently and accurately than humans).

Source: made by authors.

[1] https://dictionary.cambridge.org/dictionary/english/artificial
[2] https://dictionary.cambridge.org/dictionary/english/intelligence?q=Intelligence

Analyzing the results presented in Table 1, it becomes obvious that the simple definetion "artificial intelligence is intelligence created by humans" is weakly functional. Because it displays only one cause (efficient cause), ignoring the essence of this phenomenon.

As a rule, before the AI has been trained on a large dataset, it cannot yet be considered as corresponding to modern concepts of AI. Because here we can notice an analogy with the religious and philosophical position of deism, according to which God created man and the universe, and then withdrew and no longer interferes. Similarly, an engineer creates hardware, a programmer creates special software, launches "training" on datasets, then they remove themselves from influencing the processes that occur inside the AI. And only after training does the pre-AI become AI. The logic of this process is shown in Figure 1.

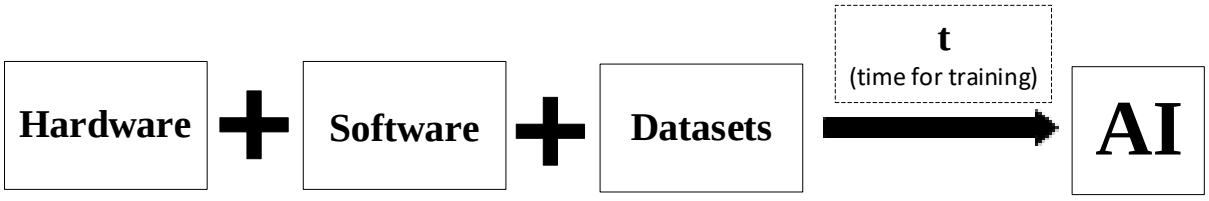

Figure 1 – **logic of AI formation**
Source: made by authors.

The growing role of AI in the economic life of society necessitates its comprehensive reflection in the sphere of legislation. So that, for instance, regulation 2024/1689 was adopted in the EU (13.06.2024). It harmonizes rules on artificial intelligence and amends regulations related to AI in EU (European Parliament, 2024). A year earlier Executive Order “Safe, Secure, and Trustworthy Development and Use of Artificial Intelligence” was adopted in the USA (The president of the United States, 2023). Both these documents contain definitions of AI that are close to each other (tab. 2).

The significant similarity of definitions on different sides of the Atlantic Ocean indicates the formation of a certain common position regarding what is meant by artificial intelligence. Based on analysis of Figure 1 and Table 2 we can propose the following AI logic as a system (fig. 2).

Table 2 – **Definition of AI in official papers of USA and EU**

Country	Definition	Key elements as part of system
1	2	3
EU	“ ‘AI system’ means a machine-based system that is designed to operate with varying levels of autonomy and that may exhibit adaptiveness after deployment, and that, for explicit or implicit objectives, infers, from the input it receives, how to generate outputs such as predictions, content, recommendations, or decisions that can influence physical or virtual environments” (European Parliament, 2024); Note: “A key characteristic of AI systems is their capability to infer” (European Parliament, 2024).	Physical basis: machine-based system; Input: data; Output: predictions, content, recommendations, or decisions that can influence physical or virtual environments that are relevant to external objectives.

The end of the table 2

1	2	3
USA	"The term ''artificial intelligence'' or ''AI'' has the meaning set forth in 15 U.S.C. 9401(3): a machine-based system that can, for a given set of human-defined objectives, make predictions, recommendations, or decisions influencing real or virtual environments. Artificial intelligence systems use machine- and human-based inputs to perceive real and virtual environments; abstract such perceptions into models through analysis in an automated manner; and use model inference to formulate options for information or action." (The president of the United States, 2023, p.3). "The term ''AI system'' means any data system, software, hardware, application, tool, or utility that operates in whole or in part using AI." (The president of the United States, 2023, p. 3)	Physical basis: machine-based system; Input: machine- and human-based data; Output: predictions, recommendations, or decisions influencing real or virtual environments that are relevant to a given set of human-defined objectives.

Source: made by authors.

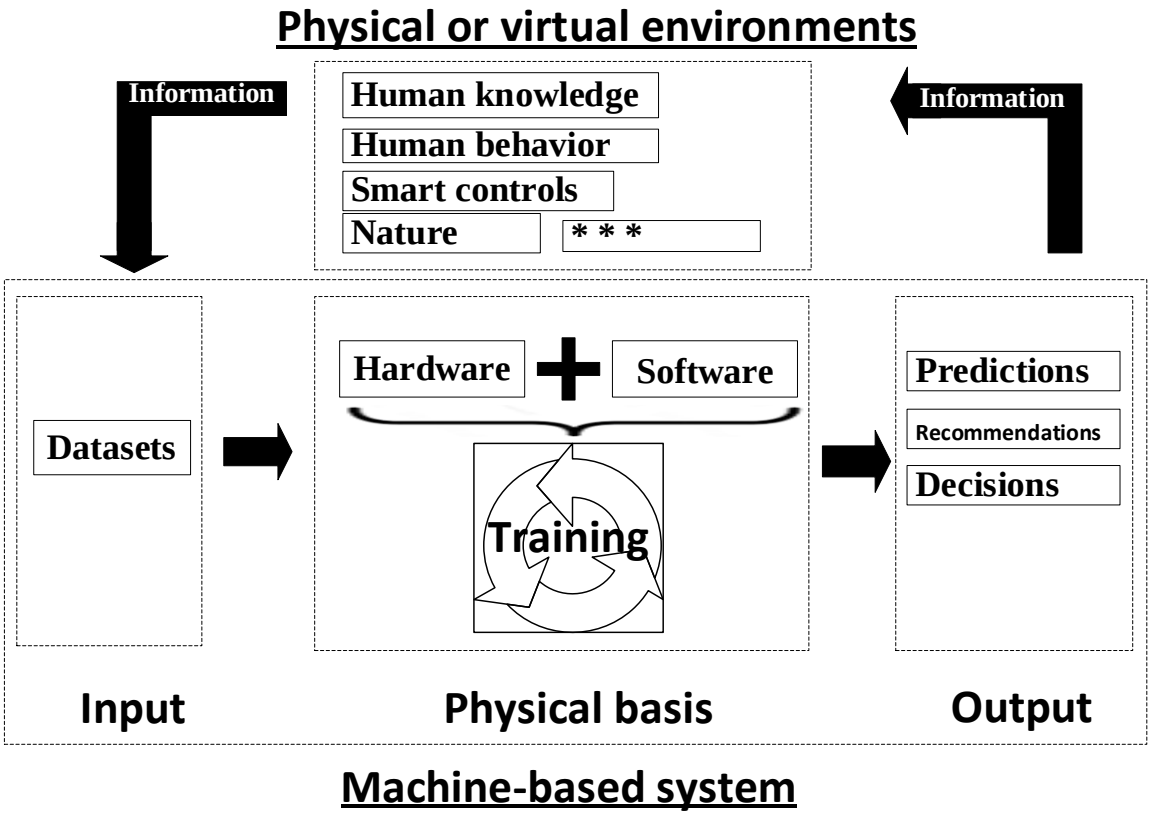

Figure 2 – **AI logic as a system**
Source: made by authors.

Within the framework of this study, AI is understood as a "machine-based system, which based on human-defined objectives uses machine- and human-based data to solve tasks influencing real or virtual environments".

It is also important to note that there are two main types of AI: narrow or weak AI and artificial general intelligence or AGI (other names include ‘strong AI’ and ‘full AI’). Some examples of narrow AI: (1) virtual assistants (Siri, Alexa, etc.), (2) chatbots, (3) image recognition, (4) speech recognition, (5) recommendation systems for selection of movies, products, songs etc., (6) self-driving cars, (7) medical diagnostics, (8) fraud detection, (9) language translation; (10) manufacturing robots.

AGI has the cognitive ability to solve complex problems in various areas, just like humans. But AGI is only a concept, which can become reality in future. So that examples do not exist yet.

It is necessary to take into account that external environments that form human intelligence and artificial intelligence are two different environments that only partially overlap (fig. 2). At the same time, the learning area of artificial intelligence is constantly expanding, which can lead to the neutralization of the factor of implicit and distributed knowledge (an important element in the Austrian school of economic theory).

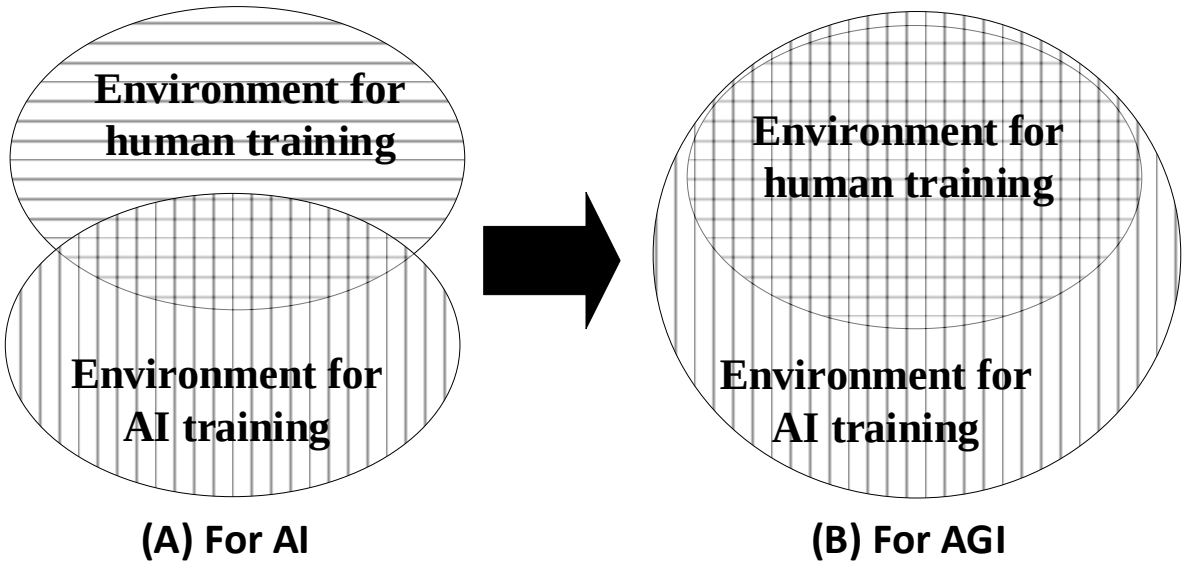

Figure 2 – **Environment for AI and AGI**
Source: made by authors.

Having defined the AI concept, we can move on to considering its role in the economy.

AI in the economy

According to various expert organizations, the further development and implementation of AI technologies has a great economic potential, which is confirmed by a number of empirical observations. For example, it is claimed that "Copilot users completed tasks in 26-73% less time than other users without access to AI" (Artificial Intelligence Index Report, 2024, p. 272). And “a Harvard Business School study found that consultants with access to GPT-4 increased their productivity in the selection of consulting tasks by 12.2%, speed by 25.1%, and quality by 40.0%. compared to a control group without AI access. Likewise, a study by the National Bureau of Economic Research showed that call center agents who use AI process 14.2% more calls per hour than those who do not use AI" (Artificial Intelligence Index Report, 2024, p. 273). As a result, the authors of this report come to the opinion that access to AI reduces the

productivity gap between low- and high-skilled workers (Artificial Intelligence Index Report, 2024, p. 275). On average, this should increase labor productivity.

Based on the above, it is natural that the interest in the shares of companies whose activities are related to the use of AI is increasing. The most convincing example is the growth of Nvidia's capitalization. If on June 13, 2023, the capitalization of Nvidia reached 1 trillion US dollars (Artificial Intelligence Index Report, 2024, p. 220), then at the beginning of June 2024 its capitalization already reached about 3 billion USD. Thus, the capitalization tripled in a year and Nvidia secured the 3rd place in the world (in terms of capitalization), second only to Microsoft and Apple, whose activities are also indirectly related to the development and use of AI.

At the same time, indicators of the intensity of AI implementation, which are related to the labor market and the attraction of corporate investments, are deteriorating.

For example, in the USA in 2023, the number of vacancies related to AI decreased to 1.6% compared to 2% (of the total number) in 2022. A similar trend is observed in most other countries. At the same time, the reduction occurred in almost all sectors (waste management and administrative support services; retail trade; transportation and warehousing; real estate, rental and leasing; wholesale trade; mining, quarrying, oil and gas production; agriculture, forestry agriculture and hunting; management of companies and enterprises; manufacturing; finance and insurance; professional, scientific and technical services; information) with the exception of two (educational services, public administration) (Artificial Intelligence Index Report, 2024, p. 228).

Another important factor is the reduction of global corporate investments in AI for two years in a row (2022-2023) from 337.4 billion USD in 2021 to 189.16 billion USD in 2023 (Artificial Intelligence Index Report, 2024, p. 242).

Thus, it can be argued that a number of contradictions has formed: (1) between business behavior and the expectations of the expert community; (2) between the dynamics of corporate investments and the dynamics of the stock market. As a result, the situation that developed in the economy and the stock market before the "dotcom crisis" of 2000 is largely repeated, which creates similar risks and opportunities.

It is not yet clear whether a crisis is going to happen in the near future. In any case, the full-scale implementation of AI will seriously reformat the global economy. This allows us to consider artificial superintelligence as a key technology for the next phase of development (tab. 3).

Table 3 – **Growth mode and global economy**

Growth mode	Date began to dominate	Doubling time of global economy (years)	Duration of era (years)	Length of era (years)	Average annual growth rate of global economy (%)
Hunting	2 000 000 B.C.	230 000	-2 000 000	1 995 300	0,0003
Farming	4700 B.C.	860	-4 700	6 430	0,0806
Science / commerce	1730 A. D.	58	1 730	173	1,2023
Industry	1903 A.D.	15	1 903	127	4,7294
Superintelligence?	2030 A. D.?	???	???	???	???

Source: made by the authors based on (Aschenbrenner, 2024, p. 70).

Such a periodization seems highly debatable, but the main idea attracts attention. It is worth noting that despite the acceleration of global economic growth in recent centuries, its slowdown has been observed in recent decades (Vyshnevskyi et al., 2020).

To assess the universality of AI as a potential core of the new industrial revolution, it is necessary to analyze it from the standpoint of all components of the reproduction process (production, distribution, exchange and consumption).

In the context of production, AI facilitates automation, optimization and customization. AI-powered robots and machines allow to reduce labor costs and improve product quality. AI can analyze vast amounts of data to optimize production processes, identify bottlenecks, predict equipment failures and create optimal plans for scheduled preventive maintenance. AI enables mass customization by quickly adjusting production lines to meet specific consumer demands, such as 3D printing based on unique specifications. It is also necessary to pay attention to the expansion of the range of goods and services, where AI is an integral part (smart homes, virtual assistants, autonomous vehicles).

In the context of distribution, AI facilitates supply chain optimization (optimize logistics, ensuring the timely and cost-effective delivery of goods), fraud prevention, optimization and ensuring transparency of performance results distribution between employees, management and owners (this helps to increase staff motivation).

In the context of exchange, AI facilitates an increase in its opportunities and speed (AI-powered recommendation systems, e-commerce platforms, smart-contracts).

In the context of consumption, AI facilitates improving the quality and quantity of purchases (AI-powered recommendation systems, e-commerce platforms, AI-enabled goods and services).

The universal nature of AI penetration into the economy is confirmed at the level of the world's leading companies that directly have no connection with digital technology sector (for instance, Coca-Cola[1], Walmart[2], Rio Tinto[3], ExxonMobil[4] , General Electric[5]). Given the specific nature of these companies' activities, they use AI to solve a wide range of problems related to predictive analytics, demand forecasting, personalized marketing, customer service (chatbots, virtual assistants), logistic optimization, price optimization, product placement optimization, mining optimization, fraud detection, predictive maintenance, worker monitoring, energy and water use optimization.

A natural reaction to the introduction of AI is an increase in incidents and hazards associated with it (fig. 3). According to the OECD AI Incidents Monitor, a sharp increase was recorded in 2023[6].

Thus, it can be argued that a significant part of the business and expert community based on objective facts considers AI as a potential core for the Fourth Industrial Revolution. This necessitates an analysis of prospects and limitations AI use.

[1] https://www.coca-colacompany.com/media-center/coca-cola-invites-digital-artists-to-create-real-magic-using-new-ai-platform

[2] https://tech.walmart.com/content/walmart-global-tech/en_us/flagship-conferences/ai-at-walmart/replay-2024.html

[3] https://www.riotinto.com/en/mn/about/innovation/smart-mining

[4] https://corporate.exxonmobil.com/who-we-are/technology-and-collaborations/digital-technologies

[5] https://www.ge.com/digital/blog/ai-accelerating-energy-transition-carbon-negative

[6] An AI incident or hazard can be reported by one or more news articles covering the same event.

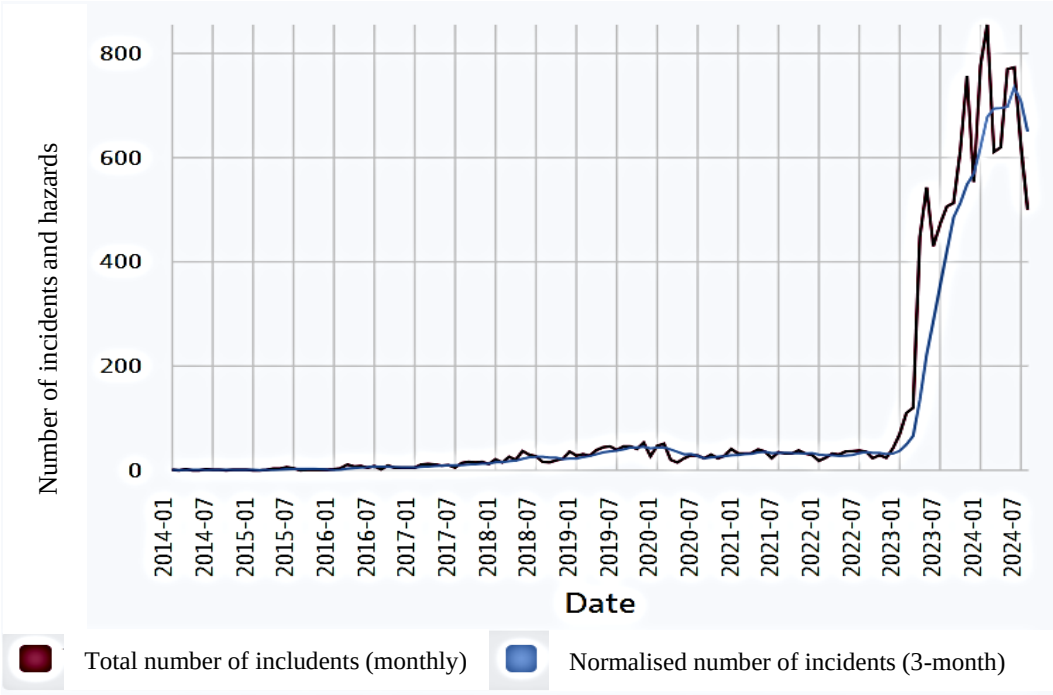

Figure 3 – **AI incidents and hazards**
Source: made by the authors based on (OECD, web).

AI prospects

Based on the analysis and literary sources, the following AI prospects can be identified on theoretical and practical levels. On theoretical level: (1) alienation of tacit knowledge from the individual (employee and entrepreneur); (2) optimization of the planning system; (3) revision of the socialist-calculation debate; (4) decreasing information asymmetry. On practical level: (1) formation of new products and markets; (2) increasing labor and capital productivity; (3) massive creation of new jobs; (4) optimization of business processes; (5) opportunity for rapid growth for small businesses and startups.

Friedrich Hayek and other representatives of the Austrian School of Economic Theory show the key role of tacit knowledge in economy and highlight the significance of knowledge that is hard to articulate or codify. That is an intangible asset, often rooted in personal experience and intuition. So that it is difficult to formalize. Tacit knowledge is dynamic and distributed among many people.

AI already has broad capabilities for alienating tacit knowledge from people and using it for its own learning. Thus, AI can alienate and digitize human voice (speech), motion and even brain activity for further use separately from humans, for example, when organizing the work of AI-controlled autonomous robots.

Big data and the enormous computing power of AI create the preconditions for improving the planning system at the micro and macro levels. Simultaneously, time costs are reduced.

Alienation of tacit knowledge and optimization of the planning by AI create bases for r*evision of the socialist-calculation debate*. One of the most vivid and insightful debates in XX century between the Austrian school of economic theory (Ludwig von Mises and Friedrich von Hayek) and Marxism (Otto Neurath, Henry D. Dickinson, Maurice Dobb, and Oskar Lange) about the question of whether it was possible to rationally allocate resources and coordinate production in a socialist economy

without relying on a market mechanism (Elliott, 2011, p.78). The study of this problem has gained close attention in recent years (Dapprich and Greenwood, 2024; Lambert and Fegley, 2023) however, a satisfactory solution has not yet been found.

At the same time, there is a position that the current capabilities of AI are not yet sufficient to understand the context and make adequate decisions. "It can simplify complexity but does not resolve contextual knowledge problems. Human insight and decision-making remain necessary to resolve the economic problem at both the macro and micro levels of the economy." (Davidson, 2024, p. 13).

The expansion of AI use creates opportunities to reduce information asymmetry at different levels of communication. For example, AI can be an assistant for both the seller and the buyer. It can help the seller find the best sales channels, determine the target audience, and build a pricing policy. At the same time, AI can help the consumer find the optimal seller based on price-quality criteria.

The amount of information that AI has is significantly greater than the amount of information that both the seller and the buyer have.

Let us assume

$$\begin{aligned} &IV(seller) > IV(consumer),\\ &IV(AI) >>> IV(seller),\\ &IV(AI) >>> IV(consumer), \end{aligned} \qquad (1)$$

where IV – information volume, ">>>" is orders of magnitude greater than ">".

From (1) we get (2)

$$IV(AI) + IV(seller) \approx IV(AI) + IV(consumer) \qquad (2)$$

Thus, the use of AI reduces information asymmetry. The same applies to other communication options. For instance, when a person and a company interact. The widespread use of AI to ensure communications at different levels of interaction between individuals and organizations creates the possibility of forming a society with minimal average levels of information asymmetry (Vyshnevskyi, 2023).

The prospects of AI (1)-(4) at the practical level have already been considered in this paper and in the studies of other authors.

Let us pay attention to point (5). For the implementation of AI in large enterprises (big business), there are restrictions in the form of previously implemented software products that are incompatible (poorly compatible) with the use of AI. For instance, IT solutions that were created in 1970-2000 are outdated (for example, using outdated programming languages such as COBOL). Therefore, old companies do not use full their potential. However, it enables young or small companies to use modern technologies such as AI-based ERP or CRM system to gain a competitive advantage.

Having considered the prospects for using AI, we can move on to the limitations.

AI limitations

Based on the analysis and literary sources we can see AI limitations at macro and micro levels.

First of all, at the macro level, the main problem that is widely discussed both within the expert community and the general public is long-term structural unemployment. The higher the unemployment, the lower the wages, the less economically justified is the implementation of AI. This alarmist forecast seems unlikely due to the fact that the introduction of new technologies always creates new jobs, the existence of which is extremely difficult to predict in advance. For example, it was extremely difficult to imagine 30 years ago that one of the most desired professions among schoolchildren would be a YouTube blogger. At the same time, the possibility of taxing robots operating on the AI basis, as well as the introduction of an unconditional basic income for the general population, may act as tools to reduce the negative consequences of the expanded AI use.

The second basic problem, which may manifest itself in the near future, is the extremely high expectations from the AI use in

all spheres of society. As shown above, these expectations have led to a rapid growth in the capitalization of companies associated with the development of AI infrastructure and the production of AI products and AI services. If these expectations are not met, then not only the stock markets, but also the entire global economy will face a deep economic crisis.

Third problem. The increasing use of AI will require more and more electric power. This creates the risk that at some point the economic costs of energy consumption will exceed the economic benefits, at least in some cases or sectors. Only in the future will we be able to see the answer to the question: "Who is more energy efficient, humans or AI?"

An additional question is the contradiction between the interests of individual businesses and the economy as a whole. For an individual business, AI may not offer significant opportunities. Thus, AI for an individual business may not create fundamental advantages. For instance, the introduction of AI at the nuclear power plant is not capable of increasing its capacity. If the unit is designed to produce 1 GW per hour, it will not be able to produce more (physically impossible). But if we have many nuclear power plants united within a single energy system, then there is potential for optimizing distribution using AI.

At the microeconomic level Skinner C. identifies 10 key reasons why most companies struggle to innovate (Skinner, 2018, p. 207-208). Some of these reasons are relevant to AI implementation on business level:

- inconsistency between actual results and those presented through the PR campaigns. Active use of AI is declared without its actual implementation;

- the company's existing IT infrastructure hinders the implementation of modern AI-based IT solutions;

- many companies do not consider AI as an urgent solution and are therefore taking a wait-and-see approach;

- lack of a culture of delegating tasks to AI that have been performed by humans for years;

- partial AI use in some departments without comprehensive use across the entire company.

From an institutionalist perspective, a significant obstacle to the most cost-effective use of AI is the current legislation, created in the pre-AI era.

The list of considered limitations is not exhaustive. It is important to note that the identified limitations are not critical for the widespread use of AI as a core of an economic system that will be primarily reproduced on AI basis.

Conclusions

1. The definition of the AI concept in the scientific community remains the subject of heated debate. At the same time, in the regulatory and legal plane, a trend is being formed towards unification of the AI concept.

2. Further improvement of AI (including the transition from AI to AGI) and the expansion of its use can make a significant contribution to solving problems related to economic calculation and minimizing information asymmetry, and therefore optimizing transaction costs in the economy.

3. AI, certainly acting as a locally useful tool at the level of individual enterprises and organizations, causes the acceleration of attracting funds to the stock market, which can lead to the formation of a bubble on global level. If this bubble bursts, expectations about the economic efficiency of AI will be revised, and some AI-related companies will experience significant margin reductions (perhaps losses and bankruptcies). But this, in turn, will initiate the next stage of AI development, will accelerate its transition from the current narrow specialization to the creation of full-fledged general artificial intelligence (artificial general intelligence), which has a greater potential to change the economy at all levels. As a result,

AI will become established as the core of the new industrial revolution.

4. AI in the context of the Internet of Things can be seen as the potential voice of a unified Technosphere. Just as humans once became the voice and conscience of the biosphere.

Further research

Based on the analysis and obtained results, the following unresolved issues can be identified that require further scientific understanding: regulation of AI; AI taxation; financial and economic stimulation of AI; ensuring economic efficiency of AI; ensuring the social effectiveness of AI; unconditional basic income and AI; AI's entrepreneurial capacity; human-machine (AI) entrepreneurial environment. Another promising question is whether AI will be able to reproduce itself.

Literature

Agrawal A., Gans J., Goldfarb A. (2024). Prediction machines, insurance, and protection: An alternative perspective on AI's role in production. *Journal of the Japanese and International Economies*. Vol. 72. DOI: https://doi.org/10.1016/j.jjie.2024.101307

Akhtar P., Ghouri A., Ashraf A., Lim J., Khan N., Ma S. (2024). Smart product platforming powered by AI and generative AI: Personalization for the circular economy. *International Journal of Production Economics*. Vol. 273. DOI: https://doi.org/10.1016/j.ijpe.2024.109283.

Artificial Intelligence Index Report 2024 (2024). Human-Centered Artificial Intelligence of Stanford University. URL: https://aiindex.stanford.edu/wp-content/uploads/2024/04/HAI_AI-Index-Report-2024.pdf

Aschenbrenner L. (2024). Situational-awareness.AI. *The Decade Ahead.* San Francisco, California. 165 p. URL: https://situational-awareness.ai/wp-content/uploads/2024/06/situationalawareness.pdf

Baldwin R., Okubo T. (2024). Are software automation and teleworker substitutes? Preliminary evidence from Japan. *The World Economy*. Vol. 47. P. 1531–1556. DOI: https://doi.org/10.1111/twec.13496

Banerjee A., Duflo E. (2020). Good Economics for Hard Times: Better Answers to Our Biggest Problems. Penguin Random House. 402 p.

Buiten M. (2024). Product liability for defective AI. *European Journal of Law and Economics*. Vol. 57. P. 239–273. DOI: https://doi.org/10.1007/s10657-024-09794-z

Dapprich J. P., Greenwood D. (2024). Cybersocialism and the Future of the Socialist Calculation Debate. *Erasmus Journal for Philosophy and Economics*. Vol. 17 (1). P. 1–23. DOI: https://doi.org/10.23941/ejpe.v17i1.781

Davidson S. (2024). The economic institutions of artificial intelligence. *Journal of Institutional Economics*. Vol. 20. P. 1–16. DOI: https://doi.org/10.1017/S1744137423000395

Elliott C. (2011). Friedrich von Hayek: The Socialist-Calculation Debate, Knowledge Arguments, And Modern Economic Development. *Gettysburg Economic Review*. Vol. 5. Art. 6. URL: https://cupola.gettysburg.edu/ger/vol5/iss1/6

European Parliament (2024). Regulation (EU) 2024/1689 [laying down harmonised rules on artificial intelligence and amending Regulations (EC) No 300/2008, (EU) No 167/2013, (EU) No 168/2013, (EU) 2018/858, (EU) 2018/1139 and (EU) 2019/2144 and Directives 2014/90/EU, (EU) 2016/797 and (EU) 2020/1828 (Artificial Intelligence Act) (Text with EEA relevance)]. URL: https://eur-lex.europa.eu/eli/reg/2024/1689/oj

Floridi L. (2023). On the Brussels-Washington Consensus About the Legal Definition of Artificial Intelligence. *Philos. Technol*. № 36 (87). DOI: https://doi.org/10.1007/s13347-023-00690-z

Lambert K., Fegley T. (2023). Economic Calculation in Light of Advances in Big Data and Artificial Intelligence. *Journal of Economic Behavior & Organization*. Vol. 206. P. 243-250. DOI: https://doi.org/10.1016/j.jebo.2022.12.009

McKinsey (n.d.). The economic potential of generative AI: The next productivity frontier. URL: https://www.mckinsey.com/ capabilities/mckinsey-digital/our-insights/ the-economic-potential-of-generative-AI-the-next-productivity-frontier#industry-impacts (дата звернення: 12.06.2024)

OECD. (n.d.) OECD AI Incidents Monitor. URL: https://oecd.ai/en/incidents?search_terms=%5B%5D&and_condition=false&from_date=2014-01-01&to_date=2024-08-29&properties_config=%7B%22principles%22:%5B%5D,%22industries%22:%5B%5D,%22harm_types%22:%5B%5D,%22harm_levels%22:%5B%5D,%22harmed_entities%22:%5B%5D%7D&only_threats=false&order_by=date&num_results=20

Roberts J., Baker M., Andrew J. (2024). Artificial intelligence and qualitative research: The promise and perils of large language model (LLM) 'assistance'. *Critical Perspectives on Accounting.* Vol. 99. Art. 102722. DOI: https://doi.org/10.1016/j.cpa.2024.102722

Russell S., Norvig P. (2010). Artificial Intelligence A Modern Approach. Third Edition. Pearson Education. 1132 p.

Sheikh H., Prins C., Schrijvers E. (2023). Artificial Intelligence: Definition and Background. *Mission AI. The New System Technology*. Springer, Cham. P. 15-41. DOI: https://doi.org/10.1007/978-3-031-21448-6_2

Skinner C. (2018). Digital Human: The Fourth Revolution of Humanity Includes Everyone. Hoboken, New Jersey, USA: John Wiley & Son. 336 p.

The president of the United States (2023). Safe, Secure, and Trustworthy Development and Use of Artificial Intelligence. [Federal Register Vol. 88, No. 210]. URL: https://www.govinfo.gov/content/pkg/FR-2023-11-01/pdf/2023-24283.pdf

Vyshnevskyi O. (2023). Platform Strategiarchy as a Tool for Reducing Information Asymmetry, Taking into Account the Scale, Cardinality and Order of the Strategy. *Economic Herald of the Donbass*. № 4 (74). P. 59-66. DOI: https://doi.org/10.12958/1817-3772-2023-4(74)-59-66

Vyshnevskyi O., Amosha O., Liashenko V. (2019). The impact of Industry 4.0 and AI on economic growth. *Scientific papers of Silesian university of technology. Organization and management series*. № 140. P. 391-400. DOI: http://dx.doi.org/10.29119/1641-3466.2019.140.32

Vyshnevskyi O., Stashkevych I., Shubna O., Barkova S. (2020). Economic Growth In The Conditions Of Digitalization In The EU Countries. *Estudios de economía aplicada*. 38 (4), Extra 3, 1 (The Recent Economic Trends and their Impact on Marketing). DOI: http://dx.doi.org/10.25115/eea.v38i4.4041

Zhao C., Dong K., Wang K., Nepal R. (2024). How does artificial intelligence promote renewable energy development? The role of climate finance. *Energy Economics*. Vol. 133. DOI: https://doi.org/10.1016/j.eneco.2024.107493.

References

Agrawal, A., Gans, J., & Goldfarb A. (2024). Prediction machines, insurance, and protection: An alternative perspective on AI's role in production. *Journal of the Japanese and International Economies*. Vol. 72. DOI: https://doi.org/10.1016/j.jjie.2024.101307

Akhtar, P., Ghouri, A., Ashraf, A., Lim, J., Khan, N., & Ma, S. (2024). Smart product platforming powered by AI and generateve AI: Personalization for the circular economy. *International Journal of Production Economics*, 273. DOI: https://doi.org/10.1016/j.ijpe.2024.109283.

Artificial Intelligence Index Report 2024 (2024). Human-Centered Artificial Intelligence of Stanford University. Retrieved

from https://aiindex.stanford.edu/wp-content/uploads/2024/04/HAI_AI-Index-Report-2024.pdf

Aschenbrenner, L. (2024). Situational-awareness.AI. *The Decade Ahead.* San Francisco, California. 165 p. Retrieved from https://situational-awareness.ai/wp-content/uploads/2024/06/situationalawareness.pdf

Baldwin, R., & Okubo, T. (2024). Are software automation and teleworker substitutes? Preliminary evidence from Japan. *The World Economy,* 47, pp. 1531–1556. DOI: https://doi.org/10.1111/twec.13496

Banerjee, A., & Duflo, E. (2020). Good Economics for Hard Times: Better Answers to Our Biggest Problems. Penguin Random House. 402 p.

Buiten, M. (2024). Product liability for defective AI. *European Journal of Law and Economics,* 57. pp. 239–273. DOI: https://doi.org/10.1007/s10657-024-09794-z

Dapprich, J. P., & Greenwood, D. (2024). Cybersocialism and the Future of the Socialist Calculation Debate. *Erasmus Journal for Philosophy and Economics,* 17(1), pp. 1–23. DOI: https://doi.org/10.23941/ejpe.v17i1.781

Davidson, S (2024). The economic institutions of artificial intelligence. *Journal of Institutional Economics,* 20, pp. 1–16. DOI: https://doi.org/10.1017/S1744137423000395

Elliott, C. (2011). Friedrich von Hayek: The Socialist-Calculation Debate, Knowledge Arguments, And Modern Economic Development. *Gettysburg Economic Review,* 5, Art. 6. Retrieved from https://cupola.gettysburg.edu/ger/vol5/iss1/6

European Parliament (2024). Regulation (EU) 2024/1689 [laying down harmonised rules on artificial intelligence and amending Regulations (EC) No 300/2008, (EU) No 167/2013, (EU) No 168/2013, (EU) 2018/858, (EU) 2018/1139 and (EU) 2019/2144 and Directives 2014/90/EU, (EU) 2016/797 and (EU) 2020/1828 (Artificial Intelligence Act) (Text with EEA relevance)]. Retrieved from https://eur-lex.europa.eu/eli/reg/2024/1689/oj

Floridi, L. (2023). On the Brussels-Washington Consensus About the Legal Definition of Artificial Intelligence. *Philos. Technol*., 36 (87). DOI: https://doi.org/10.1007/s13347-023-00690-z

Lambert, K., & Fegley, T. (2023). Economic Calculation in Light of Advances in Big Data and Artificial Intelligence. *Journal of Economic Behavior & Organization,* 206, pp. 243-250. DOI: https://doi.org/10.1016/j.jebo.2022.12.009.

McKinsey (n.d.). The economic potential of generative AI: The next productivity frontier. Retrieved from https://www.mckinsey.com/capabilities/mckinsey-digital/our-insights/the-economic-potential-of-generative-AI-the-next-productivity-frontier#industry-impacts

OECD. (n.d.) OECD AI Incidents Monitor. Retrieved from https://oecd.ai/en/incidents?search_terms=%5B%5D&and_condition=false&from_date=2014-01-01&to_date=2024-08-29&properties_config=%7B%22principles%22:%5B%5D,%22industries%22:%5B%5D,%22harm_types%22:%5B%5D,%22harm_levels%22:%5B%5D,%22harmed_entities%22:%5B%5D%7D&only_threats=false&order_by=date&num_results=20

Roberts, J., Baker, M., & Andrew, J. (2024). Artificial intelligence and qualitative research: The promise and perils of large language model (LLM) 'assistance'. *Critical Perspectives on Accounting,* 99, 102722. DOI: https://doi.org/10.1016/j.cpa.2024.102722

Russell, S., & Norvig, P. (2010). Artificial Intelligence A Modern Approach. Third Edition. Pearson Education. 1132 p.

Sheikh, H., Prins, C., & Schrijvers, E. (2023). Artificial Intelligence: Definition and Background. In: *Mission AI. The New System Technology* (pp. 15-41). DOI: https://doi.org/10.1007/978-3-031-21448-6_2

Skinner, C. (2018). Digital Human: The Fourth Revolution of Humanity Includes Everyone. Hoboken, New Jersey, USA: John Wiley & Son, 2018. 336 p.

The president of the United States (2023). Safe, Secure, and Trustworthy Development and Use of Artificial Intelligence [Federal Register, 88 (210)]. Retrieved from https://www.govinfo.gov/content/pkg/FR-2023-11-01/pdf/2023-24283.pdf

Vyshnevskyi, O. (2023). Platform Strategiarchy as a Tool for Reducing Information Asymmetry, Taking into Account the Scale, Cardinality and Order of the Strategy. *Economic Herald of the Donbass*, 4 (74), pp. 59-66. DOI: https://doi.org/10.12958/1817-3772-2023-4(74)-59-66

Vyshnevskyi, O., Amosha, O., & Liashenko, V. (2019). The impact of Industry 4.0 and AI on economic growth. *Scientific papers of Silesian university of technology. Organization and management series*, 140, pp. 391-400. DOI: http://dx.doi.org/10.29119/1641-3466.2019.140.32

Vyshnevskyi, O., Stashkevych, I., Shubna, O., & Barkova, S. (2020). Economic Growth In The Conditions Of Digitalization In *The EU Countries. Estudios de economía aplicada*, 38 (4), Extra 3, 1 (The Recent Economic Trends and their Impact on Marketing). DOI: http://dx.doi.org/10.25115/eea.v38i4.4041

Zhao, C., Dong, K., Wang, K., & Nepal, R. (2024). How does artificial intelligence promote renewable energy development? The role of climate finance. *Energy Economics*, 133. DOI: https://doi.org/10.1016/j.eneco.2024.107493.

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ШТУЧНИЙ ІНТЕЛЕКТ ЯК ЯДРО НОВОЇ ПРОМИСЛОВОЇ РЕВОЛЮЦІЇ: ПЕРСПЕКТИВИ ТА ОБМЕЖЕННЯ

Метою статті є визначення перспектив та обмежень штучного інтелекту (ШІ) як ядра нової промислової революції.

Трактування поняття ШІ в науковому співтоваристві залишається предметом гострих дискусій. Водночас у нормативно-правовій площині формується тенденція щодо його уніфікації.

Виявлено перспективи ШІ на теоретичному рівні: відчуження неявних знань від індивіда (працівника та підприємця); оптимізація системи планування; перегляд дебатів про соціалістичний розрахунок; зменшення інформаційної асиметрії; на практичному: формування нових продуктів і ринків; підвищення продуктивності праці та капіталу; масове створення нових робочих місць; оптимізація бізнес-процесів; можливість швидкого зростання для малого бізнесу та стартапів.

Обмеження, пов'язані з ШІ: тривале структурне безробіття; завищені очікування від ШІ і, як наслідок, можливе утворення спекулятивної бульбашки на світовому фондовому ринку; енергоємність ШІ; застаріла корпоративна культура та нормативне середовище, сформоване в епоху до ШІ.

Подальше вдосконалення ШІ (включаючи перехід від ШІ до загального ШІ) і розширення його використання може здійснити значний внесок у вирішення проблем, пов'язаних з економічним розрахунком і мінімізацією інформаційної асиметрії, а отже, оптимізацією трансакційних витрат в економіці.

ШІ, виступаючи локально корисним інструментом на рівні окремих підприємств та організацій, приводить до прискорення залучення коштів на фондовий ринок, що може спричинити утворення бульбашки на глобальному рівні. Якщо ця бульбашка лопне, то очікування щодо економічної ефективності штучного інтелекту будуть переглянуті, а деякі компанії, пов'язані зі штучним інтелектом, зазнають значного зниження маржі (можливо, збитків і банкрутства). Однак це, у свою чергу, започаткує наступний етап розвитку ШІ, прискорить його перехід від нинішньої вузької спеціалізації до створення повноцінного загального штучного інтелекту, який має більший потенціал для зміни економіки на всіх рівнях. У результаті ШІ стане ядром нової промислової революції.

Ключові слова: AI, штучний інтелект, промислова революція, дискусія про соціалістичний розрахунок, зменшення асиметрії інформації.

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Vyshnevskyi, O. S., Anufriiev, M. Yu., Bozhyk, M. S., & Gulchuk, T. O. (2024). Artificial intelligence as a core of the new industrial revolution: prospects and limitations. *Econ. promisl.*, 3 (107), pp. 5-21. DOI: http://doi.org/10.15407/econindustry2024.03.005

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