

# Искусственный интеллект и будущее современной экономики

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Цель статьи - раскрыть влияние потенциала искусственного интеллекта (ИИ) на развитие современной экономики. Искусственный интеллект абстрактен и труден для понимания, что приводит к отстраненному отношению к нему. Чтобы внести свой вклад в понимание искусственного интеллекта и его роли в экономическом развитии, исследуются движущие силы, преимущества, недостатки и возможности искусственного интеллекта, основанные на коллаборации цифрового и физического мира. В результате мы утверждаем, что благодаря активному использованию искусственного интеллекта возможно создать новую модель социально-экономического развития. В связи с этим ИИ исследуется как универсальный "метод изобретения", его влияние на создание инноваций и повышение эффективности производственных процессов, политики и институтов в области исследований ИИ. Это позволяет понять изменения, лежащие в основе формирования современной экономики. Как отдельные лица, так и организации должны готовиться к будущему, используя технологии искусственного интеллекта и понимая их эффективность в экономической и социальной деятельности с точки зрения создания лучшего мира для человечества. Доказывается, что экономика будущего будет основана на транзакциях, требующих высокоскоростных вычислений и моментального анализа, или анализа "на лету", что формирует новое экономическое развитие, которое ассимилирует основные функции ИИ и создает новые возможности для организованного и устойчивого роста.

**Ключевые слова:** искусственный интеллект, экономика будущего, коллаборация, искусственные агенты, эффективность производственных процессов

## 1. Introduction

Artificial intelligence (AI), or the idea that computer systems can perform functions normally associated with the human mind, has suddenly turned from futuristic speculation into a modern reality. "Computer scientists have made significant breakthroughs in machine learning and deep learning, giving machines cognitive and predictive capabilities. Today, these systems are already being implemented in real situations." [8,1] One of the reasons for the growing role of AI is the formation of huge opportunities for economic development. A project undertaken by PricewaterhouseCoopers showed that "artificial intelligence technologies can increase global GDP by \$15.7 trillion, which is as much as 14%, by 2030." [19]

AI is currently one of the most important technologies transforming the economy and society and contributing to global digital transformation. There have been significant advances in AI development in recent years, and even more significant improvements are possible in the coming decades. In this regard, the communities of technologists, scientists and policy makers should actively cooperate in creating a safer and globally profitable AI, studying the short- and long-term consequences for the safety and management of AI, as well as the potential of AI to mitigate environmental and biological risks. The availability of data that is "available for exploration" in the research community is a prerequisite for the successful development of AI. [16,7]

As AI systems become more powerful and more general, they can outperform human performance in many areas. If this happens, it can lead to extremely positive developments, but it can also potentially pose catastrophic risks from misuse. There are a number of complex technical problems associated with the design of trouble-free AI, given that accidents caused by powerful AI systems can be extremely destructive. [11,346] Reducing the risks and achieving the global benefits of AI will require global collaboration and government involvement. More advanced and powerful AI systems will be deployed in the coming years, these systems can be transformative with both negative and positive consequences. In this regard, it is necessary to make serious efforts and think about laying the foundations for the security of future systems and better understand the consequences of such achievements.

The future in AI and cognitive computing attracts the economies of all countries, especially those who want to become a world leader. AI is transforming the economy and industries. To help countries get on the positive side of using AI, companies need to invest heavily in AI technology. However, the net effect may be different, i.e. there may be winners and losers. The extent of the use of AI and its consequences is difficult to assess, because there is not enough experience to fully understand what the real benefits of using AI are. The World Intellectual Property Organization notes a sharp increase in the number of scientific papers in this field and an equally sharp increase in the number of

patents, which indicates the transition from theoretical research to the practical use of artificial intelligence technologies in the production of goods and services [2, 40]

## 2. Theoretical analysis

AI is a technology that transforms all spheres of life. "AI is already changing the world and raising important issues for society, economy and governance." [27]

AI is generally considered to refer to "machines that respond to stimulation in accordance with traditional human responses, given the human capacity for contemplation, judgment and intent." [24] According to researchers Shubhendu and Vijay, these software systems "make decisions that usually require a human level of knowledge" and help people anticipate problems or solve problems as they arise. As such, they act intentionally, intelligently, and adaptively. AI is transforming the economy and industries. To get to the positive side of using AI, companies are investing heavily in artificial intelligence technologies. It is argued that "the emergence of a new virtual workforce capable of solving problems and self-learning, a significant increase in labor productivity and capital due to more efficient management of working time and reduction of irrecoverable costs and the diffusion of innovations among economic sectors will allow by 2035 to double the pace of global economic growth." [20,3] To date, the use of AI has attracted a lot of attention from researchers and practitioners in order to open up a wide range of useful opportunities for its use in business processes and the economy as a whole.

AI broadly refers to the application of technology to perform tasks that resemble human cognitive functions, and is usually defined as:

- "the ability of a machine to simulate intelligent human behavior (for example, reasoning, learning, or understanding speech)

- a branch of computer science that deals with modeling intelligent behavior in computers." [1]

Companies as diverse as Walmart, UPS and Uber have found ways to use AI technology to create new profitable business models. Given the significant computational requirements of deep learning, some organizations will maintain their own data centers due to regulations or security concerns, but the capital costs can be significant, especially when using specialized equipment. Machine learning systems have been around since the 1950s, so why are we suddenly seeing breakthroughs in so many different fields? Three factors play a role here:

- huge increase in data volume,
- significantly improved algorithms and
- powerful computer equipment. [18]

As AI systems become more powerful and more general, they can outperform human performance in many areas. This can lead to extremely positive developments, but it can also pose catastrophic risks. This explains why the future of AI, despite having advantages, remains uncertain. Nevertheless, modern business cannot develop without the use of AI, since "the rapid introduction of AI in comparison with competitors will bring greater profit potential, which improves the business rationale of AI and, therefore, further encourages firms to implement it."

Currently, businesses need to actively move to the development of automated technical systems. The effective use of AI requires organizations to solve key data problems, including creating effective data management, defining ontologies, designing data around "channels" from data

sources, and managing regulatory constraints. Today, AI can be practically used in all spheres of economic activity. It can help in the development of personalized products or services in the production and sales departments. The potential of AI will lead to significant economic growth in those countries where companies will massively use it in their field of activity. "Optimal productivity can be achieved through the introduction of AI technologies in business processes by re-evaluating tasks and jobs based on its capabilities." [13,367] AI:

- takes on the solution of routine mechanical tasks;
- solves analytical tasks that are complex, require big data and are generally predictable;
- be able to perform intuitive tasks that are creative, challenging, experimental and contextual. [13]
- solves tasks that require managing other people's emotions and influencing them. [23]

Now everyone thinks that AI is a convenient thing, but along with this, people ignore the dangerous consequences that should be taken into account. In this regard, it is necessary to show not only the advantages of AI, but also the risks associated with it that can be caused to society. [21] It is difficult to predict where AI will lead next. Its significance is undeniable, especially as it gets closer and closer to achieving complex human intelligence.

## 3. Results

### 3.1. AI as a universal "method of invention"

AI can have a greater impact on the economy as a whole as a universal "method of invention" that can change the nature of the innovation process and the organization of R&D. AI can not only improve existing goods and services, but also significantly increase the efficiency of their production. The potential commercial benefits of AI development are a powerful incentive for specific applications. Policies that encourage transparency and the sharing of core data sets between both public and private actors may encourage a higher level of innovation-driven competition and a higher level of research productivity in the future.

AI has the potential to change the innovation process itself. From the point of view of innovation economics, there is an important difference between a narrow field of application of innovations, for example, such as robots (specially designed for narrow tasks), and with an almost limitless field of their application, such as neural networks, often called "deep learning". Namely, deep learning opens up the prospect of changes in the very nature of the innovation process. Hence, AI developments are not just examples of new technologies, but "general-purpose technologies" that can be the driving forces of long-term technological progress. Thus, if we talk about the comparison of key technological trajectories in the framework of AI — robotics and deep learning, they play completely different roles in the future of innovation and technical changes. Innovations in the field of robotics technologies themselves have a relatively low potential to change the nature of innovation itself. [10] On the contrary, deep learning is an area of research with a high degree of universality and can change the innovation process itself as a result of the introduction and dissemination of a new "general-purpose technology". Such technologies often take the form of basic inventions and have the potential to significantly improve the productivity or quality of goods or services produced. The problem associated with advances in AI is that they are research tools and have a powerful

impact on the implemented volume and nature of innovations. The most cost-effective application of AI was in the field with the large-scale introduction of industrial robots in production applications. These machines are precisely programmed to perform a given task in a strictly controlled environment. Innovations in robotics have had an important impact on manufacturing and automation, primarily through the introduction of more responsive robots that rely on programmed algorithms capable of responding to various stimuli. Continuous innovation in robotic technologies (especially in the ability of robotic devices to perceive and interact with the environment) may lead to wider application and adoption beyond industrial automation. But for now, robots are still used mainly in specialized end-use manufacturing applications. Of course, there are counterexamples to this statement: for example, robotic space probes were a very important research tool in planetary science. So, it is important to emphasize that AI is a new general-purpose invention in the form of a "method of invention", which helps to identify some preliminary consequences of this hypothesis for economic management.

### 3.2. How does AI influence the creation of innovations?

AI is a general-purpose technology and it is likely to lead to innovations in various applications, but in itself will not change the nature of the innovation production function. AI is such software systems that make decisions and usually require a human level of knowledge, help people anticipate and solve problems as they arise. As such, they act intentionally, intelligently, and adaptively. [25] The widespread use of AI as a research tool implies a transition to research approaches that use large data sets to create predictions of physical and logical events. This data is likely to have three sources:

- prior knowledge,
- online transactions and
- physical events (for example, data from various types of sensors or geolocation data).

This will lead to the replacement of capital and the abandonment of the former labor force in the production of research and the transition to AI innovations, mainly focused on deep learning, which teaches computers to perform human-like tasks such as facial recognition or understanding the voice inflections and speech patterns of the user. This is when someone asks Siri - or Alexa, Bixby or Google Assistant — to make calls, send text messages, make appointments or answer questions, the AI works. As these applications improve their ability to predict and understand people's responses and requests, pseudo-intelligence is achieved.

Deep learning:

- will increase the efficiency of existing research projects with intensive search, - will open up new opportunities for the study of social and physical phenomena that were previously considered unsolvable or even beyond the scope of systematic scientific and empirical research.

Introduction and dissemination of deep learning:

- it will require significant changes in the innovation management itself,
- may undermine long-term incentives for breakthrough research that is conducted only by people at the forefront of research and "reduce the demand for labor." [3]

Nevertheless, modern business cannot develop without the use of AI, since "the rapid introduction of AI in

comparison with competitors will bring greater profit potential, which improves the business rationale of AI and, therefore, further encourages firms to implement it." [4,54] Finally, it is possible that deep learning will change the very nature of scientific and technological progress. Deep learning offers an alternative paradigm based on the ability to predict complex multi-causal phenomena using a "black box" approach that abstracts from the underlying causes, but allows you to get a unique prediction index that can give a clear idea.

In order to balance innovation with basic human values, a number of recommendations for moving forward with AI are proposed. This includes:

- improved access to data,
- increasing public investment in AI,
- promoting the development of the AI workforce,
- Creation of a federal advisory committee,
- interact with state and local officials to ensure that they adopt effective policies,
- regulation of broad goals as opposed to specific algorithms,
- taking bias seriously as an AI problem,
- maintaining human control and oversight mechanisms, as well as punishing malicious behavior and promoting cybersecurity.

We propose to highlight several key ideas that are central to the discussion of the impact of AI on the growth of innovation:

- it is useful to distinguish significant and important achievements in areas such as robotics from the potential of a universal method of invention based on the application of multilayer neural networks to large amounts of digital data in order to be an "invention in the method of invention", which, according to experts, documents a striking shift towards applied research based on deep learning that fits this opportunity;
- the prospect of changes in the innovation process raises key questions for a range of policy and management areas, ranging from how to evaluate this new type of science to the potential of forecasting methods to create new barriers to entry into a wide range of industries. Proactive analysis of relevant private and public policy responses to these breakthroughs appears to be an extremely promising area for future research.

### 3.3. AI and increasing the efficiency of production processes

Automation and new technologies create new ways to improve the efficiency of production processes. [22] To do this, "it is necessary to assemble a team of potential strategic leaders with a collective task, i.e. to create a fully developed solution to the problem or to design a new critical potential and a way to generate it. Give them a small budget and a tentative deadline. Then carry out assessments with the help of in-depth analysis." [24] Reports on the assessment of the economic impact of AI on the formation of a mechanism for implementing the increase in the efficiency of production processes can help managers determine the timing of investment and the share of the budget for the introduction of AI. [26] In production, AI capabilities can help organizations. See Fig. 1.

Thanks to AI and, accordingly, automation of huge amounts of information, companies can:

- significantly improve the understanding of the decision-making process; increase confidence in the type,

quantity and quality of goods purchased, delivered, received and invoiced;

- reduce the need for working capital to support trade;
- to help logistics specialists better predict the likelihood of an impact on the supply chain;
- interact more deeply with customers, better understanding what they want;
- "anticipate the necessary actions and more accurately predict potential problems"; [6]
- global sourcing and vendor integration, accelerate and improve analysis, provide more efficient automation of

recurring procurement tasks, and support more efficient return and replacement operations;

- improve the efficiency of salary and benefits management, as well as workforce planning, increase the speed and accuracy of recruitment, instantly providing a 360-degree overview of a potential candidate through social networks and other channels.

The conclusion is obvious: the use of AI in production provides a qualitatively new level of business processes and the economy as a whole.

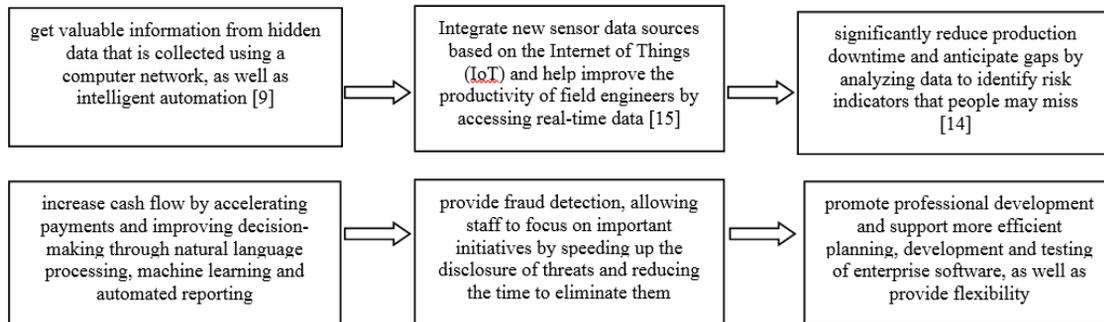


Fig. 1. Conceptual approaches to the analysis of opportunities artificial intelligence in the production process.

### 3.4. AI Research Policies and Institutions

Today, it is important to pay attention to the development and enforcement of official intellectual property rights in the field of AI. It means: - it is important to think carefully about the laws that currently regulate data ownership. Should the data, such as my shopping and travel behavior, belong to me or the search engine or ride-sharing company I use? Can consumers have a strong collective interest in ensuring that this data (of course, in the proper manner) is publicly available so that many companies can use it in the pursuit of innovation? - the emergence of AI has significant implications for the patent system. Although there have been relatively few AI innovation patents so far, this suggests that breakthroughs in research tools can lead to long periods of uncertainty, making it difficult to grant new patents. And this, in turn, leads to a decrease in research productivity and a decrease in competition. Hence AI presents complex issues for the legal doctrine of patent systems.

In addition to these traditional innovation policy issues, the AI perspective also raises a wide range of other issues, including issues related to privacy, the possibility of bias, and consumer protection. The key point is that to the extent that AI is universal, the problems that arise in each of its areas will be solved in a wide variety of sectors and contexts and at a global rather than local level. The widespread applicability of AI (and possibly robotics) in many sectors is likely to trigger a race within each sector to create its own advantage that uses these new approaches. Thus, the emergence of AI raises questions for competition policy. In every application sector, there is a possibility that firms capable of creating an advantage at an early stage will be able to create an AI-based entry barrier that will ensure market dominance, at least in the medium term. [17]

This suggests that the rules ensuring data availability are not only a matter of research performance or aggregation, but also speak to the potential for protection against blocking and anti-competitive behavior. Currently, there seems to be a large number of individual companies trying to take

advantage of AI in a wide variety of areas, but this high level of activity probably reflects expectations about the prospects for significant market impact in the future. Ensuring that AI does not increase monopolization and does not increase barriers to entry into various sectors will be a key topic in the future.

### 4. Discussion

There are many paradigms and probably more will be created for the development and understanding of AI in the development of the economy in the future. In these paradigms, the key benefits and risks materialize in completely different ways. One dimension that permeates all these paradigms is a project that explores security issues. These questions are analyzed for paradigms such as reinforcement learning, reverse reinforcement learning, adversarial settings (Turing learning), oracles, cognition as a service, demonstration learning, control or tracing, learning scenarios, curriculum and transfer learning, naturalized induction, cognitive architectures, brain-inspired AI, and others.[7] Concerns about the increasing popularity of AI are growing. The result is an increase in its social and economic importance. since endowing machines with artificial intelligence allows them to adapt to different situations, maximizing their potential. Looking into the future, there will probably be areas of scientific and intellectual progress that will require planning, abstract reasoning and a meaningful understanding of the world that we associate with general intelligence. [30] "As artificial intelligence becomes a wartime reality, it becomes possible to control a large number of unmanned systems and operate them synchronously to attack large relatively less maneuverable platforms such as helicopters and troop transports. [27]

If the issues of regulation and reliability of AI are not carefully considered, the reputation of firms can be destroyed due to the adverse impact of the product or service. AI forms global competitiveness for the future,

promising to provide its followers with a significant economic and strategic advantage. Today, national governments, regional and intergovernmental organizations are striving to develop AI-oriented policies to maximize the prospects of AI technology, as well as to address its social and ethical implications. [29] Research shows that AI can boost consumer demand by providing personalized and/or better products or services. Similar studies focus on consumer decisions about whether to use the internet and mobile networks to purchase products. In this case, the essence of the AI decision-making mechanism depends on data collected from various sources, such as customers, transactions, sensors, devices, etc. However, biased data that can lead to undesirable consequences are based on automated solutions.

Many problems of AI development can be effectively solved only at the regional or international levels. For example, a study by the McKinsey Global Institute in China showed that "AI-based automation can give the Chinese economy a productivity injection that will add 0.8 to 1.4 percentage points to GDP growth annually, depending on the speed of adoption." [5,7] China is making rapid strides in AI development because it has set a national goal of investing \$150 billion in AI and becoming a world leader in this field by 2030. All development cooperation agencies should consider how to fully integrate collaboration into AI in order to achieve the intended goals.

## 5. Conclusion

The urgency of the problems associated with the use of AI technologies and the formation of a modern innovative economy based on it arouses the legitimate interest of politicians and scientists in Russia and around the world. The era of large-scale use of AI technologies is coming. Now we can say that AI technologies are a new resource in the economy of the XXI century, the value of which is growing every day.

1. AI, as a new factor of production, can stimulate economic growth in at least three important ways. AI can stimulate innovation in the economy, complement and improve the skills and abilities of the existing workforce, as well as create a new virtual workforce and physical capital. AI, like other previous technologies, eventually becomes the genesis of broad structural transformations, since the economy using AI not only does things differently, it also does different things. Countries with experience working with AI technologies are optimistic about their prospects, since today's economy, which operates on the basis of active AI implementation, benefits significantly.

2. AI consists of several technologies that can be combined in different ways to feel, understand, act and learn. AI has the potential to increase business profitability and economic growth. But this will happen only if organizations adopt people-centered thinking and take bold and responsible steps to apply AI technologies in their business.

3. AI technologies are a catalyst for the success of other technologies that require large amounts of data, including the Internet of Things, mobile and multi-channel consumer technologies.

4. AI in the future foreshadows the possibility that many industries will be dominated by the continued growth of "platform" competition rather than conventional competition. Thanks to this, information-intensive areas such as marketing, healthcare, financial services, education and

professional services become both more valuable and less expensive for society.

5. In the future, AI can completely replace many professions. The biggest fear associated with AI, as the loss of work by most people turns out to be illusory. The majority of managers adhere to the strategy of optimizing employment as a result of the integration of human labor and AI, which is reflected in the growth of productivity, job satisfaction and prosperity of society in the future.

## Artificial intelligence and the future of the modern economy

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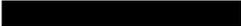
JEL classification: D20, E22, E44, L10, L13, L16, L19, M20, O11, O12, Q10, Q16, R10, R38, R40, Z21, Z32

The purpose of the article is to reveal the impact of the potential of artificial intelligence (AI) on the development of the modern economy. Artificial intelligence is abstract and difficult to understand, which leads to a detached attitude towards it. To contribute to the understanding of artificial intelligence and its role in economic development, the drivers, advantages, disadvantages and opportunities of artificial intelligence based on the collaboration of the digital and physical world are explored. As a result, we argue that thanks to the active use of artificial intelligence, it is possible to create a new model of socio-economic development. In this regard, AI is being explored as a universal "method of invention", its impact on the creation of innovations and improving the efficiency of production processes, policies and institutions in the field of AI research. This allows us to understand the changes that underlie the formation of the modern economy. Both individuals and organizations must prepare for the future by using artificial intelligence technologies and understanding their effectiveness in economic and social activities in terms of creating a better world for humanity. It is argued that the economy of the future will be based on transactions requiring high-speed computing and instant analysis, or on-the-fly analysis, which forms a new economic development that assimilates the main functions of AI and creates new opportunities for organized and sustainable growth.

Keywords: artificial intelligence, future economy, collaboration, artificial agents, efficiency of production processes

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